Risk Management in Steel Plants

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Abstract— The role of iron and steel industry in India's GDP is very important for the development of the country. Iron and steel are the more important components required for the infrastructure development of the country. India has been ranked as the world's 4th largest producer of crude steel and is expected to become world's 2nd largest producer by 2019-2020 with a production volume of 54.5 million tones (MT). Various states have signed around 222 memorandums of understanding (MOUs), with a projected capacity of about 275.7 MT and an investment of more than US$ 229 billion. Some of the growth drivers helping the sector to grow are

However the past experience shows that almost all the steel plant projects have undergone time and cost overrun considerably. To find out the different types of risks involved in a project from start to end and then as per the effect of the risk on project duration, cost of the project and quality of the project, respond to risk. The scope is to study the various risks involved in the Implementation of a steel plant project. This involves identification, assessment, quantification, response and control of the risks in different areas of the project. The various causes of overrun at various phases of the project such as Pre-feasibility stage, Evaluation phase, Technology selection and engineering phase, Contracting and procurement phase, Construction phase, Startup phase are identified and discussed to increase the growth phase of the Indian steel industry.

Index Terms— steel industry, risk.

I. INTRODUCTION

India has traditionally been one of the major producers of steel in the world. Till the 1990s the steel industry of India was regulated and controlled by government policies. After the economic reforms of the early 1990s, the Indian steel industry has evolved significantly to conform to global standards. India has set a vision to be an economically developed nation by 2020. The steel industry is expected to play a major role in India's economic development in the coming years. The steel industry of India has a very high growth potential and is expected to register significant growth in the coming decades. India is expected to emerge as a strong force in the global steel market in coming years. Major aspects that are expected to play a significant role in the growth of the steel industry in India are

A. OBJECTIVE

To find out the different types of risks involved in a project from start to end and then as per the effect of the risk on project duration, cost of the project and quality of the project, respond to risk.

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B. SCOPE OF WORK

The scope is to study the various risks involved in the Implementation of a steel plant project. This involves identification, assessment, quantification, response and control of the risks in different areas of the project.

C. NEED OF WORK

The role of iron and steel industry in India's GDP is very important for the development of the country. Iron and steel are the more important components required for the infrastructure development of the country. India has been ranked as the world's 4th largest producer of crude steel and is expected to become world's 2nd largest producer by 2019-2020 with a production volume of 54.5 million tones (MT). Various states have signed around 222 memorandums of understanding (MOUs), with a projected capacity of about 275.7 MT and an investment of more than US$ 229 billion. Some of the growth drivers helping the sector to grow are: However the past experience shows that almost all the steel plant projects have undergone time and cost overrun considerably. The various causes of overrun at various phases of the project such as Pre-feasibility stage, Evaluation phase, Technology selection and engineering phase, Contracting and procurement phase, Construction phase, Startup phase are identified and discussed to increase the growth phase of the Indian steel industry.

II. RISK ANALYSIS

A pragmatic approach to the use of risk analysis is warranted. Each project is unique, and the sources of uncertainty and risk it faces will be similarly unique to its own individual circumstances, and the extent to which risk can be quantitatively dealt with will also vary. It would not be appropriate to advocate hard and fast guidelines about application of particular risk analysis techniques to all projects.

These risk analysis techniques are of course likely to be applicable in different sorts of circumstances. The suggested elaboration of risk analysis within the existing Project Framework and the construction of a risk matrix could be applied in any project situation. It is also important to note that the use of the individual techniques are not mutually-exclusive. For example, the risk matrix technique can identify those risks that are thought to be the most serious and/or likely to occur so that they can then be further investigated through quantitative techniques.

In essence, all the techniques attempt to identify and describe risk, and some of them try to quantify the extent of this risk. (Properly of course, it is only when some quantification has been achieved that the situation can be described as having modeled risk, rather than simply identified a source of uncertainty). Whether quantified or not, ultimately a decision about whether to accept a project in the face of the simple known existence of a risk (or of a particular

level of that risk), is a subjective decision for planners and policy-makers.

