ALIGNING TECHNOLOGY FORESIGHT PAKISTAN 2025:

ISSUES AND CHALLENGES

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DECLARATION

I hereby declare that this thesis, neither as a whole nor as a part thereof, has been copied from any source. It is further declared that I have prepared this thesis entirely on the basis of my personal effort made under the sincere guidance of my supervisor.

No portion of the work presented has been submitted in support of any application for any degree or qualification of this or any other university or institute of learning.

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Dedication

I dedicate this thesis to my mother who is not in this world any more but her efforts to make me what I am and what she wanted me in the future will never go in vein. Deep down in my heart I know how to be what she wanted me to be. I dedicate my work to her for supporting me in pursuing my education so far. Then it is my whole family, my friends, my colleagues and my teachers, especially Dr. Ali Ahsan to whom I dedicate the work.

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Aligning Technology Foresight Pakistan 2025:

Issues and Challenges

List of Abbreviations

Sr. #	Acronym	Definition
1	TF	Technology Foresight
2	MoST	Ministry of Science and Technology
3	PTB	Pakistan Technology Board
4	ICT	Information Communication Technology
5	S & T	Science and Technology
6	NGO	Non Governmental Organizations
7	EAD	Economic Affair Division
8	FTA	Future Technology Analysis
9	R & D	Research and Development
10	MDG	Millennium Development Goals
11	GAID	Global Alliance for ICT and Development
12	PCST	Pakistan Council for Science and Technology
13	GDP	Gross Domestic Product
14	PSDP	Public Sector Development Project
15	UNIDO	United Nations Industrial Development Organization
16	SME	Small and Medium Enterprises
17	GoP	Government of Pakistan
18	STEEPV	Social, Technology, Environment, Economy, Political, Values
19	SPRU	Science and Technology Policy Research Unit
20	PREST	Policy Research in Engineering, Science and Technology
21	PEMRA	Pakistan Electronic Media Regulatory Authority

22	STI	Science, Technology and Innovation
23	PAMFA	Critical Technologies for Iran's Future (Persian Acronym)
24	TUBITAK	Science and Technology Department Ankra Turkey (Turkish)
25	BOT	Built, Operate and Transfer
26	TNC	Transnational Companies
27	BoG	Board of Governors

Abstract:

Technology Foresight has become a tool for policy implementation, future action plans formulation, prioritizing the future investment portfolios and enlisting the key technologies for future socio-economic well being. To streamline the socio-economic activities as per available resources and potentials Technology Foresight exercise is now undertaken by PTB. Research highlights the main obstacles in properly following up the TF and getting optimum results in terms of implementation and achieving socio-economic objectives. This is done through rigorous interactions with the team organizing the exercise of Technology Foresight Pakistan 2025, experts participating in the workshops and specialists of future/foresight studies. It also identifies key elements missing and gives suggestions for successful foresight conceived from literature and TF experts in addition to panel members of TFP 2025. At the end researcher tries to address the deficiencies in the proposed model through a process involving participant experts and foresight experts in addition to parent organizations' HR.

Keywords:- Foresight, Technology Policy, Implementation Analysis, Pakistan, Issues, Challenges, Robust Model.

Background:

Change is robust and continuously occurring with an exponential rate due to technology revolution observed globally (McNally and Inayatullah, 1987). Even it is said that belief systems are subject to change and belief can lead to transfer personal values from rigorously defined tenets to suspend fealty while techno-loyalty increases.

Adapting by the change is necessary for having a competitive edge in the market that often requires revision of goals, resilience to unpredictable and reunion of teams with procedures (Richardson, 2010). Assistance in changing individuals and organizations comes from Foresight (Inayatullah, 2005). Foresight process helps people in identifying the very foundation for their future desired scenario (Inayatullah, 2007). The desired scenario is the change which people foresee for their better future in short, medium and long run.

For economic growth in any country, uncertainties due to robust and fast changes should be overcome for smart decision making. Complexity due to ever fast changing technology is making it hard for decision makers to decide about uncertain future. Leaders have to have a multiple views of the future through scenarios (instead of linear programming based predictions about future developments) depicting social, technological, moral, economic aspects etc. that can be nucleus for new early-warning processes (Fink, et. al., 2004). Alternative scenarios of future provide a ground for devising a strategy based on R & D in Science and Technology (S & T). For prosperity

and harmony in a society, S & T is observed as an agent of change leading towards economic liberalization, industrialization, and innovation in industry (Martin and Johnston, 1999). Technology Foresight (TF) has been undertaken by many countries to benefit from S & T by identifying the 'critical' or 'key' technologies which leads to research priorities in future (Salo, et. al., 2003).

In Pakistan, MoST was mandated to work for the development of new technologies and new sciences. From 1960-80, a lowest growth rate in S & T manpower of Pakistan was observed, whereas growth of high level manpower engaged in R & D activities was diminishing after a sharp upward trend (Qureshi and Shami, 2006). Perhaps, this slowing down in S & T development motivated thinkers to pay attention to the sinking growth curve and therefore a separate ministry (MoST) was established in 80s. Now, in 2010, authorities in Pakistan face many issues due to lack of technology development and management despite the existence of MoST. Knowing the importance of technology in the current economy, MoST decided to carry out Technology Foresight for meeting future national demands through S & T.

First officially called TF is about to end (according to authorities it may end in June 2012 though issues and challenges may prolong the work further) in Pakistan which is indeed a long term planning tool for future by identifying critical technologies in key areas. Previous TF-like efforts (2005-06) presented critical technologies in key areas but was devoid of wider consultation[1] therefore benefits were rare, either tangible or

[1] Wider consultation is often done through Delphi or media campaign for smooth implementation.

intangible. It was not aiming to devise a policy for S & T related to all future investment portfolios for the country (Georghiou and Harper, 2011) as it is always conducted for the purpose of facilitating the decision making regarding technology roadmaps selection and implementation, and for formulating innovation policy (Eerola and Miles, 2011).

CHAPTER - 1

1. Introduction:

TF is a systematic and systemic process which involves all the stakeholders to achieve consensus for a common future which is acceptable to all and is socio-economic. In this process coordination is of key importance for developing and strengthening bonds between industry, academia, public sector and NGOs (Broch and Rasmussen, 2004). It is often regarded as policy implementation tool and a tool used for making a collective vision for a country, group of country, region or organization etc. It is validated and recommended by UN and is conducted globally by UN through United Nations Industrial Development Organization (UNIDO).

This research intends to look into the matters of current TF process and find issues and challenges so that next time a concrete successful TF exercise must be undertaken that produces desired outcomes after accounting for all such problems and not making mistakes in the future TF. It will look into the different aspects of TF in Pakistan which were ignored or not paid attention to. It will address the challenges in TF in Pakistani context with all its turbulence, inconsistency, passiveness, red-tape-ism and apprehension.

1.1 Purpose:

The basic purpose of research is to highlight the issues and challenges causing the process of TF achieve very little success as compared to other countries' TF programs.

1.2 Motivation:

TF is globally recognized and is considered successful model for networking, awareness and consensus for planning and public policy implementation. UN also encourages its members to go for TF. Countries showed better socio-economic outcomes after TF. Now, countries are doing TF collectively which is known as regional TF. Process identifies critical technologies which may yield maximum output (socio-economic) through identification of the sector/ area that is going to make national plans executed and policies implemented due to collective visioning and horizon scanning.

1.3 Problem Statement:

The TFP 2025 is first ever TF which needs to be refined and issues and challenges be reported to those who may conduct it in future. Foresight in the history is all about continuous refinement and improvement of the socio-economic development process. It is about learning from the past experiences. Researcher intends to find out all such problems that caused "not up to the mark" execution of TF. Also, it's intention of the researcher to identify the TF related challenges in Pakistan and how they were faced by

other countries, if faced there. The research will be a beacon house for the new TF activity planners in other ministry and for new TF team to conduct it on national level. The research will also help researchers in ministry to understand suitable model for our country and can be used successfully next time with some contextual amendments.

1.4 Research Objective:

Objective of the research is to identify the issues and challenges faced during the TFP 2025 and report them to those who may conduct it second time. Also, propose model that may work best for Pakistan in all future foresight programs.

1.5 Research Questions:

TF is situation and context based exercise. Doing it right first time is almost impossible. But lessons learnt must be communicated precisely to next generation of TF doers. What exactly this research will try to answer is the question of what can be best robust model/methodology for Pakistan's perspective, situation, scenario or context to do it best or better next time? In order to answer this following sub questions need to be answered.

1. What are the dynamics (current and historic) of TF exercise conducted in Pakistan?
2. How is TF conducted internationally?

a. How is TF conducted in Developed Countries?

b. How is TF conducted in South Asia?

3. What are issues/ challenges of TF in Pakistan?

4. How given issues/ challenges can be eliminated/ minimized?

5. How TF should ideally be conducted in Pakistan?

CHAPTER - 2

2. Methodology:

2.1 Data Collection:

This qualitative study incorporates unstructured interviews for collection of data. Unstructured interviews were used due to the unpredictability of experts in answering the questions and often questions regarding the answers about TF raised new queries which were new to the researcher. The research is applied research and researcher has experienced the work of TF team through participations in meetings and designing Delphi for different sectors. Observations along with the unstructured interviews are source of collection data regarding TF and its consequences. Case studies of various TF programS & Their outcomes also helped in collection of issues usually occurring during the process. Ethnography, as researcher was observing the outcomes of meetings and discussions keenly and noting the aspect of his research in whole TF process, in regard to data collection has been actively used during the research work. Mainly, observations, literature, group evaluations are the main source of data collection [24].

2.2 Data Analysis:

Major part of the analysis is done through literature review of the case studies of TF done in other countries. However, some experts opinions, national and international,

were also used to analyze the outcomes of the meetings done by all stakeholders and comment upon the whole process.

2.3 Scope and Limitation:

TF is a complex process which involves stakeholders in discussions for developing the desired future scenario. This complexity makes it unique for every country and every region. Therefore, every TF exercise is limited to the current scenario and to the culture of the public and private sector. Also, it is dependant upon the resources available. These limitations make this research's scope limited to the Pakistan Technology Board which is conducting foresight under MoST, Pakistan. The scope of the study is national process's fine tuning and the main limitation is access to futurists and absence of foresight specialists in the country. Passiveness from government body to conduct such a study is also a limitation. The study was carried out by the author due to his interest in inculcating the TF culture for better outcomes next time it is conducted for building consensus, forming new networks, raising awareness among general public and stakeholders, overcoming communication gaps and for paving the future for easy implementation of policies for socio economic well being.

2.4 Research Design:

The research is qualitative due to researcher's access (physical/virtual) to all those who conducted a similar to TF exercise before, to experts internationally doing it in

Australia, Europe, Asia, Africa and America through internet and meetings with some during training sessions. The research will describe the whole process of TF in Pakistan. Successful analysis is based on tangible and intangible outcomes of the exercise.

CHAPTER - 3

3. Literature Review:

3.1 Technology Foresight:

TF is a process which focuses on technology disruptions and developments so that an entity can plan for R & D priorities (Lichtenthaler, 2002) through technology scanning and monitoring activities (Arnold, et. al., 2010). TF goes beyond the other types of foresight activities i.e. competitor and customer foresights (Reger, 2006). The concepts under technology foresight deal with generating a technology vision, creating technology forecasts, evolving new future directions through cognitive processes (Bowonder and Miyake, 2000). TF performs the first two steps of Integrative Technology Management Process framework (identification, selection, acquisition, exploitation and protection) i.e. identification and selection. The remaining three are the implementation part of a policy which originates from TF process. Implementation is mediated by TF and is intangible outcome of the whole process but for tangible output we need to have political will in it.

In brief TF is not only to predict rather build future through identification of appropriate actions for an appropriate and feasible scenario out of several scenario choices (Kang, et. al, 2009). It is gaining popularity and is said to be the future of management science as at its core managers are supported for making decisions for safe and better future although in this history of globe TF is said to a global activity and changes in science (of management), culture, politics and economics are predecessor to

the TF or futures studies (Daim, et. al., 2009). Globally, TF has been conducted in the following countries or being undertaken on regular basis:

Countries that have Undertaken Technology Foresight Programs

Argentina	Australia	Austria	Bolivia	Brazil
Canada	Czech Republic	Finland	France	Germany
Hungary	India	Indonesia	Ireland	Italy
Japan	Korea	Mexico	Holland	New Zealand
Nigeria	Philippines	South Africa	Spain	Sweden
Thailand	UK	US	Venezuela	Pakistan

Fig. 3.1(a) *(Source: TFP Brochure @ PTB)*

3.2 T.F Socio-Economic Use:

UK government is doing TF for priority setting due to increasing focus on social needs and is also putting pressure on funding agencies to be economic at the same time; UK government stresses the strategic plans to consider economy for the whole nation. TF has been criticized by some researchers for not focusing on poverty elimination. Now, the objectives of TF include socio-economic well being of a country. Often TF is termed as Foresight so that true socio-economy can be focused instead of techno-economy or techno-socio-economy. TF in Pakistan also has this very objective of socio-economic

well being of the country. Socio-economic well being of a society by identifying emerging generic technologies is the broad aim of TF (O'Neil, 2003).

Dr. Ian Miles (2009) referred Dr. Rafael Popper and discussed common objectives in European Foresight exercises as given in the list below (with in parenthesis is the number of times objective was mentioned in a foresight exercise):

- Fostering STI cooperation and networking (29)
- Orienting policy formulation and decisions (33)
- Recognising key STI barriers and driving forces (20)
- Encouraging futures thinking and strategic intelligence (15)
- Supporting STI strategy- and priority-setting activities (30)
- Identifying opportunities for private sector, SMEs and NGOs (16)
- Gathering and building visions and images about the future (24)
- Helping to deliver the ingredients of sustainable development (12)

  Triggering key stakeholders' actions and promoting public debate (21)

TF socio-economic use has taken a new dimension because of IT developments. Socio-economic use of TF and its socio-economic outcomes dissemination has been made easy due to the developments in IT field although it demands internet popularity, rapid development of incoming/outgoing broadband, well established e-government services, high internet access rater (Kang, et. al., 2009) and well educated society.

3.3 International T.F Practices/Methods/Process:

International arena has witnessed the fall of technologies due to rapid development in integrated chips, nano-technology and biotechnology. Rapid developments have made the foresight experts to plan for the technologies of next 20, 50 and hundred years. Ending reserves of oil and gas often force the thinkers about "business-was-usual" phenomenon which ultimately motivates people to recover their agency and create wishful future (Anderson, 1994).

Rafael Popper in his research paper identified the literature review as the most practiced methodology which is then followed by expert panels and scenarios (PCST, 2005). The table 3.3 (a) below reflects the uses of different methodologies by different countries:

Table: 3.3 (a) *Different methodologies used by different countries*

Year	Delphi	Mixed	Panel / scenario / other
1970s -	30 years in Japan		
1989			Ministry of Economic Affairs Netherlands
1990	1st German		
1991			Critical Technologies USA
1992			New Zealand
1993	South Korea		Technologies at Threshold of 21st Century Germany
1994	France Japan/ Germany Mini Delphi	1st UK TF Programme	
1995			100 Key Technologies France
1996	Japan – German Delphi		Australia Foresight Steering Committee Netherlands 1st Italy Industry Foresight
1997		OPTI Spain	Ireland Russia
1998	Austria	Hungary	South Africa New Zealand Sweden
1999			2nd UK TF Programme FUTUR Germany
2000			2nd French 100 Key Technologies Portugal Industrial Association 2nd Italy Industry Foresight
2001	7th Japanese Delphi		Czech Republic Malta, Cyprus, Estonia
2002		Turkey	Bulgaria Romania 3rd UK TF Programme
2003			Colombia Brasil Sweden Denmark
2004			Russia Ukraine French Futuris

(Source: Saritas @ COMSTECH, 2009)

He further elaborated that methods used in TF are a combination of several methods based on creativity, interaction, expertise and evidence; and the methods which are a combination of creativity and interaction have been under-exploited. Popper calls for more research done by the futurists in this regard.

Taiwanese government current scenario was "Brain Drain". The dream scenario was "Economic Gain" which they did by taking some critical policy actions (technology parks, western style furnished houses etc.) and thus attracted the Diaspora (UNIDO, 2006).

Types of TF:

Depending upon the context, it varies. In developed nations it always about selling their technologies and seeking new markets as well as new technologies that can be sold after development or specific changes in previous innovations that can be of use in future.

For developing countries it is always looking into the core concept of TF, learning more about it, institutionalizing TF, cultivating the culture etc. They try to indentify the resources in science and technology for capitalizing on for desired future socio-economic well being. Or, they try to have complete technology license to have technology transferred within their proximity for harmony which often seems difficult as it is tied to barter trade.

