Chapter 6

Conclusions, Recommendations and Scope for Future Work

MANAGING RISKS FOR SUSTAINED BUSINESS SUCCESS OF EPC ORGANIZATIONS IN THE INDIAN THERMAL POWER SECTOR

A

Thesis submitted to

Navrachana University

For the Degree

of

DOCTOR OF PHILOSOPHY

IN

MANAGEMENT

Supervisor:
Dr. Nilay Yajnik

Researcher:
Bibhas Kumar Basu

Co-Supervisors:
Dr. Chakardhar Iyyunni
Dr. (Ms.) Darshee Baxi

NAVRACHANA UNIVERSITY
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SCHOOL OF BUSINESS & LAW

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Conclusions, Recommendations and Scope for Future Work

6.1 Background

This Chapter delineates the major conclusions, recommendations and scope of future work. Recommendations may be used by the project sponsors, business heads, project managers and project team members from all disciplines working in EPC organisations working in Indian thermal power sector. It will also be useful to the proposal & cost estimation groups in identifying & analysing major risks and adopting suitable risk contingencies. It would help in taking informed decisions to positively impact business success of these EPC organisations. Scope for future work will help further researches in this field.

6 .2 Conclusions (Corresponding to Research Objective 1)

6.2.1 Critical Risk Factors (CRF)

Total 34 Critical Risk Factors (CRF) evolved from the Study and are presented with their criticality score in **Appendix 19**. The mean critical scores lie between 3.12 to 4.34 on a (1–5) Likert Scale whereas the medians and modes are mostly at 4 implying that all 34 CRFs are very critical and need to be managed.

6.2.2 Contributions of Critical Risk Factors (CRF) to Total Risk

All 34 Risks under 7 Risk Groups are significant and contribute to total risk. However, contribution of Procurement Risk (R4) and Construction Risk (R5) are maximum followed by the contribution of Customer Risk (R7), Financial Risk (R6), Engineering Risks (R3), Proposal & Contract Risks (R2) and Management Risks (R1).

The above findings match well with the ground reality as explained below:

- Procurement typically constitutes about 60-65% of total EPC cost of power projects. So, unless planned and managed well, projects can suffer in terms of cost and time overruns besides non-performance of the equipment/ plant. On the other hand, if procurement management is done well, it can provide benefits like increased certainty, quality, cost control and reduce overall project risks. Hence, procurement is extremely critical for project success.

- Power projects are mostly built at remote and not easily accessible locations where a large number of socio-political-cultural-environmental challenges continuously impact the projects making construction activities very critical. Effective construction management helps EPC project organizaions to complete projects within scheduled time, cost, and also free of financial or legal complications. Construction management is more critical for large projects that encounter more risks. An experienced construction manager examines each design and construction decision to assess whether the same can have any adverse impact on the budget, schedule and quality. Therefore, a highly competent construction management team is very essential for success of any EPC project.
- Success of projects depends a lot on the Customers for on-time availability of critical inputs like land, fuel, water, grid power, staff, statutory approvals, review and approval of deliverables, payment as well as project closure. Any delay in any of these items can lead to time and cost overrun. Maintaining site law and order situation is another primary responsibility of the Customers that has far reaching consequences for the site activities.
- Financial risks are obviously very critical as availability of funds, on-time payments, positive cashflows, healthy working capital position etc. are keys to success. Other financial risks include bankruptcy of a project stakeholder, variations in rate of interest, forex, inflation, rise in fuel prices, insurance risk premiums, liquidity risks etc.
- Management of other risks e.g. Engineering Risks (R3), Proposal & Contract Risks (R2) and Management Risks (R1) also play important role in business success.

6.2.3 Business Success Indicators (BSI)

Following 4 Business Success Indicators (BSI) emerged from the Study:

Short-Term Business Success Indicators (BSI):

BSI 1: Financial Performance and BSI 2: Project Performance

Long-Term Business Success Indicators (BSI):

BSI 3: Brand Image and BSI 4: Creation/ Enhancement of Shareholders' Value

6.2.4 Impacts of Critical Risk Factors (CRF) on Business Success Indicators (BSI)

1. Results suggest that it is comparatively more challenging to realize Short-Term Business Success compared to Long-Term Business Success. Between the two Short-Term Business Success Indicators, especially, BSI 2 (Project Performance) is more challenging compared to BSI 1 (Financial Performance). It corroborates with the reality. Executing projects within the agreed time, cost, quality and safety standards managing all risks has always been a huge challenge. Newer risks keep emerging and many of them are beyond the control of the project team. These make realization of Project Performance more challenging. Besides, as mentioned earlier, projects are built mostly in remote areas where many issues come up quite regularly which are difficult to resolve.
2. Risks under Management Group have been found to have greater impact on BSI 3 (Brand Image) compared to the impacts of risks under other 6 Risk Groups. Customers' perception of a brand depends on a lot of factors like quality of products/ services, reliability, price, customer's value perception, legacy of the brand etc. etc. In simpler words, it is how market perceive the brand. Management through their actions portray a positive brand image to the external world through their communication, strategies, corporate governance, socially responsible behaviour, Corporate social respeponponsibilities etc.. Ths way, management plays a very important role in developing trust and goodwill of the customers that in turn, impacts the brand image of an organization. Thus, while other risks under other 6 groups are also important, Management risks have more impact on the Brand Image of an organization.
3. The Study found that there is no significant difference in the impacts of the Critical Risk Factors (CRF) under 7 Risk Groups on BSI 1 (Financial Performance), BSI 2 (Project Performance) and BSI 4 (Creation/ Enhancement of Shareholders' Value).

6.3 Conclusions (Corresponding to Research Objective 2)

6.3.1 Risk Mitigation Strategies (RMS)

155 Risk Mitigation Strategies (RMS) selected to mitigate 34 Critical Risk Factors (CRF) are given in **Appendix 13**. All 155 RMS are impactful as reflected through their mean score of 3.14 to 4.56 on (1 – 5) Likert Scale with many of them are 4 and above (ref. **Appendix 23**). It implies that these RMS are robust and have the

potential to realize short-term success every year that can lead to long-term success over time.

