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Climate Change and Project Risk: A Mutual Effect in Case of Electrical Tansmission Line Installation Project

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ABSTRACT

The paper is based on the establishment of mutual effect of project risk and environmental/ climatic changes. According to the studies present very few authors have studied the effect of these two phenomenons. The study collects the literature review on the works of various authors and decides upon the criteria for measurement of these project risk factors and climate/environmental factors. Then the study presents a statistical approach for development of relationship between the two. A survey is done in order to study a complete mutual effect on the various factors of project risk and environmental changes on the same projects. The electrical transmission line installation project related professionals are approached for survey. The statistical analysis by SPSS software in this study (based on results from the survey) confirms the presence of mutual relationship with correlation and regression of a high value between project risk and environmental/climatic changes and emerges as a tool for curbing environmental and climate abrupt changes in the immediate surroundings.

Key words: Climate/Environmental change, Project management, Project risk management, Site (Installation) work management and Electrical Transmission line.

INTRODUCTION

Climate affects projects and is itself affected by the implementation of any large project. The climate effects are to be studied for developing this mutual relationship. The overall effect of this relation is crucial to be explored. The changes in the climate pattern are studied with respect to the change in the risk level introduced in the project. The study aims at developing the relationship between the climate changes and risk management. In most of the studies undertaken for this analysis the climate change is a major factor for all civil work based projects. In other words it has been found that outdoor projects in the construction domain are most susceptible from climate change and these projects themselves cast upon a very considerable effect on the surrounding area's climate and environment. Hence it was decided that a civil work based project shall be undertaken in order to analyze the mutual effect between the two factors that is climate change and project risk. It was due to all these reasons an electrical transmission line installation project at eastern Uttar Pradesh (India) region is being undertaken for this study. The later parts of this study will enumerate more factors for selection of this particular electrical transmission line installation project for our study.

Climate and environmental changes are governed by some very sensitive factors and a detailed literature survey was done to unearth these factors and along with this factors affecting the project risk management in an electrical transmission line installation project are also studied. In other words the study embanks upon these factors for studying the relationship between the two. In a developing country like India more and more electrical transmission line installation projects will be going to be undertaken and hence with the evolution of more stringent environmental laws it is crucial to study the effect of one factor on the other with a scientific approach which is developed indigenously in this study for this sole purpose.

Project risk management is that section of project management which takes care of all sorts of diversions or uncertainties that are accounted during the entire project management cycle. The project management is incomplete without prediction of risk and managing these risks is risk management in broad terms.

In the next section we shall start with the analysis of studies already done in the case of electrical transmission line installation projects and the climate, environmental effects of these projects. The account of this analysis is given in the Literature survey section.

MATERIALS AND METHODS

The study concentrates on the mutual effect of climate change and risk management in electrical transmission line installation projects. The existing literature is analyzed for this purpose for both the climate factors and project risk factors. The overall analysis is done on these factors itself which will be presenting a more accurate process of analyzing this mutual effect. The technique used for such a literature analysis in this study is Structural Literature Review. The main components under this structural literature review of this study are –

- Project Risk management
- Project Risk management and Risk factors in Electrical transmission line installation projects
- Climate/Environmental factors in Electrical transmission line installation projects

In the next step we have analyzed the above stated steps one by one for the collection of literature review on these topics. In nut-shell we can say that project risk for electrical transmission line installation projects is analyzed and the environmental effects of these risks and vice versa is accounted for developing the relationship between the Project risk management and Environmental factors.

Project Risk management

In any project management scenario the most basic aspect that needs to be dealt with is that the amount of uncertainty is assessed and managed and most of the authors have given the name of calculated or measured uncertainty as “Risk”, along with this there are a number of other operational difficulties and phenomenon that are to be analyzed for inculcating the project risk management phenomenon. The various authors relating these operational phenomenon are Black (2007), Lin and Ying (2015), Chen et al. (2015) and Ng et al. (2015). The overall planning and re-planning conditions for any project are being studied by these authors. Almost all of these studies relate a very contrast relationship between the projects being successful and unsuccessful on the basis of these operational aspects. In our study we have analyzed these aspects for correlating the climate or environmental aspects with project risk.