In third world countries, it focuses on how to overcome problems using technologies that can make a difference. Yet, third world countries are facing problem in overcoming the issues raised due to new technologies as the technology culture hasn't met a point with local culture to diffuse into. The focus in on the problems of elections, rigging in votes, corruption (Taiwo, 2011), democracy (Kimenyi, 2011); natural resources, agriculture, migration (Page, 2011), climate change (Asma and Kimenyi, 2011), new technology adoption (Kimenyi and Moyo, 2011) etc.

3.4 International T.F Practices in Developed Countries

In developed countries new techniques in conducting the whole exercise are very common. Mike Jackson is running an online Foresight organization (www.shappingtomorrow.com). He uses online Delphi Survey technique which is considered quick approach in data analysis. Even in data collection, the IT usage gives leverage by saving time of those who have to fill in the questionnaires. Delphi has been used by Japan in all of its TF exercises (Kang, et. al., 2009). Even in the joint foresight in 1998 by Germany with Japan, Delphi questionnaire was sent to about 7000 experts of whom 2400 participated in first round and 1856 participated in second round (Kerstin and Blind).

In UK, TF has become a regular activity though some scientists believe that discovery can't be planned (Inayaullah, 2008). Experts globally believe that following are the outcomes of TF which made it a regular activity for governments:

Outcomes of Foresight

• **Formal or tangible outcomes**	• **Informal or intangible outcomes**
– Scenario description – Survey results – Sectoral analyses – Critical technology list – Technology priority list – Technology roadmaps – Panel documents – Policy recommendations – Guiding vision description – List of key projects – Implementation strategy	– Consensus --- on future challenges – Commitment --- to visions of a desirable future – Networking --- social & business networks – Common understanding --- of future challenges – Development --- of a foresight culture – Change --- in attitudes and mind sets – Indirect integration --- of foresight results into projects, programmes, strategies and policies

Fig. 3.4(a) *(Source: UNIDO TF Manual)*

3.5 International T.F Practices in South Asia:

A recent TF study has been completed in Iran. The time scope of the TF was same as that of Pakistan i.e. 2025. Iranian hired a private company for doing TF for government which conducted an international conference in which more than 5 international experts participated from all over the world. Later, they used Japanese 8th Foresight's Delphi survey with some changes. Results were 5 priority areas i.e. Electronics, telecom and hardware; Aerospace; Marine technology; IT and software; biotechnology. 5 panels were formed and meetings were held of expert panel groups in

which 60 experts participated. Respondents of Delphi were 1000 and scenario exercises were attended by 75 experts. All the above information was learnt in interviews and PAMFA project document published by National Research Institute for Science Policy, Iran.

3.6 International T.F Practices in Pakistan

In Pakistan, a TF similar exercise was conducted in PCST which used expert panels only and later a report was written. Panels were formed in 12 areas i.e. agriculture, electronics, engineering and manufacturing, energy, biotechnology and genetic engineering, water, minerals, materials, pharmaceuticals and drugs, R & D in health sector, education, technical education etc. Number of experts in the meetings was 4 to 8 and a single meeting was based on opinions, visits and literature reviews (Anderson, 1994).

The TF project has used somewhat same methodology but scientific research, which is validated and considered reliable globally, was the priority of TF. TF project team was trained in some popular methods used in TF and depending upon the situation in public sector a combination of semi-Delphi, Interviews, Expert Panels, Futures Triangle, Futures Wheel, STEEPV, road mapping, back-casting and literature review were used. Semi Delphi was used to establish the socio-economic priority areas on which investment from government is required. Later experts were interviewed and hired for expert panel discussions using STEEPV, scenarios and back-casting for roadmaps. Five

meetings at least in each priority area were held; at least 10 participating and those who didn't make it due to commitments were communicated using mail and e-mail services. Interim evaluation was done by project team meetings, inspection by planning commission and discussions with expert in Pakistan, UK and Australia. Papers were written on meetings and were published by international journals.

The number of priority areas identified was about 500 which were grouped into main categories of 12. Top six were chosen due to constraints i.e. Agriculture, Energy, Industry, Education, ICT and Environment (in priority order). Experts participating in the panel meetings were from private sector, public sector, academia and civil organizations. Private sector and academia was observed to be more interested in all such endeavors, reason unknown. Later, after consulting experts and after doing literature review the priority areas were reduced to 10 (Siddiq, et. al., 2011) i.e. Energy, Agriculture, Industry, Education, ICT, Environment, Communication and Transportation, Health, Nanotechnology and Management.

After setting the priorities, TF team faced the challenge of presenting the methodology for conducting the whole program for which a couple of them were trained for. A model was presented by TF experts for Pakistan which is given below in Fig. 3.6 (a):

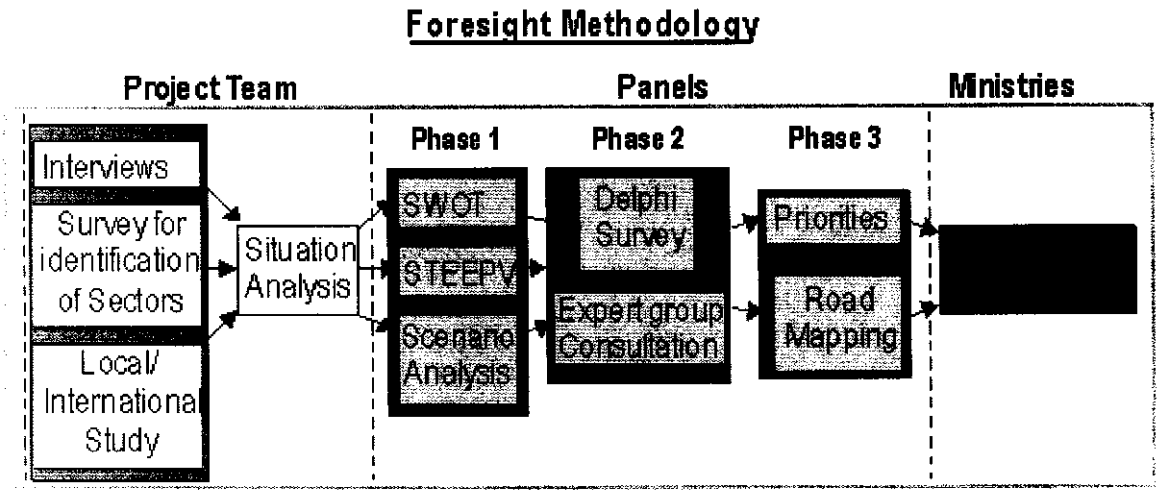


Fig. 3.6 (a) *(Source: PTB-TF 2025)*

Internationally, pre-foresight is of great importance which was not catered for properly. Project started several years before the start of real work on it. Critical HR was not hired until the project expiry date was only half year away. Only, a questionnaire was designed and responses from about 200 experts were received which was not digitized for analysis of the data either. No other pre-foresight activity was undertaken which made the real start of the project as a contingency which was never planned before and was without any political will. Still outcomes were good but how to implement was real problem.

Internationally, the common practice is to involve the ministries in the pre-foresight which is being depicted at the end of the TFP model in Fig. 3.2 (a) above. In Spain, the ministries were involved in the whole process in the beginning by making a committee of General Directors comprising 10 officials from different ministries; this committee provided the basic data for to conduct the foresight by the task force of

consultants (Miranda and Fontela, 1980). Such actions are common to have political will and ownership in the whole long term planning and implementation process/program.

In Pakistan, TF project team was facing the problem of being novice and procrastination from the authorities due to the reason that several portfolios were assigned to a person instead of hiring a technocrat and priorities for them were being perceived from agencies not owned by them ultimately leading to a shift in focus from being visionary to doer. TF team was not supported by the leadership, environment, situation, time, organization, methodology, and turbulence, lack of authority and frequency mismatch between authorities of PTB and decision makers.

Internationally recognized TF in Pakistan was a good experience for all the participants with best practices employed though with a team novice in TF. Politicians, e-media, universities, general public, university faculty, deans, vice chancellors, industrialists and many others appreciated though focus was implementation. For them, interest in implementation was due to past unsuccessful experiences of policy implementations, visions and other planning exercises. It was new them to have all the stakeholders on board, participating in the workshops regarding future technologieS & Their roadmaps for socio economic well being. Briefly, the workshops regarding energy, agriculture, education, industry, ICT and environment future are discussed below with recommendations, action plans, projects, policy recommendations etc.

3.6.1. Technology Foresight Pakistan

"Technology Foresight Exercise in Pakistan" was launched by Pakistan Technology Board with an objective to identify key technologies that can help Ministry of SandT in formulating short, medium and long term policies for socio economic benefits of the people of Pakistan. For that purpose panels of experts were formed in six fields **(Energy, Agriculture, Industry, Education, Environment and ICT)**, after carrying out nation-wide survey. The panel comprised of experts from public sector, academia, private sector, R & D organizations and NGO's.

The outcomes presented below are the result of a systematic effort by the expert panel on all six sectors constituted under the Technology Foresight project to review the present situation of all sectors in the country and defining the research and technology opportunities for each sector. During the Technology Foresight exercise, the panels considered in detail the issues and drivers through using the approach of **STEEPV**, which is an acronym for (Social, Technological, Environmental, Economic, Political and Values). Furthermore **Scenario Planning was used to formulate scenarios based on the most important and uncertain drivers.** The development of scenarios depicted the various situations in which Pakistan can be on the horizon of 10-15 years. The list of actions, policy recommendations and projects are based on practical experience of all the experts and backed by reasoning through keeping an eye on the future. The true potential of this foresight activity will only be realized if practical action plans aimed at implementing the recommendations are established and applied.

3.6.1.1. Energy Panel Outcomes:

i. Key Recommendations and Action Points

- **Renewable Energy**

1. Need for Launching of RandD and Pilot Projects and Application of Knowledge
2. LVD/LED street lights should be promoted and commercialized
3. Financial assistance by banks for renewable energy projects should be provided
4. Government should force industry to switch to Renewable energy
5. University-Industry linkage cell must be established for promotion
6. Energy fund and a separate Energy board should be developed
7. Funding for energy projects should be targeted
8. Attention must be paid to Municipal solid waste utilization as RDF in cement industry and other energy purposes
9. Need for legislation regarding promotion and efficient usage of energy
10. Need to promote Geo-thermal and establish a plant with a possibility to have an accord with countries like Turkey

- **Energy Efficiency**

11. Awareness raising amongst masses regarding efficient usage of energy
12. Education of Architects on energy efficient design of buildings

13. Advisory board for Energy efficient Buildings, for Building control authority must be Established
14. Advisory board for Energy efficient Transportation
15. Energy efficient house hold appliances
16. Energy efficient industries
17. Capacity building of Building contract Authority should be done with respect to energy efficiency and evaluation of buildings seeking permission in this regard
18. Efficiency improvement of existing Gas-geysers
19. Need to make Industrial motors energy efficient and standardization should be done in this Regard
20. Need to establish centers of excellence for research and marketing of Energy efficient technologies
21. Involve big construction and housing schemes in establishing and promoting Energy efficient houses/buildings; each government organization must announce a housing scheme for its employeeS & The houses must be built on zero-energy house concept, this will tremendously lessen the prevailing energy crisis

- **Fossil Fuels**

22. Need to check the efficiency of Lakhra Power plant and improving the performance of research

23. Need to establish a Coal sulphur cleansing/washing plant
24. Coal Briquetting should be promoted
25. Coal-gasification needs to be looked into
26. Need of process engineering for petrol refinement
27. Project should be initiated for identifying final energy mix percentage
28. Govt. offices should start using Solar thermal geysers
29. Free energy provision should be discouraged
30. O and M funding should be started immediately in Lakhra
31. Coal and IPP projects should be prioritized

ii. List of Projects based on Energy Panel Meetings

During the meetings the members came up with a number of projects which must be initiated in order to move towards a sustainable development of energy sector. These projects are given below

1. Development of Domestic Solar Thermal Power Generation Unit
2. Designing and development of Energy Efficient Houses for display to encourage investors
3. Awareness raising campaign regarding usage of Renewable Energy and Energy Efficient technologies
4. Replacement of traditional appliances (Geysers, heaters etc) in Government offices with renewable energy products

3.6.1.2. Industry Panel Outcomes:

i. Prioritized list of Actions:

After a detailed brainstorming session the expert panel reached a consensus on the following actions which are of most priority and must be addressed immediately.

1. Promote entrepreneurship
2. Establishment of Tech. Incubation Centers/Parks and technology transfer organizations
3. Ensure funding for entrepreneurs through regulation
4. Need based research in Universities should be ensured
5. Need for Industry friendly regulations
6. Reverse import trends by improving product quality and productivity
7. Development of skilled labor should be addressed
8. Need to promote expo centres for industrial development
9. Need to address lack of financial planning

ii. List of Projects Identified

Based on these action points all the members discussed various project proposals which can be initiated from the industry forum.

Table: 3.6.1.2 (a) *List of Projects by Location & Proposer*

Projects	**Location**	**Proposal By**
Inputs for Pharmaceutical Production (Drugs, Vaccines etc.)	Islamabad	Dr. Shimail Daud Arian
Assembling of various industrial parts in Balochistan e.g Cycle, bicycle etc.	Quetta	Mr. Khalid Kifah
UPS and small size generator assembling in Rwp/Isd.	Rawalpindi/ Islamabad	Mr. Khalid Kifah
Publication/booklet of small business ideas to promote entrepreneurship	Lahore/Islamabad	Mr. Abdul Rauf Chaudhary
Pilot project for designing and manufacturing Electric Rickshaw	Islamabad	Mr. Rashid Nadeem

3.6.1.3. Agriculture Panel Outcomes

i. Macro/micro Management and Institutional building

- **Macro-Management**

1. Mechanism of study of supply and demand
2. Commodity/mercantile exchange system
3. Integration of agricultural institutes/ministries/private departments.
4. Strengthening of extension department.
5. Authoritative body for price and target setting in Agriculture

- **Micro-Management**

6. Business Models
7. Communication gap
8. Availability of Technology and inputs for small farmers

- **S & T Initiatives**:

9. Implement rural energy models
10. Eco-system of union councils
11. Categorization and marking of all farms of Pakistan through GIS technology

12. Chemical/fertilizer standards checking
13. Scientific innovations in agri-business
14. Controlled atmosphere (more products in one storage capacity)
15. To promote cold pulping of tomatoes
16. Bring in Agri- process Engineers
17. Handling of bio- waste needed

ii. Marketing and Agri Business (value addition, inputs and outputs)

- **Inputs:**

18. From private sector with R & D facility
19. Handling of non- traditional inputs

- **Outputs:**

20. Grade standards specification/certification
21. Marketing regulations and reforms
22. Innovations in shipping, packaging, storing (CA compartmentalization)
23. Multi disciplinary approach in Agriculture

- **Value Addition** (Continuous activity based on R & D)

iii. Water Related Technologies

24. Innovation in Ground water technologies
25. Water harvesting
26. Zero tillage
27. Bio- degradable pipes
28. Zoning of water (salts and environment)
29. Indigenization of water related technologies
30. Biological solution for water constraints
31. Virtual water concept
32. Raised bed technology
33. High efficiency irrigation system

iv. Identification of Future Technologies/Cutting Edge Technologies

34. Soil less crops
35. Peri urban Agriculture
36. Synthetic materials manufacturing
37. Nanotechnology
38. Genome pairing
39. Vigilance in tracking new future technology/markets
40. Green Agriculture Technology

v. Special Technology Needs of Peri-Urban

- Super market revolutions
- International collaboration

3.6.1.4. ICT Panel Outcomes:`

i. Establishment of National Innovation System in Pakistan

Innovations and developments in the areas of science and technology have been a major source of growth for both the society and the industry. With the significance that SME possess in the economy of a country and the challenges they face today, especially in Pakistan, it has become absolutely necessary to establish a National level Innovation System that keeps the local SME alive and gradually increases their competitiveness in the international market through continuous injection of technological development and innovative solutions. To sustain the vital input from researchers and scientists it is crucial that their interests and rights are protected at all times. National Innovation System would also ensure that the recommendations of Technology Foresight project are implemented.

ii. E-Village

The usage and deployment of ICTs assist in creating benefits in all aspects of daily life and entail skilled personnel to employ newly developed ICT applications. ICTs also contribute to sustainable production and consumption patterns, as well as reduce traditional barriers, providing an opportunity for all to

access local and global markets in a more equitable manner. The new markets structures have necessitated a new set of skills which assist in the development and use of ICT services. ICT applications are now user-friendly, accessible to all, affordable, adapted to local needs in languages and cultures, and support sustainable development.