The Risk analysis of steel plant is done dividing the activities of the project in the following five phases:

- Development Phase
- Pre-Construction Phase
- Construction Phase
- Operational Phase
- Transfer of Termination Phase

III. METHODOLOGY

Risk Priority Number

The Risk Priority Number (RPN) methodology is a technique for analyzing the risk associated with potential problems identified during a Failure Mode and Effects Analysis (FMEA). This article presents a brief overview of the basic RPN method and then examines some additional and alternative ways to use RPN ratings to evaluate the risk associated with a product or process design and to prioritize problems for corrective action.

An FMEA can be performed to identify the potential failure modes for a product or process. The RPN method then requires the analysis team to use past experience and engineering judgment to rate each potential problem according to three rating scales:

- **Probability/Severity**, which rates the severity of the potential effect of the failure.
- **Impact/Occurrence**, which rates the likelihood that the failure will occur.
- **Detectability/Detection**, which rates the likelihood that the problem will be detected before it reaches the end-user/customer.

Rating scales usually range from 1 to 5 or from 1 to 10, with the higher number representing the higher seriousness or risk. For example, on a ten point Occurrence scale, 10 indicate that the failure is very likely to occur and is worse than 1, which indicates that the failure is very unlikely to occur. The specific rating descriptions and criteria are defined by the organization or the analysis team to fit the products or processes that are being analyzed.

RPN= Probability*Impact* Detectability

The RPN value for each potential problem can then be used to compare the issues identified within the analysis. Typically, if the RPN falls within a pre-determined range, corrective action may be recommended or required to reduce the risk (*i.e.* to reduce the likelihood of occurrence, increase the likelihood of prior detection or, if possible, reduce the severity of the failure effect). When using this risk assessment technique, it is important to remember that RPN ratings are relative to a particular analysis (performed with a common set of rating scales and an analysis team that strives to make consistent rating assignments for all issues identified within the analysis). Therefore, an RPN in one analysis is comparable to other RPNs in the same analysis but it may not be comparable to RPNs in another analysis.

Risk Mitigation Measures

The objectives of risk mitigation and planning are to explore risk response strategies for the high risk items identified in the qualitative and quantitative risk analysis. The process identifies and assigns parties to take responsibility for each risk response. It ensures that each risk requiring a response has an owner. The owner of the risk could be an agency planner, engineer, or construction manager, depending on the point in project development, or it could be a private sector contractor or partner, depending on the contracting method and risk allocation.Risk mitigation and planning efforts may require that agencies set policies, procedures, goals, and responsibility standards. Formalizing risk mitigation and planning throughout a highway agency will help establish a risk culture that should result in better cost management from planning through construction and better allocation of project risks that align teams with customer-oriented performance goals. Once the agency planner, engineers, and construction managers have thoroughly analyzed the critical set of risks, they are in a better position to determine the best course of action to mitigate those risks.

Risk mitigation and planning use the information from the risk identification, assessment, and analysis processes to formulate response strategies for key risks. Common strategies are avoidance, transference, mitigation, or acceptance. The mitigation and planning exercises must be documented in an organized and comprehensive fashion that clearly assigns responsibilities and delineates procedures for mitigation and allocation of risks. Common documentation procedures frequently include the creation of red flag item lists, risk charters, and formal risk management planning documentation. Risk mitigation and planning efforts may necessitate that agencies set policies, procedures, goals, and responsibility standards. Formalizing risk mitigation and planning throughout the agency will help establish a risk culture that should result in better cost management from planning through construction and better allocation of project risks that align teams with customer-oriented performance goals.

IV. CASE STUDY

Aditi Metallurgical & Alloys Pvt.ltd is a Private incorporated on 25 April 2011. It is classified as Non-govt Company and is registered at Registrar of Companies, Chhattisgarh. Its authorized share capital is Rs. 5,000,000 and its paid up capital is Rs. 5,000,000. It is involved in Manufacture of Basic Iron & Steel.

V. CONCLUSION

With the unsatisfied progress of proposed steel projects, entailing estimated investment of Rs 11 lakh crore, and the government is reviewing hundreds of MOUs signed by companies in past 5-6 years as most of them remained only in paper. Most of the steel plants are facing problem in land acquisition or mining leases to set up their units. Most of the MoUs have signed between private corporate houses with several states including Karnataka, Orissa, Chhattisgarh and Jharkhand. The government had set the target of producing 120 million tonnes of steel by March 2012, of which only 75-78 million tonnes capacity has been created so far. Based on the facts and figures it looks unachievable in view of delays in setting up plants.