6.3.2 Impacts of Risk Mitigation Strategies (RMS) on Business Success Indicators (BSI)

1. Risk Mitigation Strategies (RMS) have more impact on the Long-Term BSIs compared to the Short-Term BSIs. In particular, RMS has maximum impact on BSI 4 (Creation/ Enhancement of Shareholders' Value) followed by BSI 3 (Brand Image) and BSI 1 (Financial Performaance), while impact on BSI 2 (Project Performance) is the lowest. Thus, again it is found that it is comparatively difficult to to meet BSI 2 (Project Performance) compared to the other BSIs for the reasons explained in section 9.2.4 item (1) above.
2. There is a significant difference between the impacts of the different Risk Mitigation Strategies (RMS) on the Business Success Indicators (BSI) pertaining to each Critical Risk Factor (CRF) and the same has been presented in **Appendix 21**.

6.4 Recommendations

Intent of this Research Study has been to come out with a set of Risk Mitigation Strategies (RMS) to manage risks to ensure sustained business success of EPC organizations in Indian Thermal Power sector. In doing so, it dealt with three major constructs – risks, business success and risk management to meet two (2) research objectives framed for the Study. The objectives encompassed how risks adversely impact business success and how risk mitigation strategies can positively impact business success. The insights and results came out of the Study are presented in the form of a set recommendations as given below:

6.4.1 Recommendations corresponding to Research Objective 1

6.4.1.1 Relative Ranking of Critical Risk Factors (CRF)

All 34 Critical Risk Factors (CRF) have been found to be very important. However, based on their mean, median and mode scores as presented in **Appendix 19**, relative rankings have been worked out in Table 6.4.1.1.1 below:

Table 6.4.1.1.1: Relative Ranking of Critical Risk Factors (CRF)

Risk Criticality Rank	Risk Description
1	Time Overrun / LD Risk
2	Lack of managerial Bandwidth
3	Lack of Creditworthiness / Financial Soundness of the Customer
4	Delay in Customers' Inputs
5	Drastic Decline of Thermal Power Market
6	Fierce Competition
7	Stringent Payment Terms and Delay in Payment Collection
8	Variation in BOQ / Cost Estimate
9	Sub-optimal Resource Planning
10	Unpredictable Price Increase
10	Project Funding and Financial Closure
12	Prolonged Delay in Contract Closure
13	Not Meeting Shareholders' Expectations
13	Unequitable Contract Favoring the Customer
15	Engineering Delays
16	Fixed Price Contract without PVC/Steep Wage Hike not included in PVC
17	Improper Communication
17	Scope Clarity / Creep
17	Extended Stay at site & Cost Overrun
20	LD for Non-performance of Equipment and Plant
21	Lack of Financially Sound Competent Sub-contractors
22	Labor / Political / Law & Order Issues
23	Lack of Financially Sound Competent Vendors / Suppliers
24	Emerging Technologies
25	Delay in Construction
26	Change in Government Policies
26	Forex Variation
28	Shortage of Skilled Personnel
29	Quality & HSE Risks
30	Legal Risks
31	Variation in Soil / Site Conditions
32	Lack of Reliable Logistics Vendor
33	Geo-political Risks
34	Natural Calamities / Acts of God

While all the 34 CRFs are very important, the above table will help the Project Manager and his team to prioritize the risks to use resources optimally.

6.4.1.2 Major Constituents of Project Management Team

It is essential to have a very effective Project Management Team comprising professionals from all project management areas for success led by a very competent and experienced Project Manager. However, as per the findings from the contributions of various Critical Risk Factors (CRF) to total risk, the team requires very competent Procurement and Construction professionals to take care of the two most critical categories of risks,. In addition, looking at the extremely stringent and risky contract conditions (favouring the Customer) as discussed in Chapter 2, it is imperative to have a dedicated Contract and Risk Management team to manage risks.

6.4.2 Recommendations corresponding to Research Objective 2

6.4.2.1 Top 20 Risk Mitigation Strategies (RMS) with positive impacts for Business Success Indicators (BSI 1, BSI 2, BSI 3 and BSI 4): Positive impacts of Risk Mitigation Strategies (RMS) on each of BSI 1, BSI 2, BSI 3 and BSI 4 are given in **Appendix 22**. Based on the data given therein, Top 20 RMS that have the maximum positive impact on respective Business Success Indicators (BSI) are presented in Table 6.4.2.1.1 to 6.4.2.1.4 below:

Table 6.4.2.1.1: Top 20 RMS with Positive Impact on BSI 1

Sr. No.	RMS Description
1	Explore coal and gas-based power opportunities abroad e.g. SE Asia, Middle East, North Africa, Latin America
2	Diversify into emerging power businesses e.g. Nuclear, Solar Thermal, Energy Storage, Waste-to-Energy, Fuel Cell, Plasma Energy, etc.
3	Cost leadership through continuous cost reduction, innovative engineering, procurement, construction and tax optimization while creating a lean organization
4	Bidding in appropriate currency for hedging / natural hedging
5	Focus on FGD, SCR, ESP, replacement of old inefficient generating units
6	Negotiate better terms of payment with Customer with 10 to 15% interest free Advance and timely payment
7	Work measurement, proper documentation & immediate invoicing through SAP/ERP system
8	Excellent Market Intelligence of projects and competition
9	Have contractual provisions to cover impact of “change of policy during project execution” including levy of new taxes, extraordinary wage hikes, etc.

Sr. No.	RMS Description
10	Transfer back to back payment terms to OEMs and major Vendors / Contractors
11	Secure few orders being cost competitive
12	Have provision in contract for compensation of forex
13	Due diligence of Customer's financial strength, creditworthiness, risk exposure and past performances before bid / no-bid decision through formal and informal sources
14	Develop low cost competent vendors
15	Contract provision for Customer to pay in equivalent INR as per forex selling rate on the day of payment to Vendors
16	Improve Working Capital position by having longer vendor credit period / bill discounting
17	Diversify into adjacencies like R&M, Spares, O&M, Plant Performance Enhancement, etc.
18	Continuous improvement of Heat Rate & Aux Power Consumption and reduction of Plant Footprint Area
19	Make a front-loaded billing break-up to improve Working Capital position
20	Have "Deemed Completion" clause in Contract for securing Retention Money and BGs in case delay is not due to Contractor