Project Risk management in Electrical transmission line installation projects

The main authors contributing in this domain of Project risk in Electrical transmission line projects are Boute et al. (2004), Herroelen and Leus (2004), Lee et al. (2013) and Micheli et al. (2014). Most of these authors have advocated the division of risk of such projects into risk factors and then analyzing their values with respect of expert’s opinion or with the help of various techniques.

Risk factors in Electrical transmission line installation projects

The collection of risk factors is necessary for analyzing the risk of any project and the same is also applicable for electrical transmission lines. The main works selected for this study are Castro et al. (1995), Baccarini et al. (2001), Dey (2001), Thevendran and Mawdesley (2004), Wyk et al. (2007), Fan et al (2008), Iyer et al. (2010), Chen et al. (2011), Fang et al. (2012) and Aloini et al. (2012). All of these studies mainly stresses on the appointment of some common types of risks. In order to track the risk of project an analysis for all these is an absolute must. This listing of risk types is given below in table 1.

On the basis of the Table 1 the five risk factors which are collectively chosen from the work of various authors are -

I. Technical Risk (Rt) (Related to technical factors like tower preparation, stringing, sagging etc)
II. Environmental Risk (Re) (Acts of God like earthquake, tornado etc)

III. Financial Risk (Rf) (Economic factors like recession, inflation etc)
IV. Human Risk (Rh) (Risk related to loss of life of workers and other associated man power)
V. HR (Management) Risk (Rhr) (Human resource management related problems like grievance handling, strikes etc)

Table 1: Risk factors collected from various authors

Authors / Risk factors	Technical Risk	Environmental Risk	Financial Risk	Human Risk	HR (Management) Risk
Chen *et al*. (2011)	ACPT	ACPT	ACPT	NTREF	NTREF
Iyer *et al*.(2010)	ACPT	ACPT	ACPT	ACPT	NTREF
Aloini *et al*. (2012)	NTREF	NTREF	NTREF	NTREF	ACPT
Thevendran (2004)	NTREF	ACPT	ACPT	ACPT	ACPT
Fang *et al*. (2012)	ACPT	NTREF	ACPT	NTREF	ACPT
Baccarini *et al*. (2001)	ACPT	ACPT	ACPT	ACPT	ACPT
Dey (2010)	ACPT	ACPT	ACPT	ACPT	ACPT
Fan *et al*. (2008)	ACPT	ACPT	ACPT	NTREF	NTREF
Wyk *et al*. (2007)	ACPT	NTREF	NTREF	NTREF	NTREF
Castro *et al*. (1995)	ACPT	NTREF	NTREF	NTREF	NTREF
Regos (2012)	NTREF	ACPT	NTREF	ACPT	NTREF
Wu *et al*. (2008)	ACPT	ACPT	NTREF	ACPT	ACPT
Erickson *et al*. (2006)	ACPT	ACPT	ACPT	ACPT	ACPT
Dikmen *et al*. (2008)	ACPT	ACPT	ACPT	NTREF	ACPT

ACPT= accepted by author, NTREF= Not referenced

Table 2: SPSS output for Regression analysis in between environmental/climatic factors and project risk factors

Model	R	R Square	Adjusted R Square	Std. Error of the Estimate
1	.694[a]	.482	.466	.87520

Model	Sum of Squares	df	Mean Square	F	Sig.
1					
Regression	137.523	6	22.920	29.923	.000[a]
Residual	147.832	193	.766		
Total	285.355	199			

Model	R	R Square	Adjusted R Square	Std. Error of the Estimate
1	.670[a]	.449	.431	.86217

Model	Sum of Squares	df	Mean Square	F	Sig.
1					
Regression	116.692	6	19.449	26.164	.000[a]
Residual	143.463	193	.743		
Total	260.155	199			

Table 3: SPSS output for Correlation analysis in between environmental/climatic factors and project risk factors

****. Correlation is significant *. at the 0.01 level (2-tailed). Correlation is significant at the 0.05 level (2-tailed).**		**Overall combined risk level**	**environment/ climate characteristic 1**	**environment/ climate characteristic 2**	**environment/ climate characteristic 3**	**environment/ climate characteristic 4**	**environment/ climate characteristic 5**
Overall combined risk level	Pearson Correlation	1	.019	.196**	-.009	-.014	.339**
	Sig. (2-tailed)		.787	.006	.899	.843	.000
	N	200	200	200	200	200	200

		Overall environment/ climate characteristic	**Technical Risk**	**Environmental Risk**	**Financial Risk**	**Human Risk**	**Human Resource Risk**
Overall environment /climate characteristic	Pearson Correlation	1	.144*	-.008	.312**	-.031	-.057
	Sig. (2-tailed)		.043	.914	.000	.667	.425
	N	200	200	200	200	200	200

In our study the above given risk factors will be selected for analyzing the project risk.