Our case study was about up gradation and construction with additional facilities of the steel plant to increase its production capacity from 3.5 mtpa to 6.5 mtpa of steel.

However this project has seen a schedule and cost overrun because of many risks involved with the activities at different phases of project. Some of these risks are identified, analyzed and mitigated in this thesis such as

- Risk of Project cost over-run during Development Phase.
- Risk with New/ outdated Technology.
- Risk in Transportation during Construction Phase.
- Risk related to Disputes among Contractors.
- Risk of Delays.

Were identified as the major Risks and among which majority were identified during **CONSTRUCTION PHASE** with an RPN of 2,408 which is considered to be very high and mitigated so that in the future upcoming steel plant projects these risks are identified priorly and are mitigated so that the

delays and cost overrun can be overcome or reduced with the help of this analysis. Mainly from this case study we come to know that highest risk is involved in construction phase of the project so the risks involved in the different activities construction phase are identified and mitigated as we have the relevant information. Further risk mitigation has been done generally for overall Indian steel plant projects.

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	Scale>	1- Lowest 2- Low 3- Medium 4-High 5			Avg	1- Lowest 2- Low 3- Medium 4 5			Avg	1- Lowest 2- Low 3- Medium 4 5			Avg	RPN	Total RPN
Sr No	Nature Of Risk	Prob of Risk				Impact				Detectablity				RPN	Total RPN
1	Development Phase	A	B	C		A	B	C		A	B	C			
a	Legal Risk	0	0	0	-			0	-			0	-	-	
1	MoU default by private consortium		3	2	2.5		3	3	3		3	4	3.5	26.25	
2	Mou defult by government		3	3	3		3	3	3		3	2	2.5	22.5	
b	Market Risk	0	0		-	0			-	0			-	-	
1	Market change affecting the project cost	4	4	3	3.67	4	4	3	3.67	3	4	3	3.33	44.81	
2	Threat from competitors	1	3	2	2	1	3	2	2	3	3	3	3	12	
3	Variations in traffic flow		4	4	4		4	4	4		4	3	3.5	56	
c	Financial Risk		0		-	0			-	0			-	-	
1	Bankruptcy	2	2	3	2.33	4	2	3	3	3	4	3	3.33	23.33	
2	Project cost over run	4	3	3	3.33	4	3	4	3.67	4	2	4	3.33	40.74	
d	Force Majurec Risk	2		4	3	4		4	4	3		3	3	36	
e	Political Risk	2	3	3	2.67	3	3	3	3	3	2	4	3	24	
1	Conflict of interest	3		2	2.5	3		1	2		0		-	-	
f	Resource mobilization Risk	3	3	3	3	3	5	2	3.33	3	4	4	3.67	36.67	
				0	-	0			-	0			-	-	322.31
	2.PRE-CONSTRUCTION PHASE														
a	Bidding Risks			0	-	0			-	0			-	-	
1	Biased bidding process	2	3	3	2.67	3	3	2	2.67	4	3	2	3	-	
2	Union of bidders	1	3	3	2.33	3	3	3	3	3	3	3	3	21	
3	Unresponsive bidding	2	3	3	2.67	2	3	3	2.67		0		-	-	
4	No single party is competent for project	4	4	3	3.67	2	3	3	2.67	2	3	3	2.67	26.07	
5	Prequalification standards are too high	3	3	3	3	3	3	2	2.67	3	3	3	3	24	
6	Neogotiation process fails	2	4	3	3	4	4	3	3.67	4	4	4	4	44	
7	At the prequalification stage all withdraws	2	3	2	2.33	3	3	4	3.33	4	3	4	3.67	28.52	
8	Bidding document not worthwhile	1	3	3	2.33	2	3	3	2.67	2	3	3	2.67	16.59	
9	Prebid meeting proposes too many changes	2	3	2	2.33	2	3	3	2.67	4	3	4	3.67	22.81	
b	Legal Risk			0	-			0	-			0	-	-	
1	Terms of the bid document not acceptable	1	3	2	2	4	3	4	3.67	4	3	3	3.33	24.44	