Table 6.4.2.1.2: Top 20 RMS with Positive Impact on BSI 2

Sr. No.	RMS Description
1	Delay in availability of Customer inputs e.g. land, statutory clearances etc. to be documented for securing time extension and compensation
2	Detailed Route survey to identify potential bottlenecks, check adequacy of strength of culverts, bridges, by-pass arrangement, etc.
3	Validation of inputs including soil data, seismic zone, water/fuel analysis etc. through tests and geo-tech investigation at the bidding stages
4	Engage competent and resourceful logistics vendors with proven track record, not merely on L1 basis
5	Continuous Vendor development / global sourcing to increase base of financially sound vendors having proven track record
6	Conduct Design Freeze Meets (multiple – discipline meetings) with Customer / Customer's Engineer for finalizing design and securing inputs
7	Identify, assess and register competent and financially sound contractors with proven track record
8	Develop micro-plans and integrated project schedule with resource loading
9	Engage an experienced IR team at project site to ensure smooth labour / trade union relations and to build rapport with Customer and local authorities

Sr. No.	RMS Description
10	Have suitable provisions incorporated in contract for time extension and compensation
11	Pre-bid tie-ups with major OEMs/Vendors for engineering inputs
12	Contractually keep some percentage of payment against timely submission of inputs by OEM / Vendors
13	Utilize pre-NTP period to initiate design work with past data to be validated subsequently through project specific data
14	Due diligence of site ground realities like political and labour environment, other risks involved before bidding
15	Contract should have provision that non-availability of fuel, water, power evacuation beyond a certain time shall be considered as "Deemed Completion" and in turn, Customer would return Retention Money and BGs
16	Document Customer's delay in providing inputs / approving drawings for seeking time extension and additional compensation
17	Review bid document, visit site and clarify scope with Customer
18	Select Contractors with proven track record having modern construction techniques
19	Provide adequate labour facilities – proper stay & sanitation, safety, timely payment of wage, medical facilities, etc.
20	Have competent site team including good supervisors

Table 6.4.2.1.3: Top 20 RMS with Positive Impact on BSI 3

Sr. No.	RMS Description
1	Quality & HSE to have top management sponsorship with strict adherence to global benchmarks
2	Execution excellence for completing projects within time and cost for customer satisfaction
3	Review Quality & HSE credentials of Vendors / Contractors before their selection
4	Brand building through employees, customers, vendors, shareholders, success stories, Corporate Governance, CSR – use media, various forums and word of mouth
5	Conduct reviews at sites / workshops, reward / penalize performance and report to the corporate management
6	Impart Quality & HSE Training to all employees and workmen
7	Strong in-house Engineering / R&D team to explore, assimilate new technologies and knowledge management
8	Selection of global JV Partners / Collaborators and transfer of technology
9	Use digital technology like mobile apps, virtual realities for training, monitoring & reporting incidents
10	Continuous scanning of environment, adoption of contemporary / new technology to stay ahead in business

Sr. No.	RMS Description
11	Establish a lean and adaptable organization, strong business processes and faster decision making
12	Corporate communication keeping shareholders abreast of important developments including revised guidance, if any, in advance
13	Cold-eye / Per review of critical engineering deliverables and Performance Guarantees by Engineering Consultant / Experts
14	Annual Communication from MD & CEO / Chairman to all employees to meet Customer Satisfaction and enhance Shareholders' value
15	Annual survey by a Third Party for customer satisfaction level, analyze the gaps and take corrective actions
16	Hire Subject Matter Experts / Specialists
17	Visionary and dynamic top leadership having robust leadership development programs
18	Effective HR policies to acquire, train and retain talent, performance-based compensation & career growth, work environment that promotes innovation and employee engagement
19	Pass on LD back-to-back to the OEMs / Vendors
20	In-house competent Contract & Risk Management and Legal teams, for managing Contracts, dispute resolution, litigation, Arbitration, etc.

Table 6.4.2.1.4: Top 20 RMS with Positive Impact on BSI 4

Sr. No.	RMS Description
1	Execution excellence for completing projects within time and cost for customer satisfaction
2	Brand building through employees, customers, vendors, shareholders, success stories, Corporate Governance, CSR – use media, various forums and word of mouth
3	Annual Communication from MD & CEO / Chairman to all employees to meet Customer Satisfaction and enhance Shareholders' value
4	Corporate communication keeping shareholders abreast of important developments including revised guidance, if any, in advance
5	Annual survey by a Third Party for customer satisfaction level, analyze the gaps and take corrective actions
6	Due diligence of Customer's financial strength, creditworthiness, risk exposure and past performances before bid / no-bid decision through formal and informal sources
7	Try to secure payments through Letter of Credit
8	Visionary and dynamic top leadership having robust leadership development programs
9	Negotiate decent contract terms with 10 to 15% interest-free Advance Payment

Sr. No.	RMS Description
10	Cost leadership through continuous cost reduction, innovative engineering, procurement, construction and tax optimization while creating a lean organization
11	Have Contract link “zero” date with payment of advance and providing land, other inputs & all approvals required to start work
12	Continuous scanning of environment, adoption of contemporary / new technology to stay ahead in business
13	Pursue Customer to accept Corporate Guarantee in lieu of BGs
14	Develop low-cost competent vendors
15	Continuous improvement of Heat Rate & Aux Power Consumption and reduction of Plant Footprint Area
16	Selection of global JV Partners / Collaborators and transfer of technology
17	Strong in-house Engineering / R&D team to explore, assimilate new technologies and knowledge management
18	Smart Contract Drafting to have provisions to address major risks. Proposal team to be fully aware of legal risks and mitigation measures
19	Sharing of knowledge and learning from past projects
20	There shall be no auto-renewal of BG and value of Advance BG to be reduced periodically

6.4.2.2 Grouping of Risk Mitigation Strategies (RMS) based on varying impacts on Business Success Indicators (BSI) for each Critical Risk Factor (CRF)

Summary of homogeneous groups of RMSs based on their positive impacts on the Business Success Indicators (BSI) for each Critical Risk Factor (CRF) are given in **Appendix 22**. Based on the same, the following Table 6.4.2.2.1 indicates the groups of RMSs that have varying degree of positive impacts on BSI for each CRF. This list will help the project manager to select and prioritize the RMS.

