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UNDERSTANDING AND MODELLING OF KEY PERFORMANCE FACTORS IN THE AIRPORT SECTOR

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ABSTRACT

The airport sector is a driver of the economy of a country. In the recent years this sector has seen to add a considerable amount of an impact to the overall development of a nation. It can be said that a nation's development can be directly correlated to advances in its infrastructure. With increased growth in the sector and, the need for expansion projects in the airport sector has been observed in the past decade. Airport projects have set an example in terms of completing projects within the stipulated time period. But, is time the only measure of the effectiveness of the projects? The fact that the projects have to bear huge overruns in cost. Despite the fact that a considerable lot of study has been done on distinguishing the dangers in the airport sector in the running stage. Be that as it may, not a ton of hazard analysis has been done to decide the executional challenges in the pre-development stage. Airport projects in India have set a great example in the field of time management. But is time the only performance challenge faced? Despite the fact that these ventures set a decent case finishing under the stipulated time periods, the way that the tasks endured enormous cost overwhelms can't be precluded. The idea behind carrying out this research is to satisfy the need to understand all challenges that affect the performance characteristics of airport ventures to ensure project safety in terms of constructional safety, financial safety etc.

Keywords: Airport sector, Regression modeling, factor analysis, risk modelling

I. INTRODUCTION

The airport sectoris a driver of financial and social improvement of a nation.The turnover of the Indian Aviation division today surpasses Rs 1 lac crores. The venture expected in the twelfth Five Year Plan is Rs.70,000 crores and out of this Rs.55,000 is normal from private division. Consequently, Private investors have assumed an exceptional part to develop the airport sector in the country. Late research by Oxford Economics uncovers that immediate commitment of aeronautics in India to its GDP is 0.5%. Airplane terminal Council International in its projections looking at the 20 nations in the world estimated that India will be the third biggest aeronautics market in the world by 2027 in terms of passengerexchange. The World Bank assesses that a 10 percent ascend in infrastructure assets increases GDP by up to 1 percentage point. Insufficient or underdeveloped infrastructure rests as one of the biggest hindrances in a nation's socio- economic development profile. Hence, it is essential to study the various risks faced by this sector in order to facilitate forward economic growth. Alnasseriet. Al. (2013) in their work have explained the airport sector as not an indivivsual but a combination of various market industries that come together to constitute this vast industry and hence it requires a more careful and strategic management.

II. OBJECTIVES AND METHODOLOGY

There are two key objectives of this study:

1. Understanding key performance challenges of the airport sector.
2. Modelling of risks.

Understanding key performance challenges:

The risk factors obtained from the literature review and informal interviews are as follows:

Financial Risks: Financial risks can be defined as risks affiliated to the financial aspects of the projects. Considering the size of the sector, cost management seems to be one of the most common and persistent challenge in the sector. Risks such as rise in interest rates, exchange rates, inflation, cost overruns and rise in commodity prices have been identified under financial risks.

Social Risks: The passengers are the end recipients of the airport sector and the people working in it are the key providers of service. Problems faced due to poor passenger feedback effects the efficiency of the aviation sector. Some factors such as relationships between agencies participating in the project, increased expectations of the passengers and relationships between various departments directly or indirectly dependent on each other turned out to be essential social factors that affect the airport sector.

Contractual Risks: Airport projects are joint venture projects involving various public and private organizations. Thus, with such complex structures it is observed that contract related issues arise. Few risks observed were conflicting contractual terms, breach of contract.

Schedule Risks: Although airport projects have been a very good example with time management finishing the projects within the stipulated time frame. Still risks associated with time management can never be ruled out. Lack of criteria to quantify schedule delays, presence of long term contingency plans and delays due to force majeure turned crucial in managing schedule delays.

Legal Risks: Legal risks unlike contractual risks incorporate the tasks that arise due to government laws implemented that may cause trouble in carrying out the project. Risks identified were land acquisition and permits and approvals.

Political Risks: Politics dominates practically every industry in any nation. Political risks may be defined as risks associated to political complications as a result of changing strategies brought by new parties at the beginning of every term or even conflicts between various political agencies. These risks identified were changing political strategies, new polices brought by the government and corruption.

Force Majeure: Force majeure are those factors that cannot be controlled. These factors may or may not have a definite cause. Some factors such as unfavorable weather conditions, riots and natural disasters fall under this category.

