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Evaluation and Challenges of Entrepreneurs in Construction Industry

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ABSTRACT: *Engineering & Constructions, an industry where the prevalence of complex risk parameters impacts the business decisions of even the established and large-scale companies, is probably the most challenging industry for an entrepreneur to enter into. This paper briefly speaks of the risks, an entrepreneur in the engineering & constructions industry can face and suggests the usage of FMEA – 'Failure Mode Effective Analysis' as a technique for assessing and mitigating the risks involved in various stages. The paper later showcases the utilization of FMEA technique to assess the risks involved in the South Indian engineering & construction industry and leverages the information obtained from the Failure Mode Effective Analysis to build a Pareto Chart which helps in identifying the top causes for the risks associated with the projects in the construction industry.*
Key Word*: Engineering & Construction, FMEA, Risk, Entrepreneurship, Pareto Rule.*

I. INTRODUCTION

The Construction industry is one of those industries where improper risk assessment and inability to plan for projects efficiently will hugely impact the business. Dr. Nadeem Ehsan et al. (2010) concluded that formal risk analysis and management techniques are rarely employed in the construction industry and the perception of risk is mostly based on intuition and experience. Risk can be financial or operational. Risk parameters in construction industry span from Financial Liability Risk to Environmental Risk. Large companies such as Royal BAM Group, Samsung, and Larsen& Toubro etcetera have established other sources of cash flow which help them tackle cash flow problems arising from the slow-moving economies. Such large scale companies usually have pre-defined controls to assess and mitigate the risks and also employ Risk Consultants such as Ernst & Young, Deloitte & Touché etcetera to help them be risk assured. These complex risks when coupled with the sluggish economies, increased competition and compliance requirements are what hinder an entrepreneur to enter the field of constructions. Scott Jardine in the Price Water Coopers publication on Managing risk in construction projects mentioned that 'No Construction Project is risk-free' and concludes that these risks can be managed or mitigated.. In this section, we translate the challenges into risk terminology for a comprehensive assessment. Also, it is useful to organize potential project risks in a fashion similar to the work breakdown structure (WBS). PMI (2008) recommends the development of the risk breakdown structure (RBS) to show the hierarchy of potential risk categories and risks. These risks were then grouped into two categories: internal risks and external risks. El-Sayegh (2008) defined internal risks as those that are project-related and usually fall under the control of the project management team, while external risks are those that are beyond the control of the project management team. Other researchers divided project risks into internal and external (Fanget al. 2004; Wand and Chou 2003; Aleshin 2001). Aleshin (2001) stated that "internal risks are initiated inside the project while external risks originate due to the project environment." Hastak and Shaked (2000) recommended analyzing risks in international projects at three levels: macro, market, and project.