To this effect, local authorities play a major role in not only the provision of ICT services but also delivering the requisite training to empower professionals to use ICT services for the benefit of their populations. This new usage of ICT Services has made unmatched progress in rural areas and in Pakistan we can make very fast progress and make up the past slow progress. We can catch up with world progress by implementing "E-Village" in all parts of Pakistan.

iii. On line Education Study System

Institutions have played a significant role in providing high quality educational opportunities for both rural and urban people. Rural population has always been at a disadvantage because most high level institutions are based in cities. Rural learners incur the cost of travel and very often the cost of living away from home to advance their educational prospects.

As ICT has advanced at a rapid pace, our rural public school systems must take advantage of new and exciting teaching methodologieS & Tools which are

used as supplements to teachers, fostering motivation and curriculum development. Several of these current techniques and software include distance learning, experiential education and computer networking.

The said developments in electronic communication allow for much greater contact between the studentS & Teacher and are not bounded by geographical locations, thus largely eliminating the travel and distance factor. Furthermore, teachers and lecturers from all over the world can be brought to classes in remote or otherwise isolated places, students from diverse communities and backgrounds can come together to learn about one and other. Students are able to explore, communicate, analysis and share information and ideas with one another.

In view of above, the use of video and audio in teaching and learning has become a common practice in education that can be exploited very effectively in the wake of economic crunch.

Implementation of the policies has remained a sore point in Pakistan; other countries are not exception to this issue. Technology Foresight experts at international level have experienced that implementation becomes a parallel activity during the course of TF projects. Same has been experienced in Pakistan as well, under this project. Lot of activities have already been started are:

- UET's at Peshawar, Lahore, Karachi and Jamshoro have shown their willingness to provide space for Innovation Centers

- Cyber Entrepreneurship Workshops were held at UET Peshawar, Jamshoro and NED Karachi, and they are forcing PTB to conduct it regularly.

Technology Foresight activities have been shared at GAID forum. The projects proposed under TF are in line with the UN's Millennium Development Goals (MDG's)

3.6.1.5. Education Panel Outcomes:

i. Foundation Issues Highlighted and Deduced from 6 Meetings

- **Awareness**

1. Value of Education as a Basic Need
2. Objectives of education

- **Access**

3. Affordability
4. Reach [Geographical, Gender]
5. Subjects, Skills, and Technologies for Self Reliant/ Self reliance

- **Values**

6. As a Citizen
7. As a Muslim
8. As a Human Being

ii. Key Negative Drivers

1. Lack of National will and therefore political will
2. Lack of management and execution capacity and lack of accountability
3. Lack of appropriate Budget allocation (min 5% of GDP)
4. Curriculum not aligned with Societal Values and objectives
5. Lack of value of knowledge and benefits of education
6. No focus on self reliance and self employment
7. Lack of availability of Qualified Faculty
8. Social, cultural and ethical issues related to ICTs

iii. Key Positive Drivers

9. Packaged and Modular education
10. Use of Multimedia and simulation technologies
11. Gaming technologies, Immersive learning
12. Madrassa / Masjid Schools
13. Advertisements and Media
14. Private sector investment through Tax rebates on every graduating student
15. Lifelong learning and Just in time learning
16. Curriculum review, (new areaS & Teaching strategies) in areas of energy, food, education and security
17. Internet and Web 3.0, distance learning, video conferencing and webinars

3.6.1.6. Environment Panel Outcomes:

The environment panel highlighted four major issues on environment sector which include:

i. **Water (Resources, Pollution, Drinking Water)**

ii. **Loss of biodiversity (Forestry, Wildlife, Rangeland, Invasive species)**

iii. **Solid waste (Industrial, Urban waste, Hospital)**

iv. **Energy (Residue Burning, Alternative energy resources, Energy related pollution, inefficient use of energy)**

The experts are in the process of identifying the causes, remedies, policy recommendations and projects for each of the above mentioned issues in environment sector.

In such projects, participation of all the stakeholders is very difficult due to their own commitments. Some action in this regard is very critical to ensure the participation of all the stakeholders. Discussion with TF team and TF experts/participants revealed that following were the issues and challenges faced:

CHAPTER - 4

4. Issues and challenges in TFP

TF assists in identifying agency through emerging issues analysis (Metafutures). But TF itself is a complex process which is often done by conducting a pilot TF prior to embracing the fully fledged TF (PAMFA). Any project when started faces the problems of acquiring the necessary resources. Escalation of Time and Financial resources are the two main issues, and their management is always a challenge for project managers, for a project's failure. Although TFP suffered from such issues and challenges but considering TF failure in Pakistani context, the issues and challenges are dynamic and diverse:

4.1 TFP Beaconing Process:

TF is a systematic solution oriented beaconing process with 5 phases of pre-foresight, recruitment, generation, action and renewal (Popper, 2008; Miles, 2002). TF is made systematic by disciplining the activities and by continuously communicating the codified outputs (policy, project and technology recommendations) in timely manner to relevant departments (Popper, 2008). The codified outputs rarely represent the general public's issues (Slaughter and Riedy, 2009) but do set the direction for getting rid of the issues and prepare for the future challenges.

Contrary to above, TFP 2025 was not systematic due to participation problems and experts' suggestions haphazard implementation/ignoring experts' guidance. The team

management was passive and reactive. There were many uncertainties in procedures, activities. The tasks of TFP were colossal which made it a project not giving timely codified outputs rather it induced awareness about TF in addition to awareness in the key areas among all the stakeholders participating in expert panel brain storming sessions.

The concept of philanthropy was significantly highlighted and demonstrated by panelists in TFP. Slaughter and Riedy (2009) studied philanthropy as significant element in healthy society. A congregate of a philanthropy oriented social body is a great challenge. To form such a pure social congress TFP needed involvement of politically, socially and morally influential experts. Such personalities give direction in addition to avoiding conflicts participatory projects like TF. TFP team faced this challenge through co-nomination and conducting interviews of the experts for forming panels. It was having flaws but was better than doing nothing as described by TFP organizers.

4.2 Ownership:

Planning is contingent upon people characteristics (McCaskey, 1974) often resulting in approved plans for self interests. To overcome this problem, TF highlights the concept of bottom-up approach, to own the outcomes, of policy making. This is done through high level experts' discussions; and consensus building among all the stakeholders. To ensure ownership, experts from government in relation with industry and academia are invited usually to conduct future visions regarding S & T policy

(Jemala, 2010). Meso-level TF activities ensure the ownership by government departments in Japan.

In TFP 2025, despite government body conducting it, participation by many government departments was ignored due to absence of top leadership in the exercise. Many private corporations and companies were also least interested due to absence of decision makers in the TFP. This is a usual issue in TF exercises. Experts suggested inviting the politicians so that the interest of all the stakeholders can be developed but due to chaotic governance, apprehensions of misdirection or distortion of whole activity none actively pursued the idea. In Turkey, prime minister heads the key meetings of steering committee. In TFP, head of the PTB was chairing the starting meetings only. Later, panelists were independent which resulted in lack of ownership due to lack of interest.

Basic strategy in TF is fun part of it (Duin, et. at., 2010) which was not tactfully handled by TF team. No one was capable of putting life to discussions, enhancing thinking or using gadgets to provoke out of the box thinking. TF experts globally make their group discussion, scenario planning, visioning and other TF related tasks very much interesting to keep the participants active, alive and keep participating in future. In TFP, such skill was down to negative due to which participation was badly affected and ultimately, the ownership of the outcomes was very little.

4.3 Steering Committee:

Conducting national TF program is extra ordinary task and can't be performed by a single organization or person. Wide participation is most traditional approach in TF which leads to several problems (Helm, 2007). Often, brainstorming sessions lead to no solution or conflicts. Delphi exercise may also produce some ambiguous results thus forcing the organizing team to prioritize to end or to continue the whole process for a period which may result in to inundation of the outcomes of TF.

In TFP, absence of steering committee made the task more complex and difficult for the organizers to make it successful for the country. TFP was steered by TF team in addition to leading, visioning, policy analysis and implementation of the outcomes of foresight exercise which ultimately resulted in the whole program not for building future but for the sake of study or pilot project. However, experts gave feedback of some implementation that took place but on micro-level due to the efforts of TFP project team.

4.4 HRM and D:

Hiring HR trained in Delphi, media or press coordination, conducting brainstorming sessions using the STEEPV, SWOT, futures triangle, CLA and many other globally accepted methods, writing reports and other key tasks in TF is mandatory. If a strong foundation is laid by hiring TF experts then TF can be conducted successfully in a given time frame with better achievements.

In other countries, national TF programs were well planned and top futurists/foresight experts and in some cases organizations were engaged. While conducting TF, the Dutch government contacted a group of researchers from public and private sectors. Foresight there is a continuous activity now. The group meets regularly regarding future discussions, workshops and planning for technology foresight. This group is called NTV Netwerk Toekomst Verkenningen (Dutch Network Studies of the future/NTV) which is linked to the Stichting Toekomstbeeld der Techniek (Foundation Future Vision of Technology/STT) (Duin, et. al., 2010). Thus, a group of futurists and planners are being hired by Dutch government which ensures excelljence in performance and outcomes.

In TFP 2025, lack of trained HR caused impediments. The team did manage to find out a private institute called Pakistan Futures Institute (PFI) but after more than 10 years of its existence it was abandoned by renowned and the only futurist of Pakistan known as Dr. Ikran Azam. He was invited to participate and help in TFP but due to very old age active assistance was not extended to PTB-TF team. Semi Delphi conducted by TFP team was criticized for being faulty, incomplete and immature though areas of priority were determined through semi Delphi. Hiring of Delphi and TF expert from abroad was very difficult due to austerity measures imposed by government. HRD was also hampered due to inactivity of the team and leadership.

4.5 TF Methodology:

TF methodology depends on the context, environment, situation and circumstances in which TF is being conducted (Ozcan, 2007). While selecting a particular method, one needs to analyze multiple factors (Popper, 2008). Scenarios are considered better tool in TF due to several reasons including alternatives, plausible, preferred futures etc. (Miles). But there is no hard and fast rule in determining the most appropriate method for doing TF as mentioned earlier.

Basic methodology of technology foresight needs to have some objectives in its core activities. Developed countries have been observed to propose thorough and comprehensive methodology for TF giving the output for better tomorrow for the whole nation. Da Fonseca (2007) while discussing a foresight about fishery industry in South America, presented the diagram below:

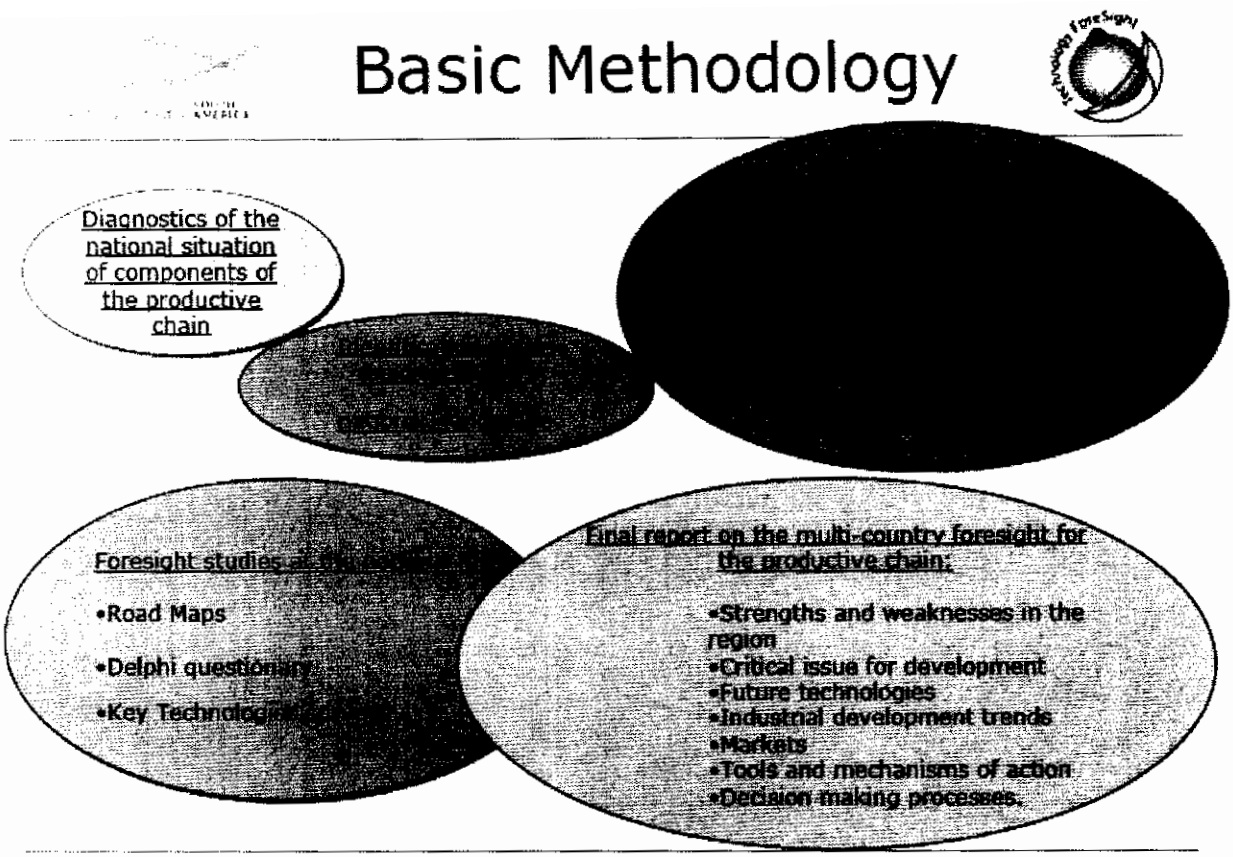


Fig 4.5(a)*(Source: Fonesca, 2009)Foresight-Methodology: South America*

In TFP 2025, methodology was often discussed and was disputed by the team members due to lack of confidence, knowledge and expertise. Lack of TF expertise resulted in lack of confidence to stick with the proposed methodology. The methodology was not decided after detailed discussion with experts rather it was decided reactively when the TF tasks were about to be performed. Some experts viewed the project team to facilitate the experts only.

In TF, the team leader needs to look deep into the aim and objectives in addition to other circumstances of the TF project as demonstrated in the figure above 3.7 (a); a thorough diagnostics of the national situation of the components of production chain,

identification of regional scope of the TFP 2025, and then to identify the methodology for the region and to launch the TFP 2025 through conferences. Due to lack of experience and exposure, TF team within the PTB and MoST started conducting the expert panel meetings after identification of the priority areas (Siddiq, et. al., 2011), which was highlighted but not paid attention due to lack of pursuance.

The table below is thorough workout done by Rafael Popper et. al. (2007) about the methods used globally in specific regions of which only a few were used and others were not at all studied deeply and never used by TFP project team:

Methods Used by Regions

Top 10	**EU27+** (485 cases and 1835 methods) **Average 4**	**Trans-Europe** (61 cases and 192 methods) **Average 3**		**Latin America** (24 cases and 188 methods) **Average 8**	**Asia** (51 cases and 280 methods) **Average 6**	**Africa** (10 cases and 47 methods) **Average 5**	
1	**Literature Review** (63%)	Literature Review (48%)	Expert Panels (57%)	Other methods (71%)	Expert Panels (80%)	Scenarios (60%)	
2	**Expert Panels** (52%)	Scenarios (41%)	Futures Workshops (46%)	Expert Panels (67%)	Scenarios (57%)	**Megatrend Analysis** (50%)	Interviews (33%)
3	**Scenarios** (47%)	Expert Panels (30%)	Literature Review (45%)	Literature Review (67%)	Literature Review (55%)	Literature Review (50%)	
4	**Other methods** (24%)	Futures Workshops (23%)		**Environmental Scanning** (63%)	Interviews (45%)	Futures Workshops (40%)	
5	**Futures Workshops** (22%)	Brainstorming (21%)		Brainstorming (63%)	**Questionnaire / Survey** (39%)	Expert Panels (40%)	
6	**Brainstorming** (20%)	**Megatrend Analysis** (19%)	Scenarios (17%)	**Questionnaire / Survey** (58%)	Brainstorming (37%)	**Essays** (30%)	Trend Extrapolation (20%)
7	**Trend Extrapolation** (19%)	Trend Extrapolation (19%)		Interviews (50%)	Delphi (35%)	**Questionnaire / Survey** (30%)	Delphi (20%)
8	**Delphi** (17%)	Other methods (19%)	Interviews (10%)	SWOT Analysis (50%)	Trend Extrapolation (27%)	**Modelling & simulation** (30%)	Scenarios (13%)
9	**SWOT Analysis** (15%)	**Modelling & simulation** (13%)		Scenarios (42%)	**Megatrend Analysis** (25%)	Trend Extrapolation (30%)	Brainstorming (13%)
10	**Interviews** (15%)	**Questionnaire / Survey** (13%)	Trend Extrapolation (6%)	**Structural analysis** (38%)	**Modelling & simulation** (25%)	Other methods (30%)	Expert Panels (13%)

Fig. 4.5 (b) *(Source: Popper, 2007)*

4.6 International Issues:

According to Borch and Rasmussen (2005) developing countries face difficulty in transfer of technology and "inventing the wheel" remains the only option for them though some of the companies workout technology transfer through financial attractions for private companies to invest in the country on BOT (build, operate, transfer) basis. Poor countries have been observed to lack financial attractions and appropriate culture for private companies (transnational Companies, TNCs). Thus, such countries lag behind in acquiring critical technology for achieving techno-economic outcomes. TNCs often abstain from technology transfer for not maintaining a threshold of cost escalations.