Climate factors in Electrical transmission line installation projects

According to some of the latest studies related to Power sector and specially transmission lines and their installation projects and the effect they have on the environment. The studies by Habib and Chungpaibulpatana (2014), Bakken et al. (2014), Chaturvedi et al. (2014) and Maddah et al. (2015) all advocate for revolutionary methods to be employed for assessing and managing the environmental aspects. In the power sector the technologies like Leap technology, Global Information System, satellite and remote sensing technologies can be successfully implemented to assess the environmental aspects and related risks present in such projects. In this section we shall discuss the various techniques and factors that can be considered for analyzing the environmental and climate factors. The main factors (Habib and Chungpaibulpatana (2014), Bakken et al. (2014), Chaturvedi et al. (2014) and Maddah et al. (2015)) that have been selected for analyzing the climate and environmental effects is given as –

Amount of Land acquisition (E1)

The transmission line installation is one such project in which apart from power generation plant, several sub stations and huge transmission line towers are to be build. These towers have length in a range of about 100-500 Km depending upon the Voltage requirements. The wires travel from one tower to another and hence even if the single tower does not occupy much of the land but when such towers are build over a span of several hundred kilometers, then it becomes a serious consideration for nearby environment.

Loss of flora and fauna habited land piece (E2)

The green belts need to be assessed for the number of inhabitants under that land, in our study we have provided five pointer scale in which 1 represents less number of trees and other living organisms, while number 5 represents extreme or highest possible number of trees and other living organisms.

Loss to species present in the available land (E3)

The gravity of flora and fauna is another factor that has to be judged for calculating the effect of project on a particular ecosystem. These factors were one of the reasons why we have to analyze the local ecosystem factors for electrical transmission line installation projects.

Vicinity to green belt/forest range (E4)

The distance of the power plant or a long range transmission line from the flora and fauna belt is another important factor that is to be analyzed for assessing the effect of project risk on climate/ environmental effects.

Endangered species location (E5)

The presence of endangered species is one of the most important legal and environmental aspects that are to be analyzed. The study has also taken into account such factors so that a complete picture can be framed.

RESULTS

In this section a survey was conducted from the national level Power Grid Company and senior employees and executives (minimum 5 years experience) are selected. The survey was also done on the forest area officials and forest rangers working in those project areas. Social activists and NGO's were also included to have a picture of risks present in those projects to the environment. The survey was done on five point scale on over 200 carefully selected statistically eligible and viable respondents the result is expressed with the help of SPSS software.

The survey is done on the basis of questionnaire on which five point likert scale is used, for achieving uniform scales around the whole questionnaire. The correlation and regression among the variables of environmental/climatic factors and project risk factors is developed. The output of SPSS is given in Table 2. The output is analyzed in order to achieve the desired relationship of interlinking between these two factors so that efficiency in operational and non operation aspects related to environment can be correlated and the planning process is mutually beneficial.

DISCUSSION

The correlation in between the two types of factors that is risk factors and climate/environmental factors is shown in Table 2. In the data set statistically analyzed the regression analysis based on the overall risk level and climate factors shows a high level of R that is .482 with a manageable significance level. On reversing the dependent and independent variables the value of R is still quiet large at .45, with ideal significance value.

The correlations shown in Table 3 between financial risk, technical risk and environmental / climate factors is quiet high, along with this the correlation between the overall risk factors and environmental factors is also quiet high. Both the individual correlations and overall correlations risk factors and environmental factors prove the dependence of one on another.

Hence the study confirms that in order to club these risk factors the associated environmental changes are also to be managed and likewise the climate changes around these areas are also dependent on these project's risk levels. Hence monitoring of the climate factors is a must for any project team, since not only it is a tool for reducing risk but it also aids in managing the environmental threats and changes.

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