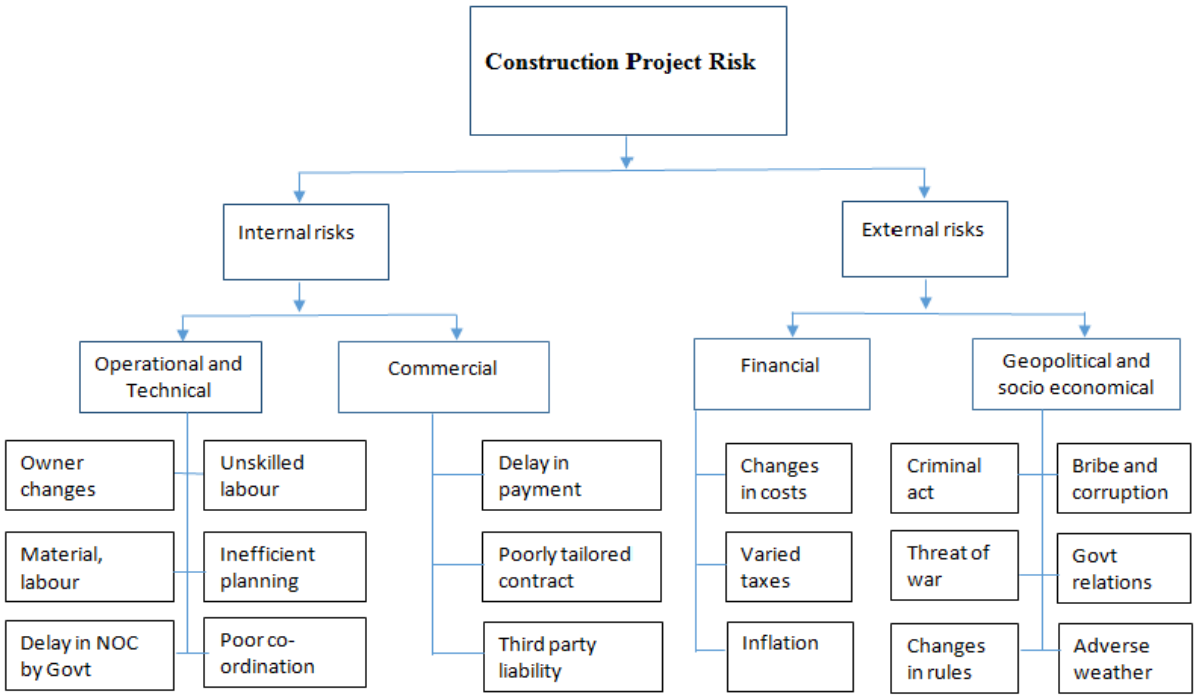

Figure 1 Risk break down structure

The present study aims at identifying the challenges faced by Entrepreneurs in Construction Sector of the Engineering & Construction Industry, translate them into the risk-based approach and identify a technique aimed at mitigating those risks.

Financial Risk

All the challenges noted from the detailed survey which directly or indirectly impacts the finances of the organization were bucketed into Financial Risk. Risks such as unprecedented price fluctuations in labor costs and raw materials, Risk of material misstatements by the on-site employees, varied tax rates in different states, expenses exceeding the capped limit of the project etcetera were bucketed into Financial Risk. Based on the feedback from several stakeholders Financial Risk was identified to be a high impact risk.

Operational Risk

Risks such as Supply Chain risk which in turn includes multi-factor risks such as delayed delivery of raw materials, transportation issues, Management risks such as Sub-Contractor walkouts, Employee turnover, design challenges etcetera were bucketed under Operational Risk. The association of each of these risks with other risks may lead to complex risk systems and therefore we observed that Operational risks could have a medium scale to large scale impact.

Geo-Political and Socio-Economic Risks

Challenges for a construction company associated with Geo-Political factors such as Environmental conditions, Political Instability and Interference, unplanned timing of activities being affected by the weather conditions etcetera were bucketed into Geo-Political Risks and other factors such as Customs Duty, local societal norms, cultural influences on the workers, Native unions etcetera were bucketed into Socio-Economic risks.

II. OBJECTIVES

- To identify and assess the risks in the construction industry
- To evaluate the risk management practices and helpful for the new investors in the construction sector
- To spread the awareness among the entrepreneurs about the risk management in the construction industry

III. METHODOLOGY

Questionnaire Survey

The rigorous questionnaire survey was carried out at 25 companies focused in the Construction sector with diverse environments, financial capabilities, and risk handling capabilities to holistically identify the

challenges and use them for efficient enterprise risk management at companies starting their business activities in the Engineering & Construction Industry. Questionnaire method was employed to gather the necessary information about the various risks associated with a project in the construction industry. Shankar Neeraj and M. Balasubramanian (2015) identified the different types of risks involved in a construction project, classified them into eight categories – construction, design, environmental, financial, management, political, procurement, sub-contractors and technology risk and assessed these categories using questionnaire method. Ahmed Mohamed Abdel-Alim et al. (2015) studied in detail using mathematical models the probability and the distribution of the different risks involved in a construction project and concluded that cost estimation and scheduling contingencies are major factors in achieving successful and realistic budget for construction projects. Mubin M Shaikh (2015) said that risk identification and assessment could be done by using the interviews/expert opinion, brainstorming, past experiences and check lists. Patel Ankit Mahendra et al.(2013) also mentions that the questionnaire survey is the best methods for the risk assessment and risk priority number was calculated for the risk analysis and management. The risks are also classified based on the types of their occurrence.

An eight-page questionnaire was used to conduct the survey across 25 companies. The first part questionnaire mainly consists of two sections where one is general information of the entrepreneur such as name, designation, company name, experience, project cost. The second part consists of forty-seven questions based four factors.

A. Operational and technical factors
B. Commercial factor
C. Geopolitical and socio-economic factors
D. Financial factors

Based on the surveys carried out and through a detailed study of literature, 47 challenges were identified and categorized into buckets of similar risks.

Failure Mode Effective Analysis – FMEA, as a Method for Risk Management

Failure Mode Effective Analysis has historically been one of the most comprehensively used tools for assessing and mitigating risks. FMEA helps in the management of risks involved in a new process/layout or product. FMEA was designed and developed to be used in the 1960s for the Apollo Mission by NASA for recording and assessing design related risks. Himanshu Joshi and Gunjan Joshi (2014) explained the significance and importance of Failure Mode Effective Analysis (FMEA) as a tool for risk assessment and mitigation and compared them to other tools such as Fault Tree Analysis (FTA).

FMEA can be thought of as a structured approach in order to identify where and how a product/process might fail, estimate the risks of causes associated with a failure, assess the impact of these failures and mitigate the impact of these failures.

Failure Mode Effective Analysis quantifies the risk associated with a failure on a numeric scale called Risk Priority Number or RPN. This quantification helps in holistically approaching the risks involved in a project. Risk Priority Number or RPN is obtained as follows-

RPN = F(X) = S*O*D

Where S = Severity {1,….9,10}; O =Occurrence {1,…..9,10};

D =Detection {1,…….,10} 0<=RPN<=1000

The higher the Risk Priority Number, the higher are the chances of failure and the risk associated with that failure.