International community of developed nations needs to give allowance for developing countries to gear up their economies with the new technologies for meeting the demands of the people through joint ventures with closest good neighbors. This issue is said to be the factor in making poor countries weak however this is not the only major factor. Infrastructure, political injustice, education etc. are also very important role players in the economy and ultimately contribute in their bad economic situation.

International factors impacted TFP badly. UNIDO had been working with the MoST in many planning projects but without any break through. TF team decided not to involve international community but only asking for help where it is needed (financial, HR etc.). According to experts, international organizations work on some specific agendas and only dictate their terms which were experienced by the technology foresight team. Also, a few micro level projects, which were initiated due to TFP 2025, came to

stand still only after their news was casted on the news paper for marketing purposes. Later, an international organization undertook the same project which in the ministry was a project on files only.

4.7 Resource Allocation:

TFP team reported abuse of resources several times. Team members did not know about the resources allocated to them and no one assisted them or gave them access to the available resources thus many tasks performed were not up to the mark. Conflicts were reported regarding the use of resources as there was a division of stable and non-stable employees. Resources allocated were in the use of those who were stable and right HR working on the project often complained about this issue.

According to experts it must be part of the PC1 and abuse must be made the use by making it legal as it was desired by all team members to have their needs fulfilled which motivated them to use them in other than the projects works. They suggested project funding reforms which can make flow of financial resource easier and audit of the project must be done after completion of project or escalation of the resources available. The whole project's success should be rewarded by a nominal audit and a thorough audit must be avoided as whole project includes many complex transactions including sacrifices by the patriots working in project, ministry, industry or civil organization.

4.8 Political Will:

Political will is said to be the core of TF. TF can involve politicians in conducting a fruitful outcome for the future socio-economic well being by developing technological capability, economic capability, manpower and identifying industry needs, and others (Wonglimpiyarat, 2007). It may happen if the whole program is being improvised by the elites e.g. ministers, secretaries of the ministries, prime minister etc. then its easy to implement the policies and projects recommended; although legislative and implementations lags (Traum, 2011) are always there. In TFP, most of the expert panel meetings highlighted that some how politicians must be involved, directly or indirectly. This was mentioned even in initial phase of the program but no concrete steps were taken by the team or the project authorities in this regard. There was no ownership of the politicians either from the opposition or the governing parties. In this context, some participants even emphasized the role of standing committees but despite the active role of the chairs of standing committees in the government no effort was made to communicate the findings on regular basis to them. Parliamentary secretaries were also suggested but again no one from team, authorities or experts tried to contact them. Some argued about the right time and some waited for good product outcomes for politicians.

In this regard project team often mentioned that it was to safeguard the ongoing activity i.e. TFP which may have faced the problems related to non indulgence of politicians. This often results into outcomes of the activity disowned or the resulted product not embraced open heartedly by the politicians due to lack of vision and

knowledge about the outcomes. Their involvement is said to be critical in nature for TF to be successful.

Reason for not involving the politicians was the lack of confidence on the amateurish politicians to own the whole process and government having other agendas to focus. Some experts believed that the absence of politicians from TFP was a strategy to do TF silently and not to give it such a hype which is expected to disrupt the work by international agencies/organizations. A few experts focused on carrying out the activities silently and keep conducting the panel meetings till a good time comeS & Team gets hold of a champion among the politician or we get to a concrete solution which then be pursued through some other channels for a successful implementation.

These problems are not specific to Pakistan, e.g. Turkish TF was observed and highlighted by an organizer from Turkey that lack of leaders owning the outcomes and lack of consistency in politics or change of leadership blocked recommendations from being implemented. However, in TFP, political problems were very much comparatively significant as compared to other countries; reason being a geo-political driven decision making process. Therefore, experts highlighted the concept of regional TF with Turkey and Iran which is expected to be more successful for involving regional stakeholders also.

4.9 Governance:

Governance which is free of vice accepts all the good ideas and openly accepts the visions of the experts. Access to such a government is often good for communicating the findings and guiding them towards right direction. Governance for the project and for the outcomes of the project is very critical in success of any PSDP (public sector development projects) projects. It is the issue which originates issues of other sort. In TFP, panelistS & Team often highlighted governance issues.

A study by Popper et. al. in 2007 depicted that the initiatives of most of the TF exercises were taken by the government and sponsorship was also from the government side to make effective and efficient decisions about the near, mid and far future. Thus, a sincere government would be the first priority for a successful TF exercise. It is ideal but TFP however was conducted to take one step towards good governance despite the reservations from panelists of a non ideal time to conduct TF. Graph below is pictorial representation of the data collected by Popper (Fig. 4.9(a)):

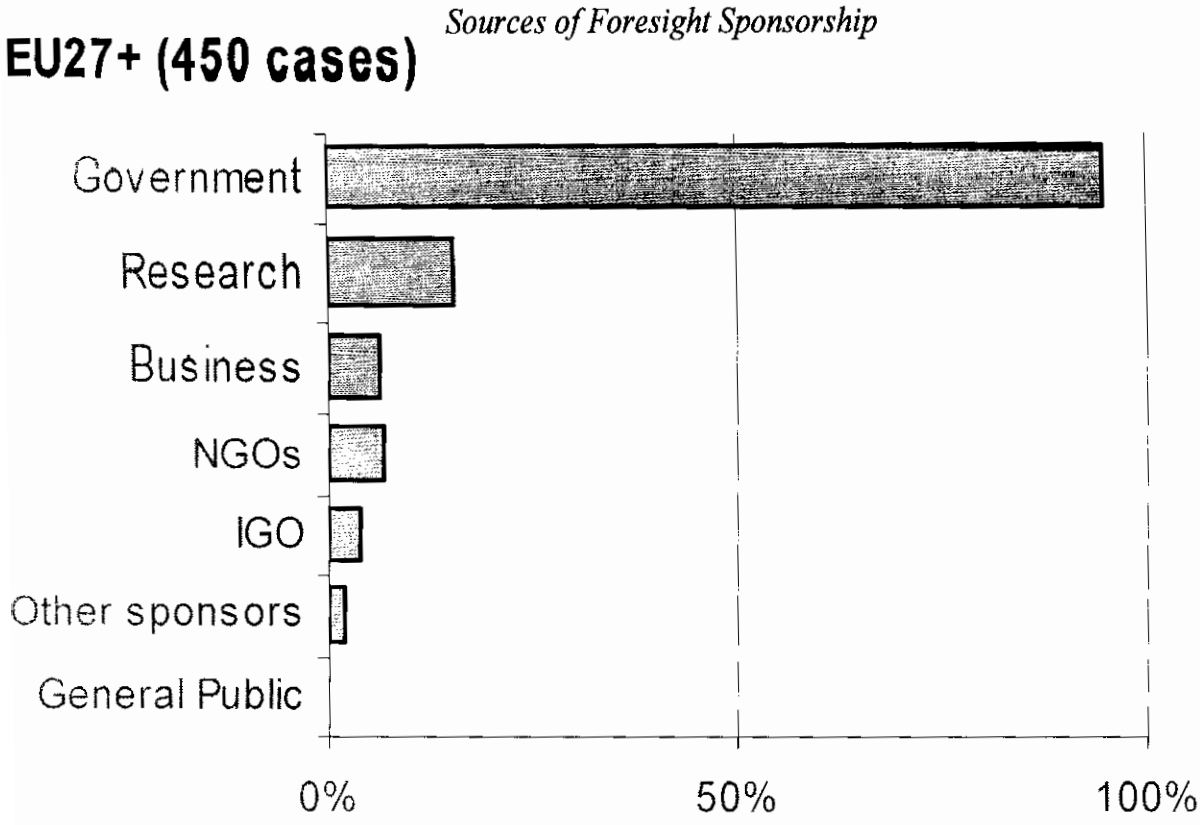


Fig 4.9(a) *(Source: GFO, 2007)*

War against terrorism, electricity shortages, corruption, and passive leadership at all levels; will to be friend of the enemies for the sake of personal gains etc. diverted the focus from TF. Thus, lack of good governance contributed in ignoring the TFP. For the successful TF, governments need to know the real client who is facing issues and link needs to be clearly established between policieS & TF process (Johnston and Cagnin, 2011).

4.10 Pre Foresight Issues:

Pre-foresight often considers mandate issues which cause problem in the future of the project. It was often iterated in the expert panel meetings and also in the interviews conducted for expert panels' formation. Experts were keen to know the role the expert panels will play in the current scenario. They were aware of the passive behavior of the government agencies and also knew how often policies implementation plays a vital role in socio-economic well being. This caused them to inquire about the scope in terms of time, responsibility, policy formulation or any other. Most of the time horizons or scopes in technology foresight exercises around the globe were from 10 to 20 years (GFO, 2007) in the future (Fig. 4.10(a)).

Above mentioned scopes were studied by TFP team but were often questioned by experts during the meetings. Some also posed queries of what will happen next or who will pursue through what procedures or is it just an exercise without any considerable outcomes. Experts queries were satisfied by TFP team only as there was no other authority owning the project practically (verbally it was owned but actions didn't support speeches). They were intimated about time and responsibility scope but due to lack of interest from the politicians' side and from bureaucracy side, their interest was lost. Participants used it as leverage for personal futures but contributions to the project outcomes were little. It was all on the basis of patriotism with no honorarium awarded for the time experts spent in the meetings. TF team managed the meetings in the ongoing circumstances with outcomes not in accordance with the requirements of the authorities.

The outcomes were filtered by TF teams in the form of projects, policies and reforms discussed in the meetings.

Time Horizons: TF Programs

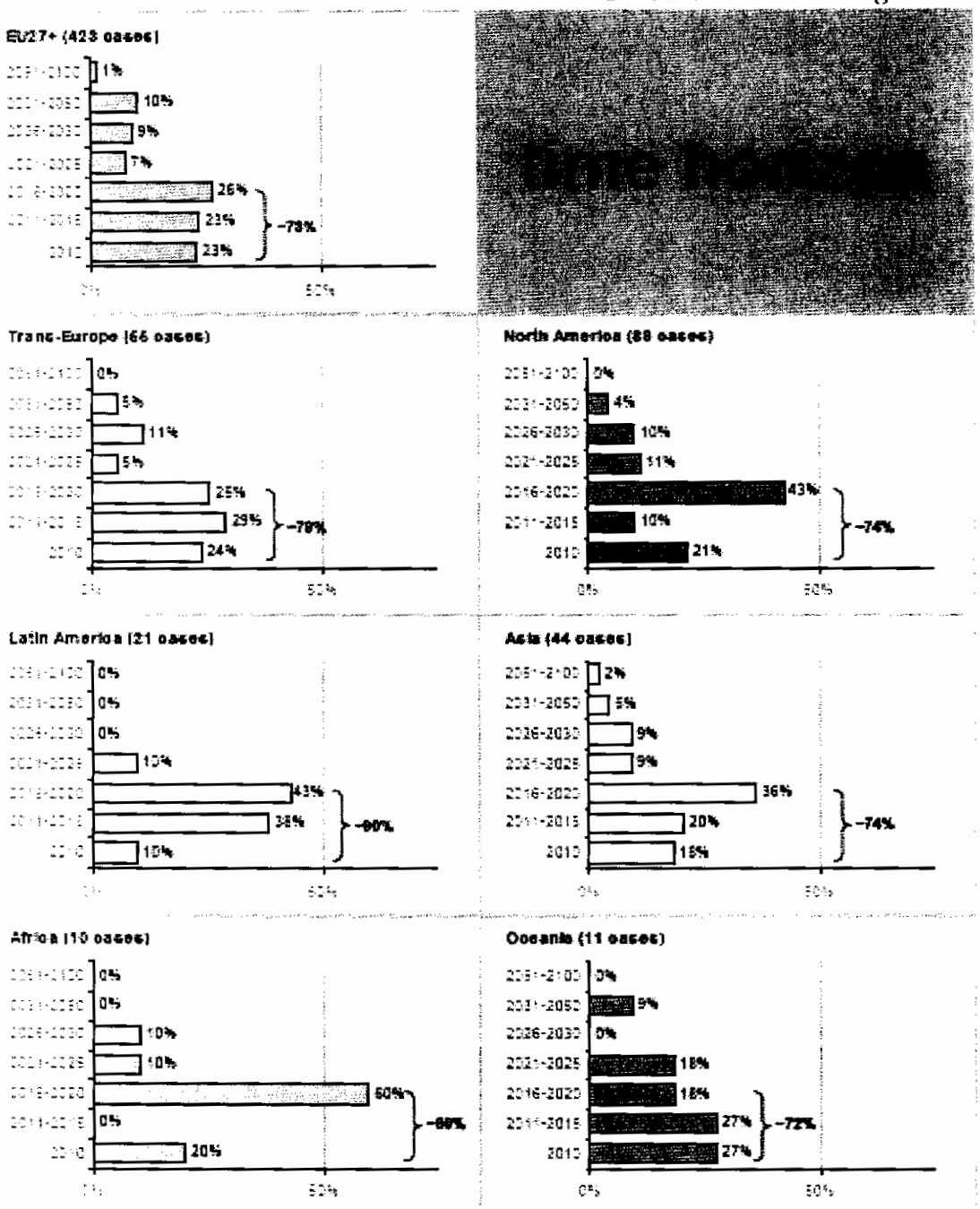


Fig. 4.10(a) *(Source: GFO 2007)*

Time Horizons mostly were 2016 to 2020, followed by 2011 to 2015 and 2010.

4.11 Decision Making:

Decision making is very critical process which always accompanies risk and ultimately uncertainty [23]. In TFP, all levels of the management were not communicating about the outcomes and the way of rendering the tasks thus resulting in lack of information for decision makers. Some experts in group discussions, brainstorming sessions and interviews maintained that this is a common practice around the globe. Decisions regarding hiring foreign TF consultants, awarding good employees, hiring new ones, retaining the employees, gaining the expertise through other sources e.g. daily wages and internships etc. were not taken on the right time and were found hard to be taken. Hence, delay in the activities forced project to go as usual without any significant achievement in the short run. Decisions regarding conferences, workshops, trainings of employees, methodology, calling a meeting, acquiring resources were also delayed due to lack of decision making which may be a cause of improper reporting or involvement of project director or because of the managers often managing multiple portfolios.

4.12 Planning in Utilizing and Acquiring Economists:

Proactive planning was lacking in the top management due to different priorities, other than the project as a whole. No economists were acquired and no foresight was done by the top management to render the tasks in a better way rather it was done by novice TF team. In the beginning no economists were acquired as reported by the team working on TF. Later, it was observed that lack time hindered their participation.TF team

often presented plans of an event involving economists but due to lacking in pursuance and proper communication procedures, the management in the middle never communicated it to the top. It was also due to one line manager being hired with no one working in the middle management.

4.13 Commitment of Panel Members:

Panel members were interested initially in the project but later when activity was observed to be restricted to report writing interest level decreased. Many stopped participating and there were even objections on the scope and steering committee's absence. Top level management was brought into notice but according to team the strategy was to bring out some concrete results without involving the steering committee. The plan was to have something credible in for proposing a steering committee. However, the team often discussed about steering committee's absence will lead it to project for procurement only, not for solving public issues. This was often highlighted by panel members that despite the good discussions which brought many projects and policy amendments into focus TFP lacked implementation. Experts were requested to highlight all these issues in front of the authorities but they also had little hope as well as commitment with the project outcomes and authorities.

4.14 Procurement of TF Experts:

Real TF experience was lacking among the members of the TF team. The team highlighted the bookish training without any experience in some industry or organization. The training of TF team was also limited to a couple of methods not all. Deep concept was also vague in the minds of team members. This resulted in activities performed with no direction and prescribed outcomes. Some team members mentioned communicating online and through one to one meetings with the world renowned TF experts but it was more an overview but deep knowledge which the panelists requested from TF team members was not provided. Experts were willing to serve [31] but lack of interest from the officials side resulted in procurement of no body from the network built by the team in 6 months.

Co-nomination was used as the tool for identifying the experts in a sector. Though it was criticized later by the new management but still expertise and other good characteristics were admitted. Lists of the experts who participated in the meetings of experts are to be found at appendix A.