Miscellaneous: These factors do not fall into any category and are exclusively different from other factors rapid changing technologies, lack of trained work force and geographic Location were grouped under this factor.

In order to achieve the result, a large amount of data is to be acquired in order to have a clear picture of the scenario present in the airport sector and how much of an effect have the anticipated risk factors achieved. Since these factors have been derived from the literature review and some may be derived from interactions with industrial experts, the degree of effect of these risk factors cannot be qualified. Only when the quantum of effect of these risks is found out, can an effective risk assessment be carried out.

The methodology adopted to achieve the results targeted to this study has been divided in two parts:

1. Data Collection using a questionnaire Survey.
2. Data compilation and tabulation of result using Quantitative risk assessment tool.

Data Collection Questionnaire Survey

The sample size of any questionnaire survey should be kept sufficient in order to achieve promising results from the responses. It is usually required to be at least twice the total number of factors being considered in the questionnaire. Since total numbers of consolidated risk factors to be analyzed were about 10 therefore, a sample size of minimum of 30 (minimum sample size prescribed for any questionnaire based survey) had to be achieved. Hence, a total of 40 responses were received. Once, all the responses were received, a detailed tabulation of all the respondents along with relevant information such as name, name of organization, designation and contact details were tabulated for record.

Also, responses were tabulated in order to acquire relevant data. The questionnaire was prepared in a way that the respondents were supposed to rate each risk factor on the severity of occurrence. Severity of occurrence means that how severe the effect of any risk factor could be. Each question was followed by 5 check boxes each check box holding a severity value ranging from 1-5.One being least severe and five being most severe. Based on the severity values received for each response, tabulation was prepared. Since the analysis was to be carried out on the consolidated risk factors hence, average value for severity was calculated for each factor and tabulated for further analysis.

2.1 Test for reliability of data

After a questionnaire survey is complete, a common problem dilemma that runs is whether the data received from the questionnaire is reliable or not. For the purpose of this, a reliability test hence becomes an essential step before carrying out further analysis. To check the reliability of the data a Cronbach's Alpha (α) Test is carried out on the data. Chronbach’salfa.is an effective and very commonly used test to check the reliability (internal consistency) of the questionnaire.

Table 1: Output for chronbach’sapha analysis

Cronbach's Alpha	N of Items
.888	35

A Cronbach's Alpha is carried out on the questions placed in the questionnaire. Each question in the questionnaire becomes an input variable in the analysis and then the test is carried out on the responses. Various tables are formed in the output table but the reliability statistics provide useful information about the reliability of data. Chronbach's alpha value achieved is 0.888 as shown in table 1 above. Various tables are formed in the output table but the reliability statistics provide useful information about the reliability of data. Chronbach's alpha value achieved is 0.888 as shown in the above table. This indicates that there is a high level of consistency in the data. Thus, the data proves to be fit for further analysis and modeling of data can be carried out.

2.2 FACTOR ANALYSIS

Another important part of my objective is to understanding weather these factors have any effect on the cost implications of an airport project. As mentioned above, the problem of huge cost overruns in the airport sector has been highlighted. This forms on of my key objectives for which a regression analysis has been selected. A regression analysis requires one dependent variable (in my case dependent variable being cost) and one or more independent variables (risk factors). But it may be difficult to run a regression model with 10 independent variables. Thus, in order to reduce the number of independent variables, factor analysis has been selected. Factor analysis is an effective data reduction technique. It is often overlooked but, carrying out a data screening is an important process to be carried out before any type of a regression analysis. It helps by determining the correlation between the factor inputs into the software to help prepare clusters of factors based on achieved correlations that may otherwise remain undetected. Before carrying out a factor analysis a few checks are should be done in order to determine whether the data is sound to carry out a factor analysis. But, carrying out a factor analysis is a technique that requires a large sample size (minimum 10 observations per variable). There are various checks that have to be carried out before a factor analysis/s result can be interpreted.

Test for multicollinearity: Multi-collinearity is defined as a phenomenon in which two factors turn out to be highly co-related to each other. So much that one factor can be linearly predicted from the other.