Table 6.4.2.2.1: Grouping of RMS based on Varying Impacts on BSI for each CRF

Risk ID	Risk Description	Positive Impact of RMS			
		Highest	High	Moderate	Low
1.0	**Management Risks**				
1.1	Drastic decline of Thermal Power Market	1. Explore coal and gas-based power opportunities abroad, e.g. SE Asia, Middle East, North Africa, Latin America		1. Focus on FGD, SCR, ESP, replacement of old inefficient generating units 2. Secure few orders being cost competitive 3. Diversify into emerging power businesses e.g. Nuclear, Solar Thermal, Energy Storage, Waste-to-Energy, Fuel Cell, Plasma Energy, etc.	1. Diversify into adjacencies like R&M, Spares, O&M, Plant Performance Enhancement, etc.
1.2	Fierce Competition	1. Cost leadership through continuous cost reduction, innovative engineering, procurement, construction and tax optimization while creating a lean organization		1. Develop low cost competent vendors 2. Excellent Market Intelligence of projects and competition	1. Continuous improvement of Heat Rate & Aux Power Consumption and reduction of Plant Footprint Area

Risk ID	Risk Description	Positive Impact of RMS			
		Highest	High	Moderate	Low
1.3	Shortage of Skilled Personnel		1. Effective HR policies to acquire, train and retain talent, performance-based compensation & career growth, work environment that promotes innovation and employee engagement		1. Outsource non-critical functions on contract basis to maintain a lean organization 2. Job enhancement, enrichment and job rotation including posting at project sites 3. Hands-on training for engineering, construction & commissioning teams
1.4	Quality & HSE Risks	1. Quality & HSE to have top management sponsorship with strict adherence to global benchmarks		1. Conduct reviews at sites / workshops, reward / penalize performance and report to the corporate management 2. Impart Quality & HSE Training to all employees and workmen 3. Review Quality & HSE credentials of Vendors / Contractors before their selection	1. Use digital technology like mobile apps, virtual realities for training, monitoring & reporting incidents
1.5	Geo-political Risks	1. Due diligence of Geo-Political risks, Country assessment, macro-economic and environmental factors, geographical survey before bid/ no-bid decision		2. Collaborate with companies already operating in these regions 3. Excellent leadership at site for execution and to strategically engage with local community 4. Tie-ups with resourceful local Partners / Agents for business acquisition & execution, interpretation of local codes. Post own person/s at target countries	Provide adequate insurance cover for assets and people

Risk ID	Risk Description	Positive Impact of RMS			
		Highest	High	Moderate	Low
1.6	Emerging Technologies		1. Strong in-house Engineering / R&D team to explore, assimilate new technologies and knowledge management 2. Selection of global JV Partners / Collaborators and transfer of technology 3. Continuous scanning of environment, adoption of contemporary / new technology to stay ahead in business		1. Hire Subject Matter Experts / Specialists 2. Use Digital Technologies and innovative solutions
1.7	Legal Risks		1. In-house competent Contract & Risk Management and Legal teams, for managing Contracts, dispute resolution, litigation, Arbitration, etc. 2. Smart Contract Drafting to have provisions to address major risks. Proposal team to be fully aware of legal risks and mitigation measures		1. Enforce Contractual rights and Claim Management including time extension and additional compensation from Customer 2. Complete awareness and strict compliance to legal and statutory requirements
1.8	Sub-optimal Resource Planning	1. Strong Construction Capability and large vendor base for timely mobilization of resources 2. Develop micro-plans and integrated project schedule with resource loading		1. Use Digital Technology and advance Analytics for deciding resource planning, mobilization and utilization 2. Frequent Project Review, Monitoring and Control as per the agreed schedule	1. Use database of past projects, norms and standards for fixing productivity of resources and keep challenging the set norms

Risk ID	Risk Description	Positive Impact of RMS			
		Highest	High	Moderate	Low
1.9	Lack of managerial Bandwidth	1. Visionary and dynamic top leadership having robust leadership development programs		1. Establish a lean and adaptable organization, strong business processes and faster decision making	1. Periodic skill mapping, gap evaluation, training, job rotation 2. Sharing of knowledge and learning from past projects 3. Hire talents for critical positions for competencies not available in-house
1.10	Improper Communication	1. Clear Role definitions with Responsibility and Accountability through RASCI matrix, SOPs, DACPs, etc.		2. Project Review at all levels and feedback mechanism driven by Project Control Team 3. Project communication protocol agreed upon at the beginning of the project to be strictly followed	4. Conduct annual team building exercise for the entire project team and all stakeholders, encourage people to participate
1.11	Not meeting Shareholders' expectations	1. Execution excellence for completing projects within time and cost for customer satisfaction		1. Brand building through employees, customers, vendors, shareholders, success stories, Corporate Governance, CSR – use media, various forums and word of mouth 2. Corporate communication keeping shareholders abreast of important developments including revised guidance, if any, in advance 3. Annual Communication from MD & CEO / Chairman to all employees to meet Customer Satisfaction and enhance Shareholders' value	1. Annual survey by a Third Party for customer satisfaction level, analyse the gaps and take corrective actions
2.0	**Proposal & Contracts Risks**				
2.1	Time Overrun / LD Risk	1. Develop integrated project schedule based on micro-planning, delivery of long-lead items, resource availability,		1. Conduct Design Freeze meetings with Customers and all stakeholders, follow up with Customer / Customer's Engineer	1. Back-to-back LD clause with all major Vendors / Contractors

Risk ID	Risk Description	Positive Impact of RMS			
		Highest	High	Moderate	Low
		constraints, required construction time, ground realities and real-time progress monitoring through state-of-the-art digital technologies		for timely approval of drawings / document 2. Document Customer delays in providing inputs, drawings / statutory approvals for securing time extension and additional compensation 3. Use pre-NTP period for planning & scheduling, critical engineering, procurement specification for long-delivery items, reconfirmation of soil data and BOQ	
2.2	Scope Clarity / Creep		1. Effective Contract drafting with exclusions, interfaces and provisions for Change Orders 2. Review bid document, visit site and clarify scope with Customer		1. Conduct Design Freeze meetings with Customer and all stakeholders reconfirming the scope of supply & service 2. Scope clarity with vendors and ensure early resolution of issues
2.3	Unequitable Contract favouring the Customer		1. Negotiate better contract terms, establish clear definition of project completion pursuant to which DLP/LDP would commence and also take deviations to highly risky clauses like absorption of IDC 2. Risk Reviews & Analysis of contract clauses and price estimation before taking bid / no-bid decision		1. QAP/FQP to be strictly followed, multiple design checks and supervision of quality workmanship for civil foundations and structures to be done 2. Transfer contract conditions back-to-back to Vendors / Contractors 3. Initial plant operations to be done through experienced O&M staff and plant to be preserved as per OEM recommendations