4.15 Media Campaign and Marketing:

TF highlights awareness as one of the 3 critical activities performed in TF process. Many countries have conducted an awareness conference and have invited many national and international experts to participate. In TFP it was observed to be a failure

due to lack of resources and expertise. No proper awareness conference was launched or no media campaign for creating awareness. The scope of activities was always limited to a very small number of people and time. Many workshops were arranged but with not media coverage. Even a grand meeting to prioritize socio-economic areas for Pakistan was not given due coverage in the media due to little networking with media personnel. Experts kept mentioning this but decisions taken were slow and due to lack of HR often new activities overruled the accomplishment of previous ones. Experts from the private sector also suggested involving media through PEMRA regulations or producing funded programs. There was also fear of the TFP being de-tracked by some pressure groups thus idea was not pursued properly.

4.16 Leadership:

In TFP, all kept working like students waiting for the guide to tell us what to do either from the top or the bottom. Real support from the leadership is critical (Duin, et. al., 2010) but in TFP it was missing. No one actively proposed hardcore plans. If there were some creative minds they were forced to leave somehow or forced to work in limited resources. Leadership at all levels died after surviving for some months. Thus, leader just wanted to finish the project for getting a reward for accomplishing a job done (not well done). It was a project for report only not for rejuvenating the nation by building consensus, networks and creating awareness, often performed by leaders.

In the current situation, politicians can't participate as leaders as they don't have any vision of their own due to external pressures. It is also because of the leaders are not born rather accidental, pre-meditated, forced, inherited, professional etc. This intensified the problems for TF team who may serve as leadership grooming program facilitators if and only if leadership decides to participate in it for learning purpose. System of leadership has already been established which requires one to be highly rich thus true leaders die down due to this reason or due to lack of security or else. TF in Pakistan may serve as leader vision training program but it needs champions to devise it in such a way that politicians can be attracted to participate in it. They need exercises which can integrate their interests with those of the nation, country or region. Usually, personal and national interests overlap but only in the long run. It only needs thinking in that perspective which could be developed through conferences, workshops, effective business models, discussing new horizons, strategies and confidence in their personality rather than on other countries policies being imposed through different tactics on the country men.

4.17 Information Technology:

IT has played a vital role in all fields. TF is not safe from its blessings. World now is using IT for conducting world class TF for the nation. Media of other nature is also used with IT for publicizing the TF and its outcomes. Now, Delphi is conducted using online applications and even emails are used to get the response of the experts. Scenarios too are being conducted through specialized software. We now have good

software providing us facility of performing mind mapping, brainstorming, forecasting etc.

For TF team members no trainings were arranged in this regard considering the popularity of online Delphi and increasing utilization of tools for making visualized roadmaps (Eeroal and Miles, 2011). Later, IT applications usage was observed by TF team member which were being used by the experts globally in conducting TF. Hiring such experts or purchasing such IT applications was not managed properly.

4.18 Trepidation Factor:

In TF team financial insecurity resulted in high turnover ratio. TFP was a project for a limited duration. TF team tried to revise PC1 for making it regular activity but no support from the directors resulted in high turnover ratio. Experts had already mentioned this as very critical for TFP. Rising inflation with insecure jobs tempted the workforce in below the level performance and then problem in retaining the work force resulted in new temporary work force which created issues of criticizing the activities. However, project director's retention carried forward the work done so far and intangible results were considered as hope to change not the whole but partially the over all problematic infrastructure through consensus.

4.19 Improper monitoring and reporting:

Lack of HR originates many problems. Now, machines are used for monitoring and reporting so that uncertainty of HR can be overcome but it requires financial resource to acquire such machines/technology. Considering the 70% of youth's availability the best strategy highlighted by the panelists was to hire HR and train them in addition to monitoring or managing their performance through experienced managers.

Proper and disciplined reporting and monitoring required more HR. Technical report writers who can produce good reports were missing in the team. Some officials were considered for writing but their work was considered as that of novice which was a right judgment but restriction on workforce made it difficult to hire more professionals. It remained a problem in TF team to report the authorities officially and monitor the activities performed. Hiring the professional report writers was also difficult due to lack of monitoring. Only some of monitoring sessions were conducted with no reporting about severe issues.

4.20 Economic Viability of Projects:

Expert panel meetings gave many good policy and project recommendations. All these were only limited to papers and were not communicated due to lack of reporting and monitoring as mentioned previously. The projects identified were almost the ones which were the outcomes of previous such exercises though in the past consensus

building and stakeholders' participation was not taken care of. Expert often stated that the only requirement left was of economic business models for all recommended technologies. TF team tried to reach a consensus about future technologies and related policy as well as to overcome the communication gap in the society. But economic viability was said to be an outcome of government's policy regarding the import of raw material and other machinery. Reverse engineering was also a problem as old machines were not economically viable but their reverse engineering was allowed. New machines were patent but the problem was limited copyrights.

Pilot projects in this regard were successful but the need of the society was food for life in addition to clean water, air and housing. Other things were not needed as critically as these basic necessities were. Expert panelists highlighted these issues but whole of the media and system was more indulged into new tech which undermined a foresight free from technology and purely poverty oriented. Hence, no investor was willing to invest in such projects which were not backed by government policies regulating its business. Pilot projects were initiated by government with much support coming in from national and international agencies.

4.21 Foresight Culture:

Short term planning is part of all creatures but humans are exception with most of us doing short term planning due to uncertainty about the far future and poor adaptability of our ancient habits to next generation futures (Pang, 2010). Most of the government

bodies do conduct planning but not long term Foresight exercises. TFP2025 was first long term planning of its nature to identify the future projects and policies executed/implemented periodically and sequentially. Other nations which are conducting foresight are well tuned and aligned to this culture of visioning the longer term future. For this they have conducted many long term visioning workshops. They are found to conduct such workshops/seminars/conferences on meso, macro, micro and organizational level. This was found to be the strategy of the government to inculcate Foresight culture.

Globally, more than one institutes exist which are conducting foresight on regular basis. In US, for this purpose, university of Houston has Dr. Peter Bishop running the department of Futures. Also, in Hawaii another department in an educational institution has it in the political science post graduate level courses. In Finland, University of Turku has a similar study program for graduates and post graduates. In Germany, a private institute is conducting regular foresight exercises though they have nominal attachment with a university in Germany. To inculcate and popularize in addition to realizing its critical needs, Australia, Sweden, Turkey, Spain, England, Venezuela, Brazil, Taiwan and many more countries have foresight related organizations. In Sweden, main purpose of foresight was to make it such popular that no one in the country should ask "What is foresight?"

4.22 Scope: Socio-Economy vs. Poverty

Technology Foresight is also said to be focusing technology for socio-economic uplift. It is often criticized for layoffs and golden handshakes due to new technologies proving efficient and predictable as compared to HR. Technology reduces reliance on HR in the short run, which is indeed uncertain to capitalize on. Other than HR we now have machines which have made prediction easier but jobs for unemployed HR is becoming an issue. Some of the US officials consider a ban on outsourcing due to increasing levels of unemployment. Technology is giving leverage to those who have access to it and is helping them in multiplying their profits.

Poverty is also being caused by technology to some extent. Humans are now trying to earn more only to payoff their bills for using technology. The technology is not directly helping them to eat but rather helping them in earning more than they consume. It is observed that the number of farmers is decreasing as jobs related to technology are more valuable than farmers. Thus welfare of people comes first and there is a need to realize that technology policy must not undermine welfare of humanity and over emphasize economic growth and competitiveness (Kastrinos, 1995) which often demoralize farmers and appreciates technologies which inflict harm of some kind to small or greater extent to the nature. Technology needs strong economy but poverty can be eradicated through social bonds endorsing the idea of Foresight only. Globally, Foresight often demotes technology for sustainable development.

4.23 TF Team Capacity

TF team comprised of young graduates but there capacity was not enhanced according to the requirements of the project. It was due to the exposure, experience, expectations and expedience the team had. TF requires communication, social, technical writing, policy analysis, presentation, leadership, networking and other skills. Young team members had all these skills but with limited capacity. TF on national level needs bigger capacities of all above mentioned skills. Graduates needed more exposure to grasp more to exploit their learning in performing.

Enhancing capacity requires more diverse exposure through participation and the use of new technology. On the contrary, their skills were exhausted in internal meetings and using labor extensive ways of performing the routine tasks. It was partially due to unavailability of technology in the remote areas but mainly due to non communicative behavior which was due to lack of interpersonal skills and because of fearing which was due to the rare meetings with decision makers regarding the future plans.

4.24 Champions Identification/Participation:

Champions are said to be the fuel for implementation of policies in private sector or public sector through their efforts and skills (of conflict resolution, networking and communications). Technology Foresight, for future implementation prospects, heavily relies on the champions. It was hard to have them actively participating in the project due

to their busy schedule and especially when the project team is new and management is bungling.

Initially, such champions must be identified through networking techniques and other sources of media. One peculiar purpose to involve champions is to put more weight in the outcomes and to boost the capacity to innovate. Due to absence of champions the innovation part which is often of keen interest to all stakeholders was not addressed. The success of TF is also attributed to its strong linkage with innovation policy and to tailoring TF approach to targeted innovation arena (Schoen, 2011).

4.25 External Pressure:

TF project team came across inter and intra organizational pressures. The team had little capacity in constructively transforming these pressures from other groups around them. This pressure can be termed as peer pressure. Pressure from other organizations regarding the mandate and regarding performing duties which are in the mandate of the other organizations was also felt. TF team also described a pressure due to high mandate of the project. Many experts maintained the view that internal and external pressures won't let the TFP 2025 achieve its objectives. Inter organizational pressure also resulted in the change of the leadership of the project.

The pressure was from the provinces also due to lack of proper direction. Expert panelists said that it's not the mandate of the MoST. Such feelings were due to the recent changes in the ministries which were given to provinces.

Another external pressure was from the international community which is justified often in special circumstances like unjustifiable deaths of many in future (Tonn, 2011). The pressure was observed in form of intervention and often diverted the priorities. It was mainly due to the dictation of global monitoring agencies, NGO, TNCs etc. It was observed that projects communicated to authorities were not entertained/pursued due to the priority list wasn't synchronized with the demands of or pressures from international community which resisted to pursue some of the suggested projects.

4.26 Involving Economic Affair Division (EAD):

TF is done for future socio-economic well being. Without the experts of economy from public departments, private organizations and academic economists, the TF is considered incomplete. The TF needs to have relevant economists in all panels for better planning and an acceptable outcome. Economic Affair Division in Pakistan is the body which is being contacted by international NGOs for collaborating with the Government of Pakistan. PTB being a small entity within the ministry of Science and Technology can only conduct its functions according to the act but for international collaborations, GoP needs to be involved through EAD.

The problem of not involving EAD in the beginning was taken as a matter of petty concern. Although they were contacted but passive response and pressure to do more forced the TF project team to proceed further. However, later it was realized that this was critical for achieving an objective of collaborating with international organizations like UNIDO and TUBITAK etc. EAD is an active economic entity due to which many others can also be involved for wider consultation and increasing participation. In Germany, other than Ministry of Economy which includes an economic policy division that carries out analyses and forecasts (Herault, 2006), following public sector bodies pursuing future planning/foresight:

- Z-punkt, ''The Foresight Agency'', (www.z-punkt.de);
- Institut fur Zukunftsstudien und Technologie-bewertung (Institute for Futures StudieS & Technology Assessment, www.izt.de);
- Netzwerk Zukunft (www.netzwerk-zukunft.de);
- Zukunftsinstitut (www.zukunftsinstitut.de);
- Futur (www.futur.de), funded by the Federal Ministry of Education and Research;
- Sekretariat fu¨ r Zukunftsforschung (SFZ, Secretariat for Futures Studies.

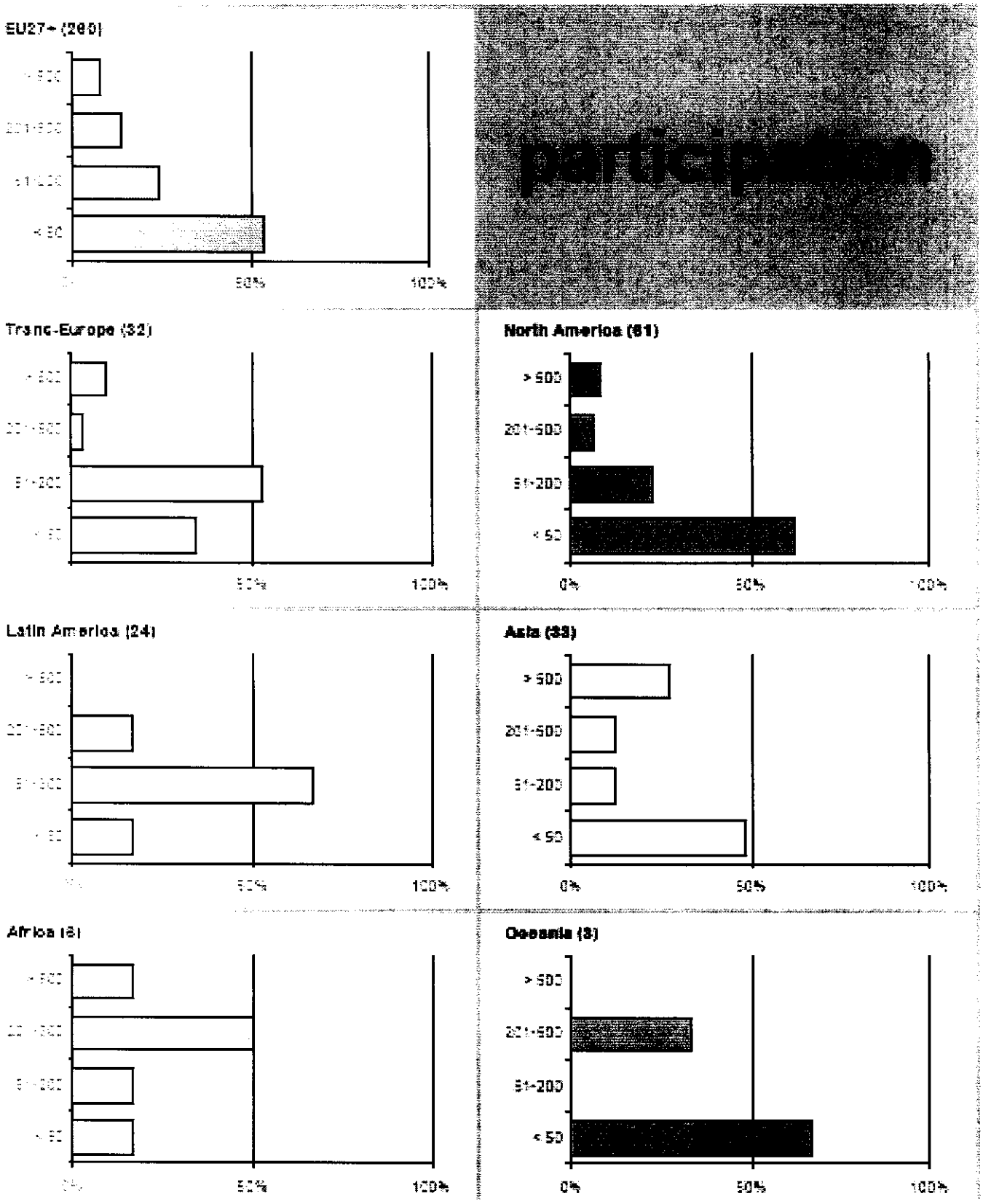
Similarly, such public sector departments exist in France, Belgium, and Finland etc. Pakistani TF included no such departments but a work in isolation. Invitations sent by TF team were not entertained due to other important commitments and also due to the absence of some authority powerful enough to oblige them to participate.

4.27 Country/Region Wide TF:

TFP mainly focused in the federal capital. Little attention was paid to get the opinions and feedback from the local experts at district and provincial level. The constraints of finances, absence of middle level management and fear of being criticized by passive departments of wastage of national resources on futile activities were the primary reasons. TF activities on regional or district level produce outcomes pertinent to that location precisely thus creation, dissemination and accumulation of ideas and strategies (Conceicao, et. al., 2006) for small locations with in a country which will bring better policy implementation results. Although, country wide TF involves greater number of experts but Fig. 4.27(a) below depicts most of TF involving less than 50.

Fig. 4.27(a) *(source: GFO – 2007)*

Participation of Experts in Foresight Programs



Experts also suggested to on board the regional countries for a foresight which is accepted by neighbors and is in their favor also. In this scenario also, pressure groups were the main reason for not involving the sister countries and the neighbors. It was tried on different forums and a joint conference among 7 countries was also organized but due to non involvement of Foreign Affairs experts from public and private sectors of all the participating countries, efforts resulted in not good results.