Severity of Effect: 1= Not Severe, 10=Very Severe Occurrence: 1=Not Likely, 10=Very Likely

Detection: 1=Likely to Detect, 10=Not Likely to Detect

Table 1 FMEA Scale

Probability of Failure	**Possible Failure Rates**	**Rank**
Extremely High: Failure almost inevitable	>1=1 in 2	10
Very High	1 in 3	9
Repeated Failures	1 in 8	8
High	1 in 20	7
Moderately High	1 in 80	6
Moderate	1 in 400	5
Relatively Low	1 in 2000	4
Low	1 in 15000	3
Remote	1 in 150000	2
Nearly Impossible	<=1 in 1500000	1

Severity is based on Failure Effect, Occurrence based on Failure Cause and Detection based on Controls.Once, the Failure Mode Effective Analysis form is complete; Pareto Rule is employed to find out the areas which account for the most significant risks. As a thumb rule, the Pareto Principle states that 80% of the problems are caused by 20% of the causes.

IV. RESULTS AND DISCUSSIONS

The average of survey results obtained from 25 companies was considered for the analysis of the South Indian market of Construction & Engineering Industry. Top 15 risks out of the identified 47 risks were used to build the Pareto chart. The causes for the each risk factor is also mentioned the table given

Table2 Top Most Identified Risks

S.no	Risk factors	causes	Combined average RPN	Cumulative average	RPN %
1	Price fluctuations in labor costs and raw materials	Economic Policy	111.08	111.08	17%
2	Government relations	Planning	61.12	172.2	26%
3	Lack of sales	Planning	57.24	229.44	35%
4	Material ,labor and equipment resourcing	Climate	55.56	285	43%
5	Affect of global financial crisis	Global Risk	49.24	334.24	51%
6	Difficulties due to Government financial policy	Economic Policy	46.6	380.84	58%
7	Changes in rules and regulations	Economic Policy	42.36	423.2	64%
8	Varied tax rates in different states	Economic Policy	40.44	463.64	71%
9	Bribery and Corruption	Corruption	33.32	496.96	76%
10	Delay in approvals	Corruption	33	529.96	81%
11	Expenses exceeding the capped limit of the project	Planning	32.44	562.4	86%
12	Delay in obtaining NOCs from authorities	Corruption	27.88	590.28	90%
13	Scheduling mismanagement	Planning	23.4	613.68	94%
14	Adverse weather conditions	Corruption	22.12	635.8	97%
15	Threat of war and revolutions	Global Risk	20.52	656.32	100%

The FMEA Chart from a mid-scale company for the top 5 risks as a sample is given below

The FMEA chart for the top 5 risks is presented as a sample. FMEA charts like the above help in identifying ways a process/design could possibly fail and then plan on how to handle those potential failures. The chart identifies risks that require the addition of controls, which are documented on the control plan. Briefly the chart columns in respective order speak of, what is the process step being analyzed? In what way could the process step fail to meet requirements? What is the effect on the outputs? How impactful/bad could be the effect? What can go wrong with the input? How often? How can this be found & what can be done and finally how well can detect?

Table 3 FMEA Process

Process	**Failure Mode**	**Failure Effects**	**Severity**	**Causes**	**Occurrence**	**Controls**	**Detection**	**RPN**
Work Order	Price fluctuations in labour costs and raw materials	Increased Liability & Operating Expenses	7	Economic Policy	5	Utilization of COSO Framework for preparedness	8	280
Procurement Order	Government relations	Delay in Projects/ Hindrance	7	Corruption & Lobbying	4	FTA analysis for the areas requiring government interactions	6	168
Sales	Lack of Marketing	Decrease in Sale	6	Planning	4	Marketing Management	5	120
Work Order	Material, labour and equipment resourcing	Increase in Capital Expenses, Delays	6	Planning	3	Iterative Planning Adjustments	4	72
Planning & Execution	Effect of global financial crisis	Decrease in Margin & Forecasted Profit	6	Global Risk	2	Check on the global scenario before entering new project	6	72

V. CONCLUSION

This research study on the "Challenges for Entrepreneurship in Engineering & Construction Industry – A Risk-Based Approach" has helped to collect information about the most common occurring problems for companies in the Construction Sector of the Engineering and Construction Industry and has formulated a way in which new entrepreneurs can apply a risk based approach, translating the challenges into risks based on their sociological and geological conditions and manage them effectively using Failure Mode Effective Analysis as a tool. Such a comprehensive framework of a questionnaire to handle the challenges observed in the industry will help the entrepreneurs plan better for the challenges that may arise during their course of business and be able to reduce the probability of a failure occurring using FMEA.

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