Risk ID	Risk Description	Positive Impact of RMS			
		Highest	**High**	**Moderate**	**Low**
2.4	Variation in Soil / Site Conditions	1. Validation of inputs including soil data, seismic zone, water/fuel analysis etc. through tests and geo-tech investigation at the bidding stages		1. Insist for "unexpected variation" clause in contract with Customers for compensation / time extension	1. Plan contingency 2. Conduct periodic testing of fuel and water during commissioning stage and inform Customer for any variation
2.5	Fixed Price Contract without PVC / steep wage hike not included in PVC	1. Have contractual provisions to seek extra compensation from Customer for extraordinary price/wage hike 2. Make all out efforts to include PV clause in the contract		1. Take help of financial experts to model price variation impact and provide for the same in bid cost	1. Transfer risks back-to-back to Vendors / Contractors and have forward Contracts with bulk material suppliers
3.0	**Engineering Risks**				
3.1	LD for Non-performance of Equipment and Plant		1. Pass on LD back-to-back to the OEMs / Vendors 2. Commission equipment and plant strictly as per OEMs' recommendations 3. Cold-eye / Per review of critical engineering deliverables and Performance Guarantees by Engineering Consultant / Experts		1 Stage Inspection & Testing at shops and at site as per QAP

Risk ID	Risk Description	Positive Impact of RMS			
		Highest	High	Moderate	Low
3.2	Variation in BOQ / Cost Estimate		1. Carry out geo-technical investigation and Digital topographic survey before BOQ estimation 2. Engineering Consultant to do Proposal Engineering, to generate layouts, 3D Models and accurate BOQ		1. Bid Cost Review by (a) a committee comprising of people from various disciplines and (b) by Senior Management 2. Pre-bid tie-ups for major / critical/ long delivery equipment and specialized work 3. Validate BOQ with Analytics tools through analysis of past BOQ data and market intelligence on competitors' BOQ
3.3	Engineering Delays		1. Conduct Design Freeze Meets (multiple – discipline meetings) with Customer / Customer's Engineer for finalizing design and securing inputs 2. Pre-bid tie-ups with major OEMs/Vendors for engineering inputs		1. Utilize pre-NTP period to initiate design work with past data to be validated subsequently through project specific data 2. Contractually keep some percentage of payment against timely submission of inputs by OEM / Vendors 3. Document Customer's delay in providing inputs / approving drawings for seeking time extension and additional compensation
4.0	**Procurement Risks**				
4.1	Unpredictable Price Increase	1. Pre-bid tie-ups with OEMs / Major Vendors, transfer back-to-back price increase risks to them 2. Insist on Price Variation (PV) clause in the contract	1. Bulk materials e.g. Structural / Reinforcement Steel, Cables, Earthing Materials, RCC etc. stall be negotiated on rate-contract basis	1. SCM to carry out commodity price trend analysis including seasonal fluctuations at both bid & execution stage and forecast price of materials / equipment	1. SCM to look for alternate low-cost Vendors

Risk ID	Risk Description	Positive Impact of RMS			
		Highest	High	Moderate	Low
4.2	Lack of Financially Sound Competent Vendors / Suppliers	1. Pre-bid tie-ups with OEMs / Vendors for critical / long delivery items 2. Continuous Vendor development / global sourcing to increase base of financially sound vendors having proven track record		1. Closer vendor follow-up and expediting including stage inspection as per QAP	1. Tap Competitors' vendor base
4.3	Change in Government Policies		1. Have contractual provisions to cover impact of "change of policy during project execution" including levy of new taxes, extraordinary wage hikes, etc.		1. Pass on the risks back-to-back to the Vendors / Contractors, to the extent possible 2. Tracking Government Policies / Regulations and aligning corporate actions accordingly
4.4	Lack of Financially Sound competent Sub-contractors		1. Develop front line experienced supervisors in the company role 2. Identify, assess and register competent and financially sound contractors with proven track record		1. Contractors with workmen to be sustained by using them at multiple project sites 2. Training of workmen at site, on safety, quality and other construction skills 3. Retention of Labour through labour welfare initiatives like providing hygienic labour colony facilities, timely payment of wages and transparent dispute settlement process
4.5	Lack of reliable Logistics Vendor		1. Detailed Route survey to identify potential bottlenecks, check adequacy of strength of culverts, bridges, by-pass arrangement, etc. 2. Engage competent and resourceful logistics		1. Provide escort vehicle, GPRS tracking, expediting approvals and arrange food for the driver / helper to reduce transit delay 2. Use more than one proven logistics vendors to have more options

Risk ID	Risk Description	Positive Impact of RMS			
		Highest	High	Moderate	Low
			vendors with proven track record, not merely on L1 basis		
5.0	**Construction Risks**				
5.1	Labour / Political / Law & Order issues		1. Provide adequate labour facilities – proper stay & sanitation, safety, timely payment of wage, medical facilities, etc. 2. Strict compliance to statutory obligations in letter and spirit 3. Due diligence of site ground realities like political and labour environment, other risks involved before bidding 4. Engage an experienced IR team at project site to ensure smooth labour / trade union relations and to build rapport with Customer and local authorities		1. Carry out local community development, CSR activities and have contingency for the safety of people and assets
5.2	Natural Calamities / Acts of God	1. Have comprehensive insurance coverage and emergency preparedness for Disaster Management 2. Have suitable provisions incorporated in contract for time extension and compensation 3. Invoke Force Majeure and other contract Clauses		1. Plant roads and drains to be constructed before commencement of construction and to be monsoon ready	1. Assessment of historical events, its impact on the project and plan accordingly

Risk ID	Risk Description	Positive Impact of RMS			
		Highest	High	Moderate	Low
5.3	Delay in Construction	1. Engineering and procurement activities to be driven by early start dates so that construction activities can have more floats 2. Select Contractors with proven track record having modern construction techniques 3. Have competent site team including good supervisors		1. Field Engineering Group to expeditiously resolve all field changes	1. FQP, Testing & Inspection, on-site Kaizen / Quality Circle Team to ensure minimum errors
5.4	Extended Stay at Site & Cost Overrun.		1. Have suitable provision in the contract for Deemed Completion and Compensation & time extension, in case delay is not due to the Contractor 2. Strong Project Management & Execution Team to ensure project completion within time and cost		1. Reduce manpower significantly, keeping a small empowered team of people to liquidate punch points expeditiously and close the project
6.0	**Financial Risks**				
6.1	Forex Variation		1. Have provision in contract for compensation of forex 2. Contract provision for Customer to pay in equivalent INR as per forex selling rate on the day of payment to Vendors		1. Increase localization, indigenous vendor development