4.28 Private Sector:

Government can't implement all recommended projects and policies alone. It needs support of experts from private sector who have experience of managing businesses and is capable of helping government through partnerships (public-private) and consultancy or participating in visioning workshops of foresight seminars. Participation of private sector is very moderating and mediating aspect of the whole process. Private sector's involvement needs proper motivation in addition to the agreements signed which if missing may result in lack of interest.

Technology is a fuel for change which is rarely conflict free. Hence, stakeholders from the groups of concerned areas need to coordinate and devise policy. For such matter proper intelligible public dialogue is considered as a driver for future technology applications without which, dangers of unrest and entropy in the system are more obvious. TFP 2025 relied on workshops with experts rather than general public.

4.29 Study on Current and Emerging Trends:

There was no study on current and emerging trends. All the experts participating in the workshops were anticipating as well as instructing to have the implicit knowledge about it. Experts in the sessions mentioned that studies are needed at this point of time however; constraints didn't allow going ahead with such projects. Joint ventures in this regard with the research institutes were proposed however feelings of insecurity about the ownership of the outcomes de-motivated the TF team. In some instances improper communication channels hampered the activity of the project. Joint venture with international organizations was discussed but capacity to conceptualize and materialize such a project was absent in all the TF team.

Globally, such studies are integral part of long term planning exercises. A group of experts in Spain highlighted the use of ICT getting into our homes a basic necessity and becoming more individualized in the future (Martinez, 2000). Despite the existence of EGD, the use of IT was not incorporated in the TF which resulted in low response rate, slow data analysis, limited area and organizations covered in the survey. Later when young team was inducted, efforts to utilize IT were all in vein due to no political will and steering committee. The trend now a day of IT as problem solver increases its significance for its use in TF though in Pakistan it may not be as widely used as it is in developed world.

4.30 Delphi:

It was a challenge to conduct Delphi with no experience. Management was also reactive in addition to void of planning. Project team did not know what to do with the outcomes of the semi-Delphi and how to proceed further. Often, authorities reflected discomfort regarding the validity and reliability of the study. Delphi process was not even used by TUBITAK (Saritas, et. al., 2007) for several reasons of which lack of expertise is primary reason. Delphi conducted in TFP was circulated to about 80 experts mainly in academia and some belonging to private/public sector. It was criticized to be way too small for a national foresight exercise though outcome due to snowball sampling was about 200 experts. Despite the justifications of team about lack of resources of all sort and limitations in addition to the argument that it was solely to have some base for TF to go ahead as in some cases TF was conducted without Delphi, consensus lacked on the validity of the outcomes and areas of critical nature chosen in TF.

A review of some countries' Delphi revealed that it is mandatory to have responses from around 1000 experts. Minimum rounds of the Delphi survey are preferred to be 2. More than two may make it problematic and tedious to analyze. Fig 4.30(a) gives the picture of Delphi conducted in 3 countries.

(Source: Damrongchai, 2008)

Delphi Response Rates

Fig. 4.30(a)

	Japan '99	Korea '99	Austria '98	UK '95
1st round	86%	41%	46%	31%
2nd round	82%	79%	71%	41%
responses	3106	1444	1224	1022

Above data shows that at least two rounds must be conducted in Delphi as it is qualitative instrument and needs thorough analysis from the experts conducting it. Also, the point to be noted is, the number of responses are more than one thousand which undermines the credibility of the Delphi in TFP. Delphi was abandoned by TF organizers in Turkey due to lack of expertise and same was the reason for Pak-Semi-Delphi.

4.31 STEEPV:

STEEPV is globally recognized method used for systematic brain storming sessions. It is used to list down issues and drivers faced in a sector. In STEEPV experts are invited to discuss the ideas which can bring change or a strategy in the current circumstances. It stands for social, technological, economical, environmental, and political and values. It tries to accumulate all the issues and drivers pertinent to the area under discussion and rigorously filters the variables of greatest importance, highly uncertain and most influential in a country's socio-economy. This is done through voting and discussions in a very disciplined and systematic way like an automatic production system. The last two or more variables, (which is the ultimate outcome of the process), after thorough discussion and are used for scenarios two by two matrix.

In TFP 2025, the methodology was deemed successful in brainstorming sessions. Systematically, experts were able to find out the top two variables (for scenarios analysis) which are considered to be the most significant in all the variables/drivers identified in discussion sessions. Experts' panels liked the method with some changes suggested by

each one to make it more effective for the brainstorming session. An example of the TF panel's work using STEEPV in industry technology foresight (Minhas et al, 2011) is attached at appendix B. Identification of variables and drivers through STEEPV were very much like factors identification in a market research.

However, later in the TF exercise, the effectiveness was reduced to only carrying out the same sessions over and over again with no solid outcome. In some cases the STEEPV was not even done completely and was left incomplete due to lack of monitoring from the TF team. This was due to HR related issues in the TF team with sense of insecurity prevailed among whole of the team. This was also due to team management practices. All of the team members were found busy in conducting a sector expert panel meeting due to only one was trained and confident in conducting the whole process.

The process of STEEPV was a success as far as identification of issues and drivers is concerned. All the brainstorming sessions conducted were appreciated by all the panels' members due to the first ever experience they had of such a methodology incorporating diverse representatives for building consensus and making new networks for awareness and ease of communication purposes. However, the outcome of STEEPV was not translated into scenarios planning and analysis. Some experts even complained that all the outcomes of STEEPV have been produced already by expert reports, conferences, seminars and reports by private organizations.

CHAPTER - 5

5. TFP Analysis:

5.1. TFP Process Mock-up:

In the current scenario media is considered very strong and if tapped can produce good results in policy implementation, awareness, consensus building and participation. The only thing to be done is to involve it in the exercises of building the networks, special workshops regarding media, inviting them in conferences and seminars etc. One method is to build good relations with them through actively inviting them in the expert panel meetings. All the panelists highlighted this very issue of not having media persons on board. Media, as depicted in the Fig. 5.1(a) below, is considered somehow as a lead role player in any activity; whether it's the initiation, procession, validation etc. Often, media proof for activity performed is mandated by authorities for officially ending the task.

Some experts even highlighted the absence of S & T channel which may conduct panel meetings for awareness of the people and hence inviting the experts in all such panel meetings will be relatively easy. Such a channel must be funded by the government and such meetings may be broadcasted on such an S & T channel for raising awareness among the masses instead of conducting Delphi. This can serve as continuous monitoring tool and evaluating such a foresight program through public feedback which is going to increase value for upcoming sessions.

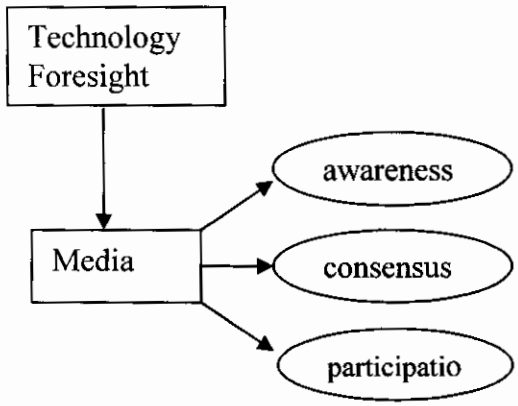


Fig. 5.1 (a)

Another way to do Foresight in Pakistan is to be upright confident (Fig. 5.1(b)) and keep pushing the authorities in pursuing whatever is right. Keep reporting each and every meeting (internal/external) and report the findings to authorities with specific demands which are necessary to conduct TF. TF team should be given the confidence to communicate on any level of the government and pursue the projects' successful completion. Communication is continuous and systemic as well as systematic process which must not be stopped but monitored and guided properly to have good outcomes. 360' communication is healthy but it must be timely.

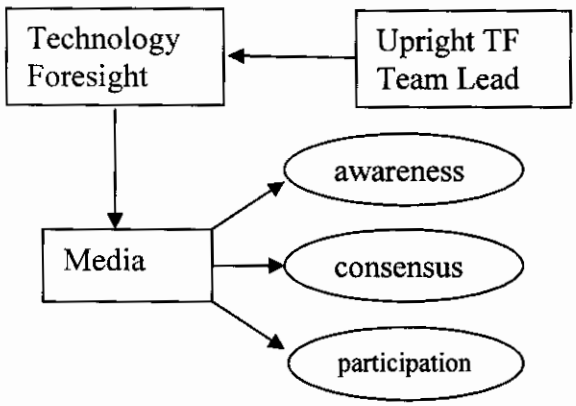


Fig. 5.1 (b)

Best way to do TF is to have the political will. This will define the scope and goal of the whole visioning process. TF backed by politicians faces least obstacles in implementation. This is considered the most ideal situation of conducting TF and model below relates political will with other variables in Fig. 5.1(c) below. Authorities keenly interested are open to take any necessary actions identified in a roadmap and may go ahead with the recommendations (policy/project) of the expert committee. Many experts pointed out this issue of "absence of political will" in TFP and somehow tried to get the politicians of the concerned department on board. This was difficult task due to busy schedules and different objectives and goals (political).

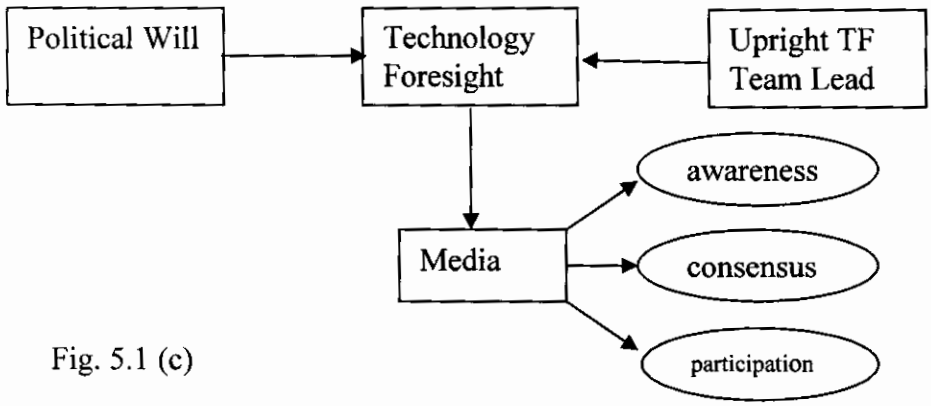


Fig. 5.1 (c)

In the absence of will of politicians, it is necessary to make TF somehow attractive for them to involve into the process. This can be done through media, holding world class conferences, inviting figures which have close terms with politicians and meet them regularly etc (Fig. 5.1(d)). This again needs a team lead in TF which is void of any fear and is a leader in its own personality.

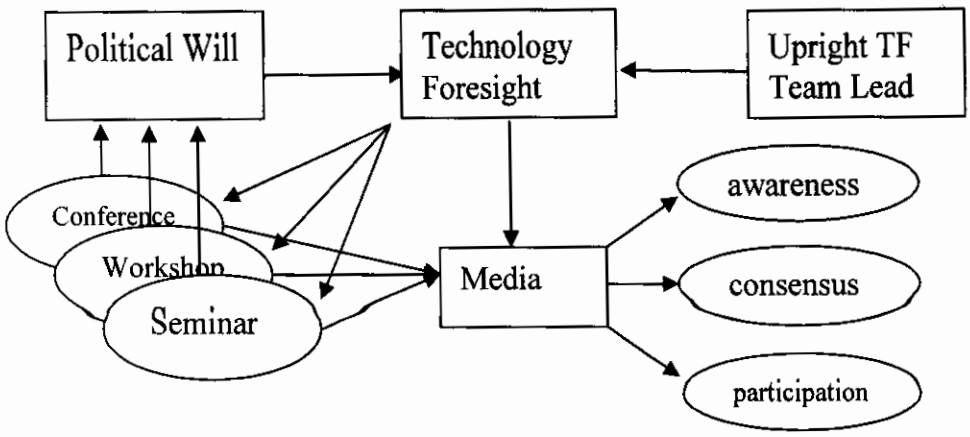
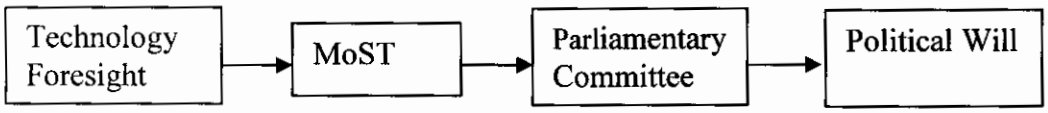


Fig. 5.1 (d)

Political will is hard and especially when in the beginning the steering committee was absent and even till the end no steering committee was formed then two ways can workout implementation. One is through parliamentary standing committees. TF should report the findings to the board which then communicate with officials in ministry. From there recommendations can be taken to parliamentary committee (Fig. 5.1(e)) thus paving the way to gain political will. Second method suggested by the expert panels was to pursue the politicians and give them the knowledge and benefits of implementing the policies and projects recommended by the stakeholders group. This also needs to show them the benefit for them in the long run.

Fig. 5.1 (e)



One model proposed by a champion from US highlighted the wish and will of the concerned department. The main idea was to know about what some organization or department foresees in the near future. Either it is wealth generation, good will, social

responsibility etc. Then according to that what ministry of industry can offer as a product to Pakistan. Then change the system accordingly through media and developing networks which can be social or technical. Then to analyze the potential to export the product for earning revenue or even going for joint ventures with others to find out the potential as a group or cartel in the globe.

One expert in industry panel proposed (Fig. 5.1(f)) to do TF by identifying the priority areas for socio-economic well being of the country. This may be followed by the list of critical local and global existing and future technologies for short, medium and long term socio-economy of the nation. Then, an expert committee (comprising of all stakeholders) is to analyze the potentials to import; and local capability to assist in that technology usage, maintenance and R & D in near and far future. Accordingly, decisions must be taken to get the technology transferred or any other option which is feasible. Technology licensing was highlighted as potential issue in this model of TF. Educational institutions were to play a role starting for now till an infinite period of time in educating the future HR for gaining expertise in current and future technologies.

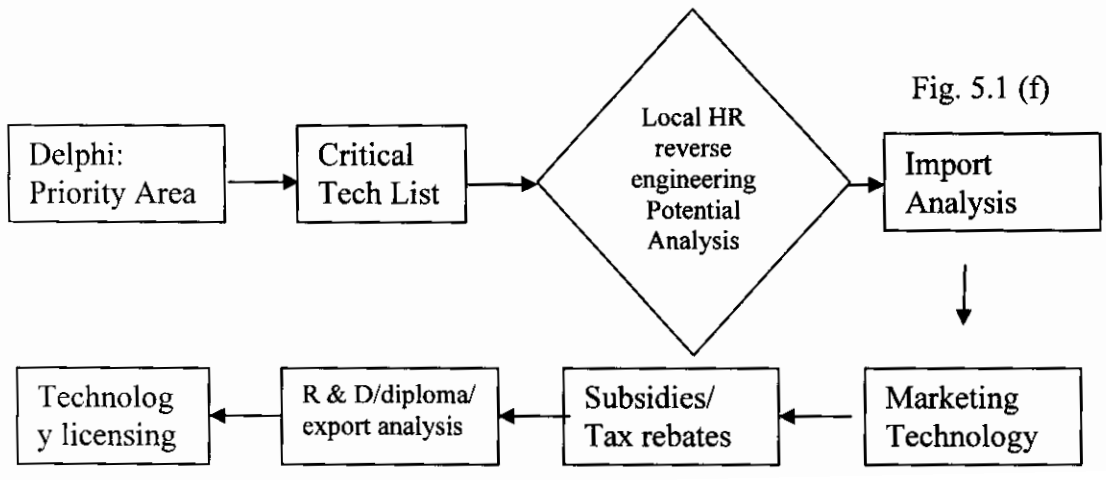


Fig. 5.1 (f)

One model was to establish innovation centers at all levels i.e. districts, provinces and federal capital. These innovation centers will promote the futuristic thinking and will try to inculcate the foresight culture in the country. The working of these will be like that of technology foresight team: conducting innovative workshops for near and far future technologies which are socio-economic and every one onboard has consensus to pursue them locally or import them from abroad. This model of innovation centers is expected to inculcate the foresight culture and will induce innovation in all walks of life through consensus, networking and awareness. Innovation Centers were thought to highlight the real problems in the real professions of the locals and solutions will come from the groups made for this purpose.

An expert in TF presented a new model to conduct expert panel meetings rigorously and then communicate the findings through seminars, workshops and other media so that awareness can be raised. This is partially followed by TF team though there were many limitations to conduct rigorous workshops about futures. Experts believe that such workshops need to have future thinking as well as list of critical future technologies to conduct a better TF.

One aspect of the TF was suggested to be planning which in Pakistan done by planning commission. Some experts also suggested that it must be conducted on that level to overcome the problems related political will and participation. It is believed that on that level participation will be fine as well as politicians will participate and will own it. Conducting it in a weak and new body is not going to have greater impact due to its

role in the upper echelons is not effective. Rather, it is ignored due to weak marketing and little good will. Primer minister's ownership will ultimately be achieved when conducted in Planning Commission due to the situation of government infrastructure.