- To check for multicolinearity is he first step in a factor analysis for which the determinant of the correlation matrix should be less than 0.00001. In my case, the determinant value was 0.22. Hence there was no multicollinearity.
- Test for sphericity: A KMO and barett's test is carried out. This test is important as it tests the data for its adequacy. Usually for a data to be deemed as adequate, the value for KMO test should be greater than 0.5 and barret's test should be less than 0.05. The table below shows values of the data acquired when the test was carried out.

Table 2: Results for KMO and Bartlett's test.

KMO and Bartlett's Test

Kaiser-Meyer-Olkin Measure of Sampling Adequacy.		.521
Bartlett's Test of Sphericity	Approx. Chi-Square	130.945
	Df	45
	Sig.	.000

Since value for KMO was 0.521 and sig value for Bartlett's test was 0.000 hence, data was considered as adequate. For a factor analysis to be useful, we require some relationships between the input variables so that they can be grouped together in order to interpret a fruitful output. Thus, a sig value of 0.000 proves that there is presence of some correlation between the input factors. In case the level of significance would have been greater than 0.05 level of significance the R-matrix obtained would be an identity matrix and the analysis would not provide useful results. Once all the above tests have been passed and data has proven to be adequate for analysis, the final result may be obtained from the rotated component matrix provide by the software as shown in the table below.

Table 3: Shows final transformation matrix obtained after rotation.

Rotated Component Matrix[a]

	Component		
	1	2	3
VAR00001	-.595	.411	.371
VAR00002	-.153	.040	.832
VAR00003	.669	.352	-.120
VAR00004	.172	.725	.034
VAR00005	.720	.071	.271
VAR00006	.615	.591	.072
VAR00007	-.730	.167	.293
VAR00008	.233	.091	.785
VAR00009	-.078	.795	.106
VAR00010	.664	.174	.270

From the above matrix, it has been observed that the 10 input factors have been concised into 3 groups. These 3 clusters consist of various factors and factors falling into a cluster depict that they have some correlation with each other but not enough to cause multicollinearity. Results achieved from factor analysis are given below.

Group 1: Contractual risks, Legal risks, Political risks and Geographic location.

Group 2: Financial risks, Schedule risks and Lack of trained workforce.

Group 3: Social risks, Force majeure and Rapid changing technologies.

The free clusters have become three new factors that can be defined and regression modeling can be carried out on them. The three clusters have been given names and hence new factors obtained are as follows:

Factor 1: Contractual and legal complications caused due to controversial site location and political intervention.

Factor 2: Financial risks as a result of scheduled delays due to lack of trained work force.

Factor 3: Social challenges due to rapid changing technologies and force majeure.

2.3 Modelling of Factors Using Regression Analysis

2.3.1 Preparation of data for analysis:

- Three new factors have been defined using the clusters formed as a result of factor analysis hence; factors falling from every factor were averaged out to provide values of each cluster groups formed.

- Also, the question related to cost was of a different type and was to be judged over a different parameter than the other questions asked in the study. Instead of rating, cost was asked on a percentage scale (i.e. 20-30%, 30-40% and so on) as a closed question with options provided.
- Sine, in regression a single value is required and in the same scale as other input values therefore each percentage was averaged in every response obtained over the assumption that each percentage value between a group has equal probability of occurrence.
- A regression modeling required two variables in my case they were:
  - Dependent variable: Cost.
  - Independent variables: Risk factors obtained after factor analysis.

Once all the factors were brought down to a common scale and attended to regression analysis can be carried out.

Table 4: Model summary from regression analysis.

Model Summary[c]

Model	R	R Square	Adjusted R Square	Std. Error of the Estimate	Change Statistics					Durbin-Watson
					R Square Change	F Change	df1	df2	Sig. F Change	
1	.771[a]	.595	.584	.04474	.595	55.811	1	38	.000	
2	.829[b]	.687	.670	.03986	.092	10.874	1	37	.002	2.115

a. Predictors: (Constant), VAR00003

b. Predictors: (Constant), VAR00003, VAR00002

c. Dependent Variable: Cost

2.3.2 Testing for model fit

Coefficient of determination also represented as R^2 is used to measure the strength pf the model. It depicts what percentage of the dependent variable is affected by the independent variables explained in the input equation. For an equation to be considered fit, the value of R^2 should be at least greater than .30. Value of coefficient of determination obtained from the data is shown in the table 4 above. Since Model 2 has greater value i.e. 0.687 hence, model two is selected. It also means that 68.7% of the cost overrun is a result of all factors included in this model.