#	Risk														
2	Selected party becomes bankrupt	2	3	3	2.67	4	3	3	3.33	4	3	4	3.67	32.59	
c	Technology Risks			0	-			0	-			0	-	-	
1	New/outdated Technology		3	3	3		3	3	3	4	4	3	3.67	33	
				0	-			0	-			0	-	-	294.37
3.Construction Phase															
a	Operational Risks			0	-			0	-			0	-	-	
1	Damage to propety	2	4	3	3	3	4	4	3.67	4	3	3	3.33	36.67	
2	Transportation Risks	3	4	4	3.67	4	4	3	3.67	4	3	4	3.67	49.3	
3	Defective material	2	3	3	2.67	4	3	4	3.67	4	3	3	3.33	32.59	
4	Poor quality material	3	3	4	3.33	4	3	3	3.33	4	3	4	3.67	40.74	
5	Poor workmanship	4	3	3	3.33	4	4	4	4	4	3	2	3	40	
6	Poor quality of work	3	3	3	3	4	3	3	3.33	4	3	3	3.33	33.33	
7	Site condition	4	3	2	3	4	3	3	3.33	4	3	4	3.67	36.67	
8	Low productivity of labour	4	3	3	3.33	4	4	3	3.67	4	3	3	3.33	40.74	
9	Non availability of material	4	3	4	3.67	4	3	4	3.67	4	3	3	3.33	44.81	
10	Brekdown of mechanical handling plan	3	4	3	3.33	4	3	3	3.33	4	3	4	3.67	40.74	
b	Legal Risks		0		-			0	-			0	-	-	
1	Work overlaps	3	3	2	2.67	4	3	3	3.33	3	3	4	3.33	29.63	
2	Construction of defective works	3	3	3	3	4	3	3	3.33	4	4	3	3.67	36.67	
3	Dispute among contractors	3	3	4	3.33	4	3	4	3.67	4	3	4	3.67	44.81	
4	Period of completion	4	3	3	3.33	4	3	3	3.33	4	3	3	3.33	37.04	
5	Unable to pay liquidated damages	3	3	3	3	4	3	4	3.67	3	3	4	3.33	36.67	
6	Disputes regarding interpretation of clause	3	3	3	3	4	3	4	3.67	3	3	3	3	33	
7	Price escalation not provided	4	4	4	4	3	3	3	3	2	4	3	3	36	
8	Other contractors resources	2	3	3	2.67	3	3	2	2.67	2	3	4	3	21.33	
9	Damages for failure to meet	4	3	3	3.33	4	3	4	3.67	3	3	3	3	36.67	
10	Accumulation of claims by both the parties	3	3	2	2.67	3	4	3	3.33	3	3	3	3	26.67	
11	Etension of time not permissible	2	3	3	2.67	4	3	2	3	2	3	4	3	24	
12	Violation of patent right	2	3	2	2.33	4	3	3	3.33	2	3	3	2.67	20.74	
13	Bankruptcy of contractor	3	4	2	3	4	4	3	3.67	4	3	3	3.33	36.67	
14	Bankruptcy of employer	2	4	3	3	4	3	2	3	4	3	4	3.67	33	
15	Violation of regulation	2	3	3	2.67	4	4	3	3.67	4	3	3	3.33	32.59	
16	Breach of trust by the contractor	2	3	2	2.33	4	3	4	3.67	4	3	2	3	25.67	
17	Breach of trust by the employer	2	3	3	2.67	4	3	3	3.33	4	3	4	3.67	32.59	
18	Suspension of work by employer	3	3	2	2.67	3	4	2	3	4	3	3	3.33	26.67	
19	Terminition of contract for default	2	3	3	2.67	4	3	3	3.33	4	3	4	3.67	32.59	
20	Employer taking over before completion	2	4	2	2.67	3	3	3	3	2	3	2	2.33	18.67	
21	Disputes arising from prolonged defects	3	4	3	3.33	4	3	3	3.33	3	3	4	3.33	37.04	
22	Disputes regarding measurement of works	2	3	3	2.67	4	3	2	3	3	3	3	3	24	
23	Default of other contractor	3	3	2	2.67	3	3	3	3	2	3	2	2.33	18.67	
24	Default of sub contractor	3	3	3	3	3	3	3	3	3	3	3	3	27	
25	Default of the goverement	1	3	3	2.33	4	3	4	3.67	3	3	3	3	25.67	
c	Delay Risks			0	-			0	-			0	-	-	
1	Construction delays	4	4	4	4	4	3	3	3.33	4	4	3	3.67	48.89	
2	Delay in providing right of way	3	4	3	3.33	4	3	3	3.33	4	4	4	4	44.44	
3	Delay in clearances	3	4	3	3.33	4	3	3	3.33	4	3	3	3.33	37.04	
4	Delay due to lender payment		3	4	3.5		3	4	3.5		4	4	4	49	
5	Delay in drawings	3	4	3	3.33	3	3	3	3	4	3	3	3.33	33.33	
6	Due to unavailability of resources	3	3	4	3.33	3	3	2	2.67	4	3	2	3	26.67	
7	Delay in approvals	4	3	3	3.33	4	3	3	3.33	4	3	3	3.33	37.04	