Some experts also believed that it can be made successful by foreseeing who is going to be the next prime minister and involving him in the exercise. This may not help in near future but in the long run if he ever comes into government the implementation will be ultimately achieved. This was considered rather a risk to the whole project as no involvement of the key stakeholder i.e. government was supposed to be a threat to the whole project. Uncertainty in the upcoming elections poses threat of non stable political infrastructure.

One strategy for successful TF is by indulging large number of youth in this process; using the platforms of universities and colleges (public/private) for the purpose of building consensus, awareness and networks; conducting seminars and workshops for that matter; producing youth foresight programs of long lasting impact on their personalities; making them listen to expert panel discussions and comment later on etc. This was highlighted due to the future ownership practically is in the hands of youth. They are the future flag bearers, nation builders, politicians, thinkers etc. For this purpose, TF courses may be designed for post graduates or Doctoral programs can be initiated in futures studies. This is being highlighted in a conference by WSFS for cultivating HR and for provoking young minds in futures thinking.

5.2 Recommendations:

TF is continuous and rigorous program rather than a one time job. It needs to be done on regular basis through experts working as a group. The main objective is consensus and policy implementation. Whole of the process needs programming and back up support from the government. TF requires funding for the projects recommended by the expert panels, policy pursuance for the amendments made in the discussions and trends analysis during brainstorming sessions, Delphi etc. Government has to work as catalyst not passively or through low level management's involvement but through active participation of the ministers and prime minister which ensures implementation and will to change the prevailing issues and problems in the country.

From that perspective, TF in Pakistan failed completely. Tapping the upper echelons of the ministry and government as a whole was not at all achieved in the program. Experts' panels were often found to have upper level experts on board but no one paid attention due to incapacity of the experts, TF project team and higher level management which was busy in other tasks rather than taking keen interest in TF. Work was being pushed forward and needs of the TF project team, experts coming for change and to change agents and citizen of Pakistan were ignored due to the agenda of TF was not marketed properly and perhaps some of the officials were aware of the activity going on for socio-economic uplift of the country.

Steering committee was the main flaw as it was nowhere to be found in TFP. The team pursued secondary objectives in conducting TF rather than the primary supreme objective. Continuous emphasis from project was ignored due to the passive leadership and afraid to take decision. Steering committee would have eased up the task for the team members. The team was often criticized for not choosing the right experts and were often said to have used persons which were not at all experts. This was due to the absence of a strong body (of policy and decision makers) directing the whole project and its outcomes.

Panels of experts on different occasions highlighted different issues and recommended which can be summarized as:

1. Adoption of policies focused on making a national innovation system work through product and financial market reforms
2. Reduction in barriers to technology entrepreneurship
3. Support to research and development.

TF team studied various countries TF programs and emphasized a conference for awareness purposes. Awareness of all echelons through a great conference has been observed in UK, Turkey, Iran and other countries. This technique can clarify the importance of TF and Political Infrastructure can be involved by doing so. Or TF team may form innovation centers and conducts futuristic workshops, brain storming sessions rigorously in all parts of the country. This will also enhance the understanding of the general public, politicians and youth. This is going to inculcate a futuristic culture in

Pakistan. Experts also suggested having a private body pursuing it as a business consultancy. Some foresight entities were found but were passive and meant to provide businesses consultancy regarding strategic management unlike foresight which is shaping the future.

5.3 Lessons:

Political will is core of technology foresight which contributes to the implementation later on. In TFP also, Involvement of politicians was a motivation for all the participants to take interest. Initially some private sector experts were motivated but the results they were foreseeing (project for report writing, not implementation) lessened their morale to take interest in the whole program. One of the key industry owner who was also part of the project expressed concerns over the practical involvement in the project. Indirect and non practical involvement resulted in experts notifying their ideas but not able to communicate them to higher authorities. Although, intangible outcomes demonstrated a movement in the society as there were many meetings conducted with many officials serving as bureaucrats. The "Word of Mouth" marketing of Technology Foresight made it more effective though not efficient. TF team's meetings with media focusing financial gains through unethical means and private sector focusing only profits and civil organizations having their own interests and bureaucrats resulted in somewhat harmony for the whole nation. Discussions with commoners mediated in consensus which gave them vision of future. Many projects were observed by expert panelists for a better future.

Despite all these issues and challenges faced it was observed that intangible outcomes were good and made the environment of the whole country conducive as many were contacted and a new culture was observed to focus the long term benefits instead of short term outcomes for politicians. Many collaborations of the private sector and many communication gaps were observed and filled by participants who motivated about 7 to 10 participants in all the panels working and contributing to TF project in some way.

TF process takes a long time to payback due to which need of continuously pursuing the outcomes of TF be translated into government activities (Wonglimpiyarat, 2007). The TF is yet not finished due to the issues and challenges faced above. Still, intangible outcomes are there. Networking is going on and awareness, though on smaller but top level, is going on either. This has promoted a culture of TF which is expected to take yet more longer to bear fruits for the nation or if allowed the next TF is expected to be more mature and success worthy due to greater number of expertise are now available and better ways of doing it have been identified with in Pakistani context.

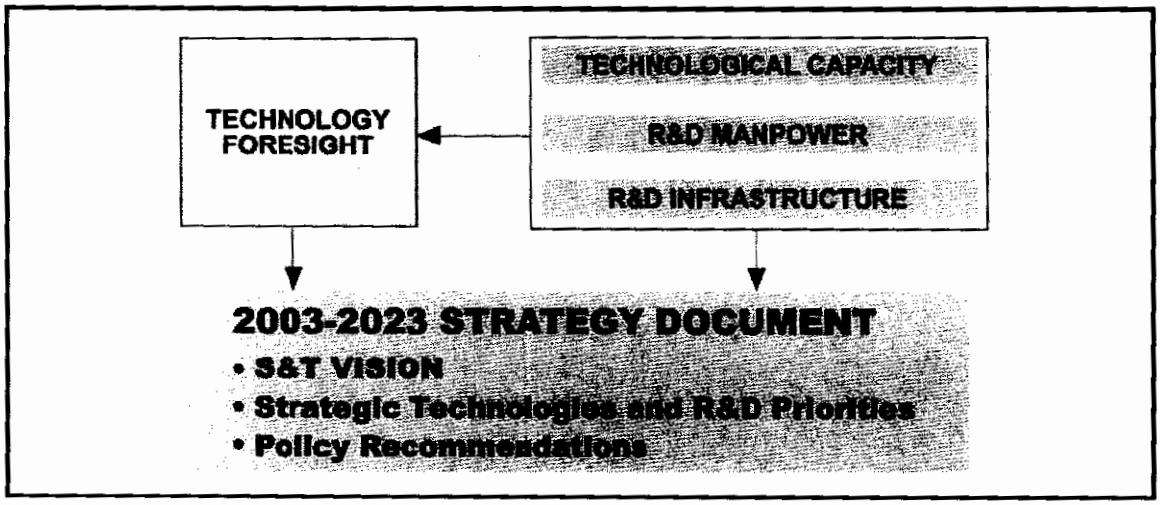
From another angle, cultural context is very important for new technologies be promoted in which fashion or way. Culture context of a region, nation or locality dictates how future technologies will be used (Davies, 2011). Public opinion is thus very important which reflects the social and cultural norms of a region, country or place. TF in Pakistan needs to know the culture and social norms and STEEPV exercises outcomes attached at appendix B reflect that even experts were conscious about norms in the

country and were precautious in their words for outcome be accepted and implemented with little resistance. APEC is aimed at developing the capability of regional countries and making TF a culture for ease if conduction and implementation of the recommended policies, projects etc.

5.4 TF Model amendments:

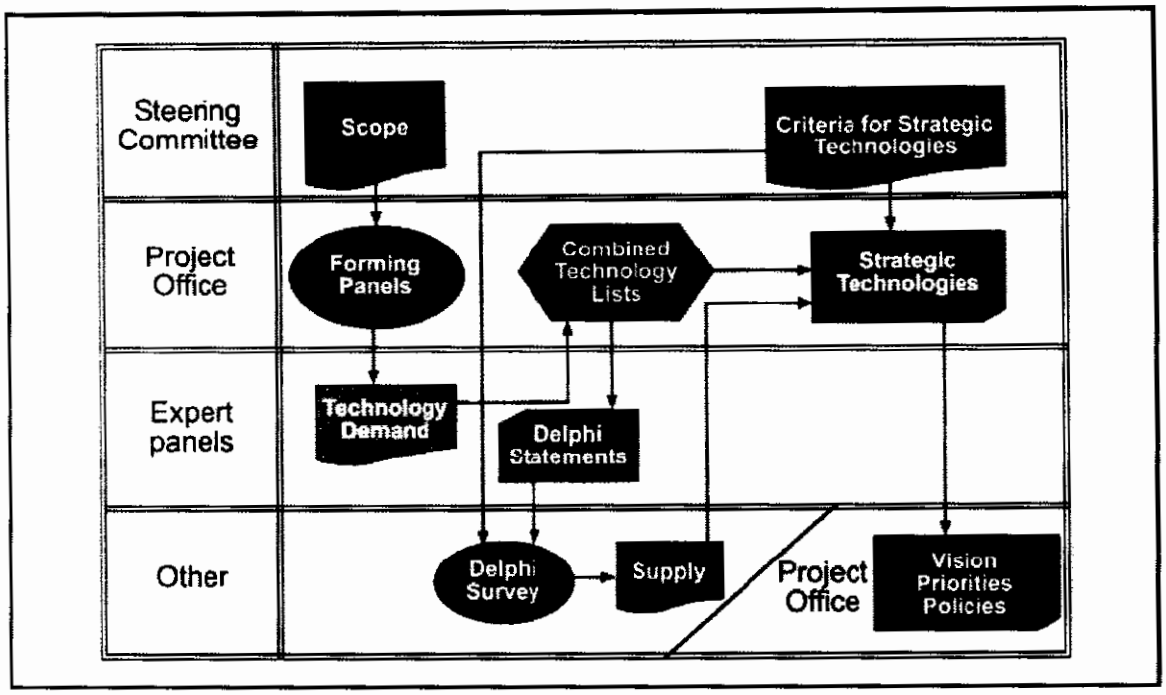
It is clear that model was the effort of the TF team with no experience of doing such a great work before for the whole nation. Contrary of TFP, Turkish TF model is shown below:

Fig. 5.4(a) *(Source: Daim, et. al., 2009)* *Turkish TF Model*



Turkish TF was more mature as they prior to doing TF did R & D manpower analysis, studied the relevant infrastructure and the current technological capacity of Turkey. In TFP it was just a jump start with no considerable study done in above mentioned areas in Turkish TF (Daim et. al., 2009).

Fig. 5.4(b) (*Source: Daim, et. al., 2009*) *Activity Based Turk TF*



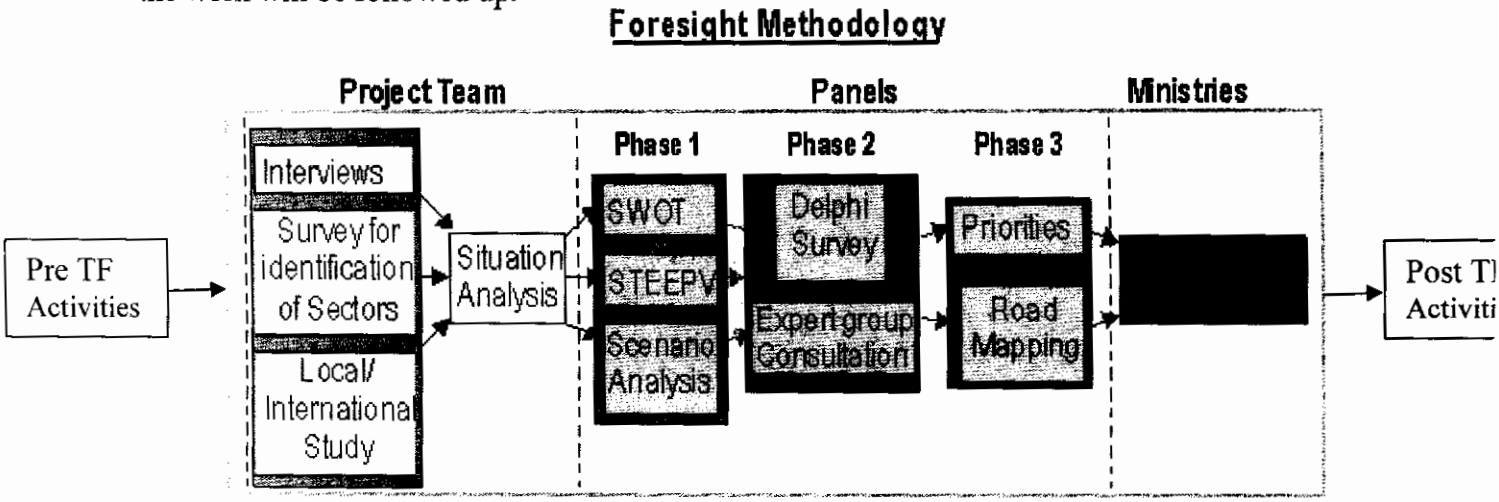
Above model (Fig. 5.4(b)) has been reviewed in the paper on Turkish TF. But it is more comprehensive and clear in classifying the tasks of steering committee, project team, expert panels and others involved in the project. In UK foresight, the maturity and seriousness was demonstrated as they first tried to find out the best method suited to the then situation of UK through a study by SPRU at University of Sussex, at a later stage department of Trade and Industry and Office of S & T contacted German group, some private consultants, PREST and SPRU to validate the methodology to conduct TF which later was called Foresight only (Miles, 2007). Later in UK's first experience of TF, a steering committee was formed. This particular action needs to be taken in TFP next endeavor to conduct TF again or it is very possible to replicate the Turkish model which

is very likely a sibling and can be resembled to us in many ways due to many things in common.

In Turkish TF, 200 workshops were conducted as compared to 40 in Pakistan. In UK, the number is fairly large with events related to TF were more than 600 and Delphi was sent to about 10,000 experts all over UK and responses received back were 3000 (Miles). In Japan and Korea the motive of the government was to conduct a technology foresight for change management and technologies which can give them edge on the other countries (see appendix C). Appendix D gives the brief details about TF of different EU and Asian countries. In Pakistan Delphi was conducted with limited number of experts receiving it and not much at the end was achieved in wider consultation in addition to naming it semi Delphi. Delphi in the second phase remained a goal never achieved due to hurdles and a culture of ending the project in its premature stage. It happened because of no involvement of ministries in the start too or absence of steering committee.

For the success of TF an important part of the model should be convening the meeting of BoG of PTB for designing the whole program model. This can ensure government funds pouring into the exercise as well as will. For making political part of the whole program, it is very necessary to have at least minister of S & T in the steering committee as chairman. Then a TF expert must be made in charge of the whole program with all the requested data available to him. The model below needs to show what is to be

done and how and after the whole process depicted in model needs clarity to specify how the work will be followed up.



Amended TFP Model

In addition to replicating the Turkish TF model, experts suggested some pre and post TF activities. In the pre TF activities, real TF awareness campaign is required for the secretaries, ministries, R & D organizations, professors of the academia and private sector. This could motivate some of the officials of the ministry to be part of such a huge policy making, policy amending and project initiating in addition to abandoning process which requires all the stakeholders to discuss about the emerging technologies, their socio-cultural concerns and financial implications on the society. This will also enhance the ethical understandings of the society relevant to that technology or amendment in the policy, power relations of the government and others in the society, and role of experimental and local knowledge thus contributing in a process of systemic and systematic transformation smoothly into a democracy rather than enforcing autocracy (Cagnin et. al., 2011).

In the pre-TF activities, clarity regarding the emphasis of TFP is required. Do we need to focus on engagement of users in the program as it was thought to be getting stronger in FTA conferences or is it evaluation of the impacts of previous policies, higher education or business/industry (FTA conference review. 2011)? Covering all in one TF program is not easy specially when it is first time in a chaotic environment and deliverables must be specified prior the start of TF. TF team in PTB was intimated when the six areas TF was about to end that goal should be dissemination and informing the policy makers rather than implementation. Focus was guided by the ministry to be impact analysis and not pursuance about implementation which some of the expert panelists were pursuing as their core objective. Other necessary actions to align TF in Pakistan as suggested by experts are:

1. Hire Technical HR and identify priority technologies in priority areas
2. Technical experts/researchers assisting expert groups
3. Involving extremist groups as potential change agency in Pakistani context
4. Involving all political parties and regional diplomats
5. Studies regarding technical HR availability

Before TF, the above mentioned activities will produce harmony and ownership of the outcomes of TF. As TF is context based program and all the countries have adopted different approach according to prevailing circumstance, so for Pakistan in the current scenario, best is to involve all in this exercise and to come up with a

comprehensive plan. It is expected that extreme religious groups participation will not stop technology diffusion rather it will enhance it through culturing the technologies according to the needs of the religious groups which are very large in number as well as other moderate groups which have affiliation but don't completely boycott the technology's usage.