Risk ID	Risk Description	Positive Impact of RMS			
		Highest	High	Moderate	Low
			3. Bidding in appropriate currency for hedging / natural hedging		
6.2	Stringent Payment Terms and delay in Payment Collection	1. Make a front-loaded billing break-up to improve Working Capital position 2. Work measurement, proper documentation & immediate invoicing through SAP/ERP system 3. Negotiate better terms of payment with Customer with 10 to 15% interest free Advance and timely payment		1. Transfer back to back payment terms to OEMs and major Vendors / Contractors	1. Improve Working Capital position by having longer vendor credit period / bill discounting
6.3	Prolonged delay in Contract Closure	1. Establish delays with Customer to seek time extension and compensation 2. Have "Deemed Completion" clause in Contract for securing Retention Money and BGs in case delay is not due to Contractor	1. System wise handover of facilities with As built Drawings/Manuals	1. Have contractual provision for quarterly/half-yearly pro-rata reduction of Advance BG	1. Be prepared for legal recourse/litigation/ Arbitration, if such need arises
7.0	**Customer Risks**				
7.1	Delay in Customer's Inputs	1. Contract should have provision that non-availability of fuel, water, power evacuation beyond a certain time shall be considered as "Deemed Completion" and in turn, Customer would return Retention Money and BGs 2. Delay in availability of Customer inputs e.g. land, statutory clearances etc. to		1. Place orders on vendors only after receipt of basic inputs e.g. Land, MOEF clearance, financial closures etc. 2. Mobilize resources as per front availability	1. Facilitate Customer on securing various statutory approvals

Risk ID	Risk Description	Positive Impact of RMS			
		Highest	High	Moderate	Low
		be documented for securing time extension and compensation			
7.2	Lack of Creditworthiness / Financial Soundness of the Customer		1. Try to secure payments through Letter of Credit 2. Due diligence of Customer's financial strength, creditworthiness, risk exposure and past performances before bid / no-bid decision through formal and informal sources		1. There shall be no auto-renewal of BG and value of Advance BG to be reduced periodically 2. Pursue Customer to accept Corporate Guarantee in lieu of BGs 3. Negotiate decent contract terms with 10 to 15% interest-free Advance Payment
7.3	Project Funding and Financial Closure	1. Have Contract link "zero" date with payment of advance and providing land, other inputs & all approvals required to start work 2. Due diligence on Project funding and Financial Institutions involved, before bid-no bid decision		1. Place order on vendors only after the financial closure happens 2. Submit CPBG to Customer only after the financial closure happens	1. Facilitate customers for financial closure as well as various approvals from statutory authorities

6.4.3 Other Recommendations

6.4.3.1 Action Plan Framework for Business Success

Thirty-two (32) recommendations received for sustained business success from the qualitative survey feedbacks have been presented in Table 5.2.4.1 of Chapter 5. As given in Section 5.2.4, 25 recommendations were considered while developing an actionable framework. in consultation with the supervisors and the experts, that can be implemented by EPC Organization (ref. Table 6.4.3.1.1 below). This Action Plan gives corresponding to each BSI, Strategy/ Policy Choice, Supporting Process and Critical Pre-requisite for the successful implementation of the strategies.

Table 6.4.3.1.1: Action Plan Framework for Business Success

Business Success Indicators (BSI)	Strategy/Policy Choice	Supporting Process	Critical Prerequisites
BSI 1: **Financial Performance**	• Cost Reduction/ Cost Leadership / Cost Competitiveness • Superior / Cutting Edge / Sate-of-the-Art Technology/ • Internationalisation / Exploration of new Geographies • Diversification into R&M, O&M, Nuclear, Solar with Storage, IGCC, Clean Energy/After Sales Services/ Spares/Fuel Cell/Other Areas and focus on FGD, SCR & other Enviro Products	**Finance & PMG Function:** • Timely Invoicing/Collection / Maintaining Positive Cashflows / Strong Working Capital Management **Proposal / BD:** • Due Diligence of customer, Project Contractual Obligations, Project Funding, Clearances, Geo-political Factors, Risks	• Strong BD & Proposal Team / Market Knowledge, Trends & Intelligence / Competitors' Strategies & Information • Engineering Capability / Innovative Engineering • Value Added and Innovative Engineering • Accurate BOQ/Optimisation of BOQ/ Continuous Review & Management of BOQ • Knowledge Management and sharing of past experience