#	Risk				Avg				Avg				Avg	Score	Total
8	Mobilization of suffecient resources	3	4	4	3.67	3	3	4	3.33	4	3	3	3.33	40.74	
9	Credit risk of contractors		4	3	3.5		3	3	3		3	4	3.5	36.75	
10	Delay in issuing inquires to vendors		3	4	3.5		3	3	3		3	4	3.5	36.75	
11	Delay in supply of raw material	2	3	3	2.67	3	3	2	2.67	4	4	3	3.67	26.07	
12	Delaying in issuing certificates		4	4	4		3	3	3	3	3	4	3.33	40	
13	Delay in decision taking	3	3	3	3	4	3	3	3.33	4	4	3	3.67	36.67	
14	Delay due to existing traffic		4	4	4			0	-		3	2	2.5	-	
d	FORCE MAJURE RISK			0	-		0		-		0		-	-	
1	Non political risk		4	3	3.5		0		-		0		-	-	
2	Indirect political risk		4	3	3.5		0		-		0		-	-	
3	Political risk	2	4	4	3.33	4	3	4	3.67	4		4	4	48.89	
e	REGULATORY RISK			0	-		0		-		0		-	-	
1	Interference for local contractors	2	3	2	2.33	3	3	3	3	3	4	3	3.33	23.33	
f	TECHNOLOGY RISK			0	-		0		-		0		-	-	
1	Change in design	3	3	3	3	4	4	2	3.33	4	3	4	3.67	36.67	
2	Change in location	1	3	2	2	4	3	3	3.33	4	3	3	3.33	22.22	
3	Technical interreletionships	2	3	3	2.67	3	3	3	3	3	3	3	3	24	
4	Limits & Tolerence	2	3	3	2.67	3	3	3	3	3	3	3	3	24	
g	Management Risks			0	-		0		-		0		-	-	
1	Deal with local labour unions	3	4	3	3.33	3	3	2	2.67	4	4	4	4	35.56	
2	Bad labour relations	2	4	3	3	4	3	3	3.33	4	3	3	3.33	33.33	
3	Incompentacy	2	4	3	3	4	3	3	3.33	4	3	3	3.33	33.33	
h	SAFETY RISK			0	-		0		-		0		-	-	
1	Accidents	4	3	4	3.67	4	3	3	3.33	4	3	3	3.33	40.74	
2	Handling of hazardous material	4	3	3	3.33	3	3	2	2.67	4	3	4	3.67	32.59	
3	Unsafe site	3	3	2	2.67	4	3	4	3.67	4	3	3	3.33	32.59	
4	Unsafe working condition	3	3	3	3	4	3	3	3.33	4	3	4	3.67	36.67	
5	No proper planning	3	3	4	3.33	4	3	3	3.33	4	3	3	3.33	37.04	
i	Environment Risk			0	-		0		-		0		-	-	
1	Impact on air quality	4	4	3	3.67	4	4	3	3.67	3	4	3	3.33	44.81	
2	Impact on noise level	3	4	4	3.67	3	4	4	3.67	3	4	4	3.67	49.3	
3	Impact on water	2	3	2	2.33	3	3	3	3	3	4	3	3.33	23.33	
4	Curing & filling	3	3	3	3	3	3	2	2.67	3	3	4	3.33	26.67	
5	Loss of agri land	4	3	4	3.67	4	4	3	3.33	4	3	3	3.33	40.74	
6	Loss of trees	4	3	2	3	4	3	4	3.67	4	3	3	3.33	36.67	
7	Soil erosion	2	3	3	2.67	3	3	3	3	4	3	3	3.33	26.67	
8	Use of trees	2	3	2	2.33	3	3	4	3.33	3	3	4	3.33	25.93	
9	Impact on river	2	3	4	3	3	3	3	3	4	3	3	3.33	30	
				0	-		0		-		0		-	-	2,408.09
4.OPERATIONAL RISK															
1	Delay in start	4	4	3	3.67	4	4	3	3.67	4	4	4	4	53.78	
2	Many items in punch list	4	3	4	3.67	3	4	4	3.67	4	4	3	3.67	49.3	
3	Project not performing	2	3	3	2.67	4	3	3	3.33	4	3	3	3.33	29.63	
4	Too much gap	2	3	3	2.67	4	3	3	3.33	4	3	4	3.67	32.59	
5	Life of structure	2	4	3	3	4	4	4	4	3	4	3	3.33	40	
b	Technology Risks	2			2	3			3	4			4	24	
c	Market Price	4			4	4			4	3		4	3.5	56	
d	Management Risk			0	-		0		-		0		-	-	
1	Operating efficiency	4	3	4	3.67	4	3	4	3.67	4	3	4	3.67	49.3	
2	Increase in O&M	4	4	3	3.67	4	4	3	3.67	4	4	3	3.67	49.3	