Covering all in one TF program is not easy specially when it is first time in a chaotic environment and deliverables must be specified prior the start of TF. TF team in PTB was intimated when the six areas TF was about to end that goal should be dissemination and informing the policy makers rather than implementation. Focus was guided by the ministry to be impact analysis and not pursuance about implementation which some of the expert panelists were pursuing as their core objective.

Post-TF is all about holding conferences and using mass media for raising awareness to avoid possible hindrance from public bodies, civil organizations or citizens etc. Here, decision makers need to ensure that after such an extensive work, implementation is only in their hands and funds may be allocated for the activities sooner for the fruits of TF be trickling down to end users for sustainability and socio-economy. The steps after foresight in Pakistani context are:

1. Holding conferences
2. Seminars for joint venture projects in TF with other countries.
3. Funding initiated for pilot and development projects

4. Brochures printed for general public's awareness program
5. Involving media for creating awareness and producing programs accordingly

Apart from pre and post TF activities, experts suggested that Pakistan is in turbulence. It will be a good practice if private institutes and public sector universities establish foresight departments or institutes as it is present in University of Hawaii, Manoa in political science in addition to such departments at University of Manchester, Sussex, Tamkang etc. around different part of the world. This will ensure availability of foresight experts for future activities and researches regarding TF will continue round the year void of any such program is being funded by government departments within R & D organizations or not.

5.5 Conclusion:

Technology Foresight in Pakistan needs politicians to undertake it wholeheartedly. Aligning this whole process demands politicians be attending visioning workshops through Foresight STEEPV brainstorming sessions. It can only be done by a positive role played by the media rather than a role of making money at the cost of disturbing the balance and social norms in the society. Despite no time for them to participate in all of these sessions, it is considered a basic necessity for the future well being. Best is to take the whole program on media and broadcast it on all channels at the same time and then invite politicians of the concerned ministries. Technology needs to be used as solutions for special purposes not general purposes for general public.

For successful TF we have to engage several elements and have to extend a couple of leverages to TF team. First most is to acquire the HR and attain it by giving them sense of security and liberty with necessary resources. Second, media must be engaged as leader in guiding the leaders rather than earning money, viewership surveys, ads etc. Frequently, the workshops must be conducted for engaging as many actors as possible thus converging to an action research which is validated by all stakeholders. Academia has to be the major role player due to youth presence and due to the resources availability. The real champions must be on boarded by the TF team through rigorous pursuance and active HR hunting. All sorts of databases must be readily available to meet the demands of the actors, champions and project team members. Need to realize the importance of TF by all cadres is critical otherwise, it has to one man show who is the man to work 24/7 for achieving the goals as TF is lead process undertaken by exposed or hidden leader who has capacity to deliver but devotion is must with openness to all for any change in policy or product. Religious beliefs must be the analytical framework for any changes, amendments or attachments in the policy.

There is also a need to involve other regional countries to do R & D in S & T sectors of importance and mutual benefit. Their involvement will enhance the outcomes and will ease implementation process through synergy. For this, workshops, conferences and seminars must be arranged to raise awareness among the diplomats of the regional countries to initiate a regional foresight process.

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APPENDIX

A

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Appendix B **STEEPV: Identification of Issues and Drivers:**

Social	Technology	Environment	Economical	Political	Values
1. Public need oriented Technology Management 2. Awareness Campaign i- Wastage of Energy ii- Wastage of Water 3. Primary Education 4. Energy Education System	1. Adoption of Indigenous technology 2. Battery manufacturing plant 3. LED technology, LFD technology, HFED technology 4. Energy presentation using low technology 5. Coal technology 6. Nuclear energy 7. Real Time data base 8. Pak resource data base 9. Alternative Energy/ Renewable Energy (Wind, Solar, Micro Hydel, Biomass, Waste to energy)	1-Education related to Energy Technology 2- REEE think tanks 3-Industry-Academia linkages 4-National thinking lacking 5-Natural resource management 6-Marketing oriented R & D environment 7-Carbon credits 8-Previous projects/project management	1-UNDP funding to wind energy technology 2- Un-economical high-tech purchase for educational institutes 3- incentives for research and technology 4- Dependence on foreign models is not economical 5- Patents and Royalties/ IPO. 5- Micro and Macro finance Institutes 6- Re-invention 7- Economic indigenous projects 8-Employment generation oriented project. 9- Zero- energy building	1-Banker's leadership 2-Scholars's political leadership 3-Abide by rules and regulations. 4-Awareness of decision makers. 5-Vested interests, monopoly/lobbies. 6-Technology policy. 7-Legislation policy. 8-PEMRA enforced media.	1-Religion oriented technology. 2-Simple life style. 3-Researchers low social value. 4-Feel human loss. 5-Ethics/ morals. 6-Journalist energy group. 7-Institutional- up gradation / evaluation.

Appendix C

Selected foresight projects addressing societal challenges

Project	Outcomes	Future perspectives	Management	Stakeholder engagement
Nordic ICT Foresight[a] [17]	*Informative* Evaluations of key ICT applications. Nordic scenario set in context of ICT development scenario-based visionary roadmaps. Building views of the Nordic potentials in ICT development among key actors. Action proposals and policy recommendations.	*Diverse* Alternative scenarios. Also identification of ICT applications with development potentials in Nordic region; future-oriented elaboration of factors affecting the Nordic business and development environment in ICT.	*Fixed* Structured discussion and the generation of new ideas in the workshops *Autonomous* Creative brainstorming and ideation in the different scenario and roadmapping workshops.	*Exclusive* Intensive stakeholder engagement in core group *Extensive* Co-operative idea and concept creation among stakeholders from different Nordic organisations and firms; networking.
VTT Water Research Roadmap 2006[b]	*Informative* Create common understanding on future challenges and VTT expertise. *Instrumental* Support the formation of different streams of R&D actions within VTT.	*Diverse* Inclusion of alternative views on priority-setting. The identification of key action areas for VTT water research and their priority-setting.	*Fixed* Structured questionnaire; defined agenda for workshops and structured priority-setting. *Autonomous* Flexible use of methods in working groups.	*Exclusive* VTT expert engagement in steering group and workshops to enable intensive communication. *Extensive* Networking among VTT experts on water related R&D through questionnaires, co-writing.
Nordic H2 Energy Foresight[c] [18]	*Informative* Awareness raising and deepening the overall understanding of the entire value chain (hydrogen production, storage, distribution, stationary hydrogen uses and hydrogen uses in transport). An action plan for the Nordic key actors – without a direct link to any decision process.	*Consensual* Shared understandings were searched for in order to be able to give action recommendations for the Nordic key actors. Still, a variety of views and opinions were considered and debated during the process.	*Fixed* The overall design of the process was determined already when planning the project. The model and modelling techniques in use guided the data gathering of the system analysis part. *Autonomous* There was still a significant degree of freedom to adapt to the perceived needs during the process and the development of roadmaps and scenarios.	*Extensive* The participation was open for research institutes, industry, associations and public organisations of the five Nordic countries.
EU: IRRIIS scenario work[d] [19]	*Informative* Identification of emerging safety and security issues in an EU project to ensure the safety of critical infrastructures.	*Consensual* A project level consensus on the future developments. Still, different scenarios were considered.	*Fixed* A fixed procedure and methods selected in the beginning of the project. *Autonomous* Autonomous scenario work among the stakeholders. The experience of stakeholders "overwrote" the methodological rigidity in some points.	*Exclusive* The work was carried out among the project partners. *Extensive* The results were tested against available expertise outside the project consortium.

Table 1 (Continued)

Project	Outcomes	Future perspectives	Management	Stakeholder engagement
UK DCDC Global Strategic Trends Programme	*Informative* Identification of cross-dimensional analysis of the future context of defence in the next 30 years. *Instrumental* The document is a source for the development of the UK Defence policy.	*Consensual* This process aims to provide new evidence and thinking on strategic trends on specific risks highlighting significant defence and security implications. The findings consist in probability based outcomes	*Fixed* The procedure was fixed at the beginning of the process It applies trend analysis with a time-horizon of 30 years. *Autonomous* Expert group work.	*Exclusive* Process was mainly small expert group work. *Extensive* Ideas were exposed in conferences and a survey was launched to opinion-formers leaders in business, government, media, NGOs and academia. The outcomes were reviewed by external experts. The findings were tested against the views of an international and largely non-Western peer group.
Foresight Canada[e]	*Informative* Identification of emerging and frontier technology domains addressing subjects such as future fuels, bio-health innovation, geo-strategic systems, animal health and infectious disease. *Instrumental* The outputs were used to contribute to a joint security technology initiative of Canada as well as strategic S&T investments in the Defence R&D Canada Centre for Security Science.	*Consensual* The outputs drove discussions of national security challenges to provide input into capabilities needed to meet these challenges.	*Fixed* Strategic environmental scan based on experts' view was used assess probability and impacts of projected threats. *Autonomous* The overall process was based on workshops. Creative workshop discussions.	*Extensive* The process involved a network of security stakeholders. These were coming from different government departments, private companies, and research organisations. *Exclusive* Only invited participants.
Generation of innovation ideas in Finnish Foresight Forum[f] [20]	*Informative* Identification of future developments in nutrigenomics, (ii) health care and social services and (iii) services for the provision of personal experiences. *Instrumental* Identification of innovation ideas and promoting stakeholder networking.	*Diverse* Analysis of diverging views on innovation ideas among stakeholders.	*Fixed* Robust portfolio modelling, online surveys. *Autonomous* Stakeholder workshops.	*Extensive* Wide stakeholder participation in online surveys. *Exclusive* Limited but open stakeholder participation in the workshops.

Table 1 (Continued)

Project	Outcomes	Future perspectives	Management	Stakeholder engagement
FISTERA: Foresight on Information Society Technologies in the European Research Area[a] [21]	*Informative* Identification and SWOT analysis of socio-techno-economic trends, drivers and challenges; key characteristics of ICT research in Europe including human resources aspects; futures challenges, applications and priorities for developing the information society in the EU. *Instrumental* Outputs contributed to prepare the FP7 (Framework Programme) ICT programme.	*Consensual* FISTERA identified priority application areas where investments in ICT research should be intensified in the future, motivated both by S&T developments and by socio-economic needs.	*Fixed* Scenario workshops, on-line Delphi study, on-line forum, national seminars ("FISTERA road show"), supported by desk research) *Flexibility* Results of each phase of the project were widely disseminated and feedback on these results was used in the next phases, also to adapt the methodological approach.	*Extensive* There was an extensive engagement of stakeholders. More than 500 experts including policy makers, business actors and researchers from all EU Member States responded to the on-line Delphi study. In addition, more than 600 stakeholders in a various EU Member States were addressed in a series of national seminars. A number of scenario workshops were held, each involving in average 25 participants.
Future Impact of ICTs on Environmental Sustainability[b] [22]	*Informative* Explore how ICTs will influence future environmental sustainability (time horizon: 2020) and develop policy recommendations. Results were discussed with both DG Information Society and DG Transport and Energy of the European Commission.	*Diverse* Description of a large degree of uncertainty of impact of ICTs on the environment. The scenarios developed during the project accommodated a diverse range of views and suggested a number of possibilities.	*Fixed* The methodology was fixed at the beginning of the project. It consisted of data gathering and combination of qualitative scenarios and quantitative modelling.	*Exclusive* The project was mainly conducted by the research partners. The scenario building step involved around fifteen external experts and stakeholders. At various steps of the projects, experts were consulted to validate the results and methodological aspects. Policy recommendations were validated thought interviews of about twenty experts in ICT or environmental policy
The 8th Japanese technology foresight program	*Informative* Understanding future S&T challenges. *Instrumental* The 8th Japanese technology foresight program aims to provide necessary information for making the 3rd S&T basic plan of Japan.	*Consensual* The 8th Japanese technology foresight program consists of consensual Delphi survey, scenario, bibliometrics and needs analyses.	*Fixed* The methodology for the 8th Japanese technology foresight program is fixed at the beginning of the project, including: Delphi, Scenario, bibliometrics, and social and economic needs analysis. *Autonomous* There was still a significant degree of freedom to adapt to the perceived needs during the process and the development of scenarios and social and economic needs.	*Extensive* There was an extensive engagement of diversified stakeholders. About 2239 experts participated in Delphi survey. Also, many experts of social sciences participated in scenarios analysis and needs analysis.
Innovation 25 in Japan	*Informative* The final report of "innovation 25" has set out 5 scenarios for future Japan, and find out the prior S&T topics to achieve the social goals. Instrumental "Innovation 25"aims to make long-term strategy for Japan.	*Consensual* "Innovation 25"has set 5 scenarios of Japan society in 2025,and it includes "Long Health Society", "Safe and Secure Society", "Society with Multiple Career Path", "Japan contributing to Global Issues" and "Japan Opening to the World".	*Fixed* The methodology was fixed at the beginning. The Cabinet Office established the Innovation 25 Strategy Council and the Innovation 25 Special Mission, and six fields were discussed by workshops independently. *Autonomous* There is freedom in discussion for social scenarios in each field, and the priority setting of science and technology based on technology foresight.	*Extensive* There was an extensive engagement of diversified stakeholders from government, academia and industry.

Table 1 (Continued)

Project	Outcomes	Future perspectives	Management	Stakeholder engagement
National Technology Roadmap in Korea	*Informative* Learning about the technology pathways and needs. National Technology Roadmap in Korea aims to make long term strategy plan.	*Consensual* National Technology Roadmap (NTRM) in Korea has set up five complementary visions, two of which are related to sustainability and security directly including "Advancing the E2 (Environment and Energy) Frontier" and the "Improving National Safety and Prestige".	*Fixed* The major activities in establishing NTRM have been guided by the NTRM Head Council. The Executive Committee was also set up with 5 sub-committees that are the core body in developing NTRM. In addition, TRM teams (in total 74 teams) were set up to draw TRMs for key technologies in the second stage. *Autonomous* Each TRM team consists of around 10 technology experts from industries, academic circles and research circles.	*Extensive* A total of 751 committee members have participated in drawing NTRM.
The Revision 3rd Korean technology foresight	*Informative* S&T developments *Instrumental* The "Revision of 3rd Korean TF" aims to strength the linkage between the foresight and policy-making, namely to provide necessary information for making the 2nd Korea S&T Framework plan.	*Consensual* The "Revision of 3rd Korean TF" has analysed the impacts of 19 megatrends & issues, and identified 182 future strategic technologies.	*Fixed* The methodology was fixed at the beginning.	*Extensive* There are broad engagement of diversified stakeholders from government, academia and industry.
National Technology Foresight in China	*Informative* Understanding future S&T developments and needs. NTFC aims to provide also necessary information for making five-year plan of science & technology development.	*Consensual* NTFC has identified lots of key technologies in 9 research fields based on the Delphi survey.	*Fixed* The methodology was fixed at the beginning.	*Extensive* Very diversified stakeholders from government, academia and industry have participated in NTFC.
Technology Foresight towards 2020 in China	*Informative* TF2020 aims to provide necessary information for making long term strategy for science and technology development in China, and for influencing the allocation of S&T resources in CAS.	*Consensual* TF2020 has set up 6 pictures of China development in 2020, and identified 734 key technologies in 8 research fields based on the Delphi survey.	*Fixed* The methodology was fixed at the beginning.	*Extensive* Diversified stakeholders from government, academia and industry are very active in the process of TF2020.

Appendix D

Foresight process

The process of technology foresight can be divided into three stages: pre-foresight, foresight, and post-foresight (Irvine and Martin, 1984). "Pre-foresight stage – two main functions of the pre-foresight stages are:

1. To prepare a strategic plan specifying the principal issues to be addressed, basic guidelines on the approach to be employed, and appropriate operating and reporting procedures.
2. To establish an organizational framework for executing the exercise and in particular for building the links necessary to gain the active involvement and commitment of relevant stakeholders.

Main foresight stage – four main tasks in this stage are:

1. Detailed design of the foresight process.
2. Strategic analysis of the potential benefits associated with different research options.
3. Agreeing on the most promising options.
4. Disseminating the results to those involved directly or indirectly to determine scientific priorities.

Post-foresight stage – this stage focuses on the implementation of the findings into policy actions. These aim to ensure that the preferred options of today are translated into the realities of tomorrow. All priority-setting foresight exercises proceed directly to the policy implementation phase. We will adopt the definition of these stages and review VISION 2023 along them.