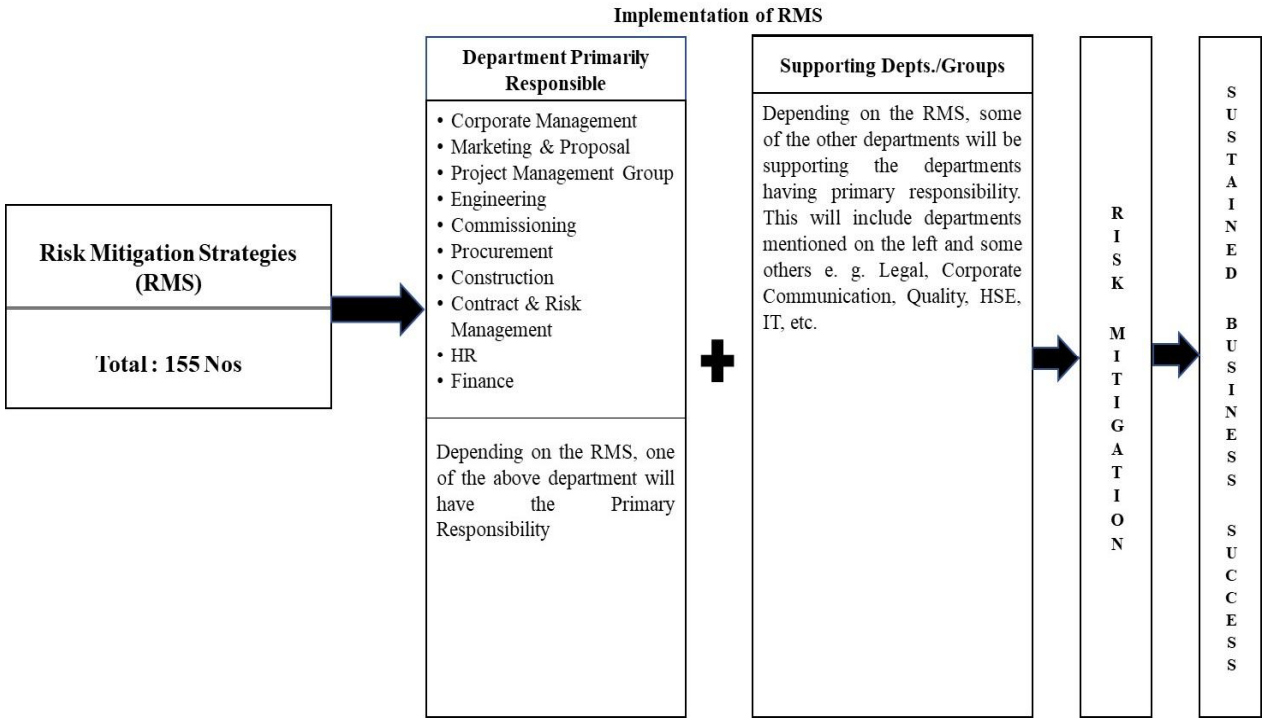
Business Success Indicators (BSI)	Strategy/Policy Choice	Supporting Process	Critical Prerequisites
BSI 2: **Project Performance On-time Project Completion within Cost**	• Strong Project Management / Execution / Operational Excellence • On-time Project Competition within Cost • Zero Tolerance to Quality & Safety	**HR Functions:** • Building Capability, Skills, Competent Employees / Workmen / High Performing Teams / Teamwork • Employee Engagement / Motivated Employee / Retention of Talents / Positive Attitude / Value People as Human **PMG Function:** • Construction-driven Project Micro-Planning (L3/L4), Project Reviews, Monitoring & Control including Cost Control / Project Closure **CRM:** • Robust Risk Management • Smart Contract Negotiation & Drafting / Contract Management / Documentation including Management of Legal Aspects	• Digitalisation • Lean / Agile / Dynamic/Flexible/ Innovative Organisation • Strong Procurement (SCM) / Logistics / Global Sourcing Team • Knowledge Management & sharing of past experience

Business Success Indicators (BSI)	Strategy/Policy Choice	Supporting Process	Critical Prerequisites
		SCM • Development of Financially Sound/ Competent Vendors/Site Contractors/ Effective Vendor Management • Partnering with Major Vendors/ • OEMs/Contractors & Transfer back-to-back all contract conditions to them / Timely Payment of Vendors / Contractors	
BSI 3: Brand Image	• Strong & Visionary Leadership Development/Empowered Faster Decision-Making Teams • Investment in Business and R&D • Customer Focus/Satisfaction/ Customer Relationship/After Sales Services	• Supporting Process required for BSI 1 and BSI 2	• Sustained Success (year-on-year basis) of BSI 1 and BSI 2
BSI 4: Shareholders' Value Creation/ Enhancement	• Meeting Shareholders' and other Stakeholders' Expectations	• Supporting Process requires for BSI 1, BSI 2 and BSI 3	• Sustained Success (year-on-year basis) of BSI 1, BSI 2 and BSI 3

6.4.3.2 Generic Framework of Implementation of Risk Mitigation Strategies (RMS)

As discussed in Chapter 5, it was intended to develop a generic framework for implementation of the Risk Mitigation Strategies (RMS) in any EPC Organization. The scheme was developed by the Researcher in consultation with the experts and supervisors and the same is presented in Figure 6.4.3.2.1 hereinafter.

Figure 6.4.3.2.1: Generic Framework of Implementation of RMS



6.4.4 Suggested Recommendations to the Government Bodies

Although this Study was intended to come out with a set of recommendation for the EPC Organisations working in Indian Thermal Power Sector, it may be prudent to put forward the following recommendations to the various Government Authorities with a view to make reforms in the EPC Contracting policies to make it equitable and fair to the EPC Organisations to minimise their risks. The major ones are given below:

- Old inefficient thermal power shall be retrofitted with Flue Gas Desulphurisation (FGD), Selective Catalytic Reduction (SCR), and Plant Efficiency Enhancement initiatives. While these have been implemented in

some of the plants, the same needs to be done for all other plants, on an urgent basis. This will help protect the environment in reducing emissions and will also the EPC Contractors with new business.

- Availability of land free of all encumbrances, clearances/ approvals from Ministry of Environment and Forest (MOEF), aviation etc., construction power/ water, grid connection etc. and more importantly and the financial closure must be ensured before placing order on the EPC Contractors.

6.5 Scope for Future Work

1. It is seen in this Study that a major pain area for the EPC Contractors is the project contract that contains multitudes of risks involved in a project much more than what a contractor can logically manage. The owners transfer all risks imposed by the lenders to the EPC contractors. Such contracts are virtually one-sided and leave no room for the EPC contractor seek any relief. This has led to insolvency of EPC contractors and leaving the business.

   It is seen that by having very stringent contract does not guarantee project success. A large number of projects continue to record huge cost and time overruns in India. Besides the EPC contractors, the owners, the lenders and everyone in the ecosystem suffer. As on June 2017, there are more than Rs. 35,000 Crore Non-Performing Assets (NPA) in the sector.

   In order to find a solution to this problem, s major change in the mind-set is needed for all the stakeholders. It is heartening that Government has also acknowledged this problem and has proposed some initiatives. GOI Notification No. F.1/1/2021 – PPD dated 29th October 2021 titled, "General Instruction on Procurement and Project Management" released by Ministry of Finance, Department of Expenditure is a move in that direction.

   Thus, one of the future research works could be **to study the all issues as well as regulations in the Thermal Power Sector that are hugely impacting the EPC contractors and other stakeholders and come out with recommendations to the government bodies for effecting policy reforms**.

2. It is seen in this Study that Renewable Power is becoming the next big thing in Indian power sector and it will increasingly play a larger role. Here, the business model is changing from EPC contracts to project Development. Renewable power is mainly dominated by Solar power. In this context, there are a few challenges involved the sector has to address:

   Technologies (in solar, wind, batteries, hydrogen etc.) are changing rapidly. Manufacturers have to be extremely careful in technology selection technology, getting into any arrangement with technology licensor/ provider in setting up manufacturing shops or any JV.