f	Legal Risk	2	3	3	2.67	3	3	3	3	4	3	4	3.67	29.33	
g	Financial Risk	3	3	4	3.33	4	3	4	3.67	4	3	3	3.33	40.74	
h	Performance Risk	3	3	3	3	4	3	3	3.33	4	3	4	3.67	36.67	
i	Political Risk	2	3	3	2.67	4	3	2	3	4	3	3	3.33	26.67	
j	Environment Risks	3	3	3	3	4	3	4	3.67	4	3	4	3.67	40.33	
				0	-			0	-			0	-	-	557.63
5.TRANSFER OF TERMINATION PHASE														
a	Financial Risks			0	-			0	-			0	-	-	
1	Final payment to sponsers		4	3	3.5		4	3	3.5		4	3	3.5	42.88	
2	Operator compensation		4	4	4		4	4	4		4	4	4	64	
3	Valuation issues	3	3	3	3	3	3	3	3	4	4	3	3.67	33	
4	Escrow account balance		3	2	2.5		3	4	3.5		5	4	4.5	39.38	
b	Operation Risks			0	-			0	-			0	-	-	
1	Condition of facility	3	3	3	3	4	3	3	3.33	3	3	2	2.67	26.67	
2	Facility economic life	3	3	3	3	4	3	2	3	3	3	4	3.33	30	
3	Issue of transfer	4	3	4	3.67	4	3	3	3.33	3	3	3	3	36.67	
4	Capacity needs		3	3	3		3	4	3.5		3	4	3.5	36.75	
5	Replacement of machinary	2	4	2	2.67	4	4		4	3	3	3	3	32	
c	Legal Risks			0	-			0	-			0	-	-	
1	Extension of concession		3	3	3		3	3	3		4	3	3.5	31.5	
2	Problem in identification of assets	2	3	2	2.33	3	3	4	3.33	3	4	4	3.67	28.52	
3	Settlement of Escrow account		3	4	3.5		3	2	2.5		3	3	3	26.25	
4	Discharge of regulator		3	3	3		3	3	3		3	4	3.5	31.5	
5	Previous litigation	2	3	1	2	2	3		2.5	3	3	2	2.67	13.33	
d	Political Risks			0	-			0	-			0	-	-	
1	Political interference in various issues		4	2	3		4	3	3.5		4	3	3.5	36.75	
				0	-			0	-			0	-	-	
				0	-			0	-			0	-	-	509.19