2.3.4 Durbin Watson Statistic check for autocorrelation:

The Durbin Watson (D-W) statistic is used to check for autocorrelation. The hypotheses for Durbin – Watson test are:

H_0: $\rho = 0$ (first order autocorrelation in absent in the population)

$H_{1:}$ $\rho > 0$ (positive first order autocorrelation is present in the population)

A = 0.05

Value for Durbin – Watson can be acquired from table 4 above depicting the model summary. Values falling close to 2 indicate absence of any type of autocorrelation where as a value

Falling near to 0 indicates positive autocorrelation.A value towards 4 indicates negative autocorrelation. Since the values obtained in the output is near to 2 (about2.115) hence, we it can be said that there is no autocorrelation in the data provided to the software as input.

2.3.5 Forming regression equation

Once the model has been selected, the regression equation can be obtained from the selected model. The variable with the highest partial correlation achieves the first position in the model. If we look at the model provided in table 5 given below. It has been observed that variable 2 has highest value for partial correlation (0.477) and hence occupies the first position in the equation. Thus, from the results the regression equation derived as follows:

$$\mathbf{Y= -0.68 + 0.20X_2 + 0.399X_3}$$

Table 5: Checking for partial correlation.

Excluded Variables[a]

Model		Beta In	t	Sig.	Partial Correlation	Collinearity Statistics		
						Tolerance	VIF	Minimum Tolerance
1	VAR00001	.191[b]	1.904	.065	.299	.993	1.007	.993
	VAR00002	.327[b]	3.298	.002	.477	.858	1.165	.858
2	VAR00001	.107[c]	1.105	.277	.181	.898	1.113	.776

a. Dependent Variable: Cost

b. Predictors in the Model: (Constant), VAR00003

c. Predictors in the Model: (Constant), VAR00003, VAR00002

From the above equation, the following conclusions can have been drawn:

- 20% of the variation of cost may be attributed to factor 2 (comprising of Financial risks, schedule risks and lack of trained work force).
- About 40% of the variation of cost may be attributed to risks associated with factor 3 (comprising of social risks, force majeure and rapid changing technologies)
- The constant value of -0.68 means that if the value of independent variables s set to 0, in that case the value of independent variables will have a value < 0 i.e. we will have no cost overrun. Thus, also proving the fit of the regression equation.

It should also be noted that the above modelling has been carried out with the application of ordinary least squares (OLS) based on the assumption that the various explanatory variables entered are not correlated to each other. Violation of this assumption may give unreliable and unwanted results. This phenomenon is also known as multicollinearity

2.3.6 Anova test:

Table 6: Shows output for ANOVA test.

ANOVA[a]

Model		Sum of Squares	df	Mean Square	F	Sig.
1	Regression	.112	1	.112	55.811	.000[b]
	Residual	.076	38	.002		
	Total	.188	39			
2	Regression	.129	2	.064	40.594	.000[c]
	Residual	.059	37	.002		
	Total	.188	39			

a. Dependent Variable: Cost

b. Predictors: (Constant), VAR00003

c. Predictors: (Constant), VAR00003, VAR00002

The analysis of Variance or ANOVA test is carried out to check the significance of R^2 value. Significant value of variance of determination directly implies that the model obtained is significant. Hence, it is supposed to be less that 5% or 0.05 level of significance. Since the value obtained from ANOVA test is 0.00 as observed from the above table, the assumption stands correct and the regression is significant at 5% level of significance.

III. CONCLUSIONS

From the above study the following conclusions can be drafted:

1. Risks identified are in fact critical and affect airport projects significantly.
2. Although some factors such as geographic location have achieved high priority in terms of level of severity but fail to form a part of the regression equation. This proves that geographic location may be a significant risk factor but does not participate in causing heavy cost overruns.
3. Correlation achieved between various factors such as financial risks, schedule risks and lack of trained work force depicts that these factors are interrelated and are affected by each other.
4. Controlling all three factors as a common group would go a long way in effectively managing and controlling risks.
5. The six factors hence forming a part of the regression equation affect the cost dynamics of airport projects by 68.7%.
6. The above statement also means that there are more factors present that significantly affect airport projects.

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