   Presently about 95-98% materials (polysilicon, ingots/ wafers, cells and modules for solar power) are imported, mostly from China. The price is increasing rapidly in view of Chinese monopoly. This scenario is expected to continue for next 2-3 years, till indigenous manufacturing picks up. While indigenous manufacturing will mainly cover solar cells and panels, polysilicon and ingots/ wafers will continue to be imported. Ability to source materials consistently at a lower price will decide business success or failure. Procurement excellence will be the game changer.

   The proposed imposition of Basic Customs Duty (25% on solar cell and 40% on solar modules) with effect from April, 2022 will make input cost very high. This problem will remain till indigenous manufacturing is in place.

   Thus, the other future research work could be **to critically analyse and bring out various issues related to the Renewable sector and provide recommendations to the Project Developers as well as the Government bodies to ensure success to fulfil India's ambitious target of reaching 500 GW of renewable power by 2030.**

3. This Study found out the Critical Risk Factors and suggested Risk Mitigation Strategies. Another future Study can be undertaken **to review various risk quantification techniques available to handle EPC risk – both qualitative involving Probability (P) of incidence of risk and Impact (I) of risk matrix and quantitative techniques e. g. Decision Tree, Sensitivity Analysis or Monte Carlo Simulation through commercial software like @Risk and come out with recommendations of the most appropriate techniques to use.**

4. As the project order values are increasing, project execution model is changing from EPC to EPCM. In EPCM mode, customer places orders directly on the Suppliers/ OEMs. EPCM Contractor manages detailed engineering, procurement engineering including preparing technical bid specifications, bid evaluation, technical recommendations, review of vendor drawings / designs and construction management. This model has been successfully adopted in international Oil & Gas projects. This model considerably reduces the risks of the EPC Contractors. **A Study may be taken up to review the pros and cons of various project execution models and set out recommendations on the same**.

6.6 Theoretical Implications of the Research Study

While the outcome of the Study will certainly help the EPC organizations, it has significant theoretical implications that would contribute to other researchers in their future studies also.

To begin with, an extensive literature search was done to find if there are any relevant and specific research works already available which can be used as reference. However, no such research paper was available, in the public domain that dealt with business success of EPC organizations in Indian thermal power sector by managing risks. Quite a few literatures were available on project and construction risk management like the 24-literature cited in the thesis that provided a number of generic project risks which have been considered in the study. The list got significantly enriched by the contribution of the Pilot Study, Case Studies and Risk Map which were specifically focused on risks in thermal power projects. Critical Risk Factors (CRF) derived out of this study are more specific to the Indian thermal power projects. It would be very useful for the future researchers.

This Study deals with 3 constructs as discussed earlier – risks, business success and risk management. Business success is manifested through the Business Success Indicators (BSI) defined in the Study. The analysis of how the Critical Risk Factors (CRF) adversely impact BSIs constitute a major part of the study. Similarly, analysis was done to understand the positive impacts of the Risk Mitigation Strategies (RMS) on the BSIs. In other words, the business success has been seen through the lens of both risks as well as risk management.

6.7 Practical Implications of the Research Study

The topic of research is an extremely relevant to the EPC organizations working in Indian Thermal Power sector. It is applied research and accordingly, large data were collected from the field besides the literature review. A big number of subject matter experts participated in the exercise and provided their valuable inputs. The Study concluded with a set of specific recommendations to be implemented by the EPC organizations.

The analysis of impacts of Critical Risk Factors on BSI is quite insightful. It came out that (1) the impact of CRFs on the long-term BSIs (Financial performance and Project Performance) is much more compared to the long-term BSIs (Brand Image and Creation/ Enhancement of Shareholders' Value), (2) the impact of CRFs on Project Performance is far more compared to Financial Performance and (3) brand name of an organization is impacted more by the Management risks. This three invaluable information will help the EPC project organizations immensely in gearing up for successful execution of the complex projects. Further, the corporate management would play their role effectively towards creation and maintaining brand name and reputation of the organization.

The Study gave a relative ranking of the 34 CRFs to help the project team to prioritize the risks for optimum use of resources. Procurement and Construction risks came out to be the most significant for the project. Apart from the EPC organizations, these recommendations will also be very useful to the future researchers.

The analysis shows that unlike the impacts CRF on BSI, the impacts of RMS on BSI is more on the long-term BSIs (Brand Image and Creation/ Enhancement of Shareholders' Value) compared short-term BSIs (Financial and Project Performance). RMS have minimum impact on the Project Performance. From both CRF and RMS points of view, it is more challenging to meet Project Performance.

Lastly, the uniqueness of this Study is that it has recommended multiple Risk Management Strategies (RMS) for each Critical Risk Factors (CRF). These RMS are specific to the Indian thermal power projects. In additions to the RMS recommended in this Study, generic risk response strategies suggested by traditional risk management like Avoid, Transfer, Accept and Mitigate shall be adhered to. The

subject Research Study provides 155 comprehensive Risk Mitigation Strategies (RMS) specifically applicable to EPC contracts in thermal power projects in India. These data will also help the EPC organizations as well as future researchers. Majority of the RMS can be used by other infrastructure sectors also.

155 RMS came out of the Study can be grouped under few major categories like Business Development, Contract & Risk Management, Project Management, Engineering, Procurement, Construction, Quality, Health, Safety & Environment (HSE), Human Resources, etc. based on the group responsible for implementation of the RMS. Generally, one group will be primarily responsible for the same where other groups will play the supporting role as shown in Figure 6.4.5.2.1 of this section.

6.8 Summary

The outcome of this Study has been a set of valuable recommendations which cover the following:

1. Relative Ranking of Critical Risk Factors (CRF)
2. Top 20 Risk Mitigation Strategies (RMS) for Business Success Indicators (BSI 1, 2, 3 and 4)
3. Grouping of RMS based on its varying impacts on the BSIs
4. Action Plan Framework for Business Success
5. Generic Framework of Implementation of RMS
6. Suggested Recommendations to the Government Bodies
7. Scope for Future Work
8. Theoretical Implications of the Research Study
9. Practical Implications of the Research Study

The above set of recommendations or tools will be very useful to the EPC organisations. Recommendations, 1 to 4 will help project sponsors, owners, Project managers and their team members from various disciplines in manging risks. Item no. 5 will guide implementation of RMS in the organisations.

Item no. 6 recommends two important research studies one in renewable power and the other in thermal power sector. Item nos. 8 and 9 will help future researches in the field.