KSF-CA Correlation Matrix for Probabilistic Cashflow Model on Construction Project Financing in South Korea

Jin-hyuk Yoo, Dong-gun Lee and Hee-sung Cha
Department of Architectural Engineering, Ajou University, Suwon, South Korea

Keywords: Cash Account, Cash-flow Model, Correlation Matrix, Key Success Factor, Project Financing.

Abstract: In the construction industry, the main obstacle in successfully completing a project is a failure in identifying and responding the project risk factors. Especially for construction project financing (PF), many project practitioners are struggling in developing a cash-flow model by integrating the key risk factors for the subject project. This study has identified key success factors (KSFs) of construction project financing (PF) throughout an extensive literature review in collaboration with an industry survey. They have been further derived from Factor Analysis technique and qualified using Fuzzy-AHP method. Throughout the evaluation of the derived success factors in real building construction projects, a strong correlation has been identified between the score of each PF success factor and the level of success and/or expected rate of return (ROR). Using the result of this investigation, this study has been developing a correlation matrix for inter-relating each KSF and its corresponding cash account in order to effectively measure the financial viability of PF projects. With the help of this mechanism, the project stakeholders can reach more objective and transparent decision-making process. The contribution of this study will help decision makers of the PF project make a better decision and give a meaningful guidance in achieving more successful PF projects.

1 INTRODUCTION

1.1 Research Background

Project Financing (PF) is a type of project delivery method which contributes to the development of national economy and business through a private sector investment. PF is also termed as Public-Private Partnership (PPP). The various types of PF have been further developed as Build-Operate-Transfer (BOT), Build-Own-Operate (BOO), and Build-Transfer-Lease (BTL). In many cases, however, PF projects have been forecasted too optimistically to financially succeed, lacking in intensive consideration of various project-related risk factors. As such, the recent financial crisis has jeopardized most PF projects resulting in investment shrinkage due to extremely conservative approach in financial model evaluation (Ye and Tiong 2000). Although many financially-viable PF projects are recognized in these days, the private-sector investors are reluctant to launch a new PF project because there is no comprehensive risk evaluation model which identifies various types of risk factors, evaluates them, and recommends future cash-flow profile based on the quantitative risk evaluation approach (Lucko 2011).

Although many researchers have been conducting a study in relation with project risk evaluation in a qualitative approach, little research has been conducted about a quantitative analysis which links risk factors with cash account items in developing a cash flow model on PF projects (Odeyinka et al. 2008; 2012).

The objective of this study is to develop a correlation matrix between risk factors and cash accounts, by identify Key Success Factors of a PF project. To achieve this objective, the authors have identified Key Success Factors (KSF) on a successful PF projects throughout an extensive evaluation of various influential factors on a PF project. The risk-cash correlation matrix contributes to a more predictable cash flow analysis model for various types of PF project on a quantitative evaluation approach. In addition, it helps decision makers to make better decisions in investing their money to PF projects, resulting in a more reliable foundation in predicting their financial models of PF projects.

Yoo J., Lee D. and Cha H..
KSF-CA Correlation Matrix for Probabilistic Cashflow Model on Construction Project Financing in South Korea .
DOI: 10.5220/0005253903830388
In *Proceedings of the International Conference on Operations Research and Enterprise Systems* (ICORES-2015), pages 383-388
ISBN: 978-989-758-075-8

1.2 Research Methodology

This study has first induced key influential factors from an industry survey (1st) in order to develop a list of KSF for a PF project. In the 2nd survey, a list of cash accounts (CA) has been developed. By objectively evaluating the financial outcomes of previous PF and then establishing the appropriateness with the weights of the influential factors, a total set of 23 KSF has been established as the most significant factors to PF with an analysis of the interviews from the industry experts.

Subsequently, this study derived Cash account (CA) in order to define the cost/revenue elements which influence the cash-flow model of PF projects.

From an industry survey (2nd) the CA elements were justified. Finally, the matrix has been established in order to integrate the KSF with the CA. This Matrix was established from the result of the industry survey (3rd) with PF practitioners, and its implication has been defined as the magnitude of interrelationship between the two factors, KSF and the CA. The figure 1 below depicts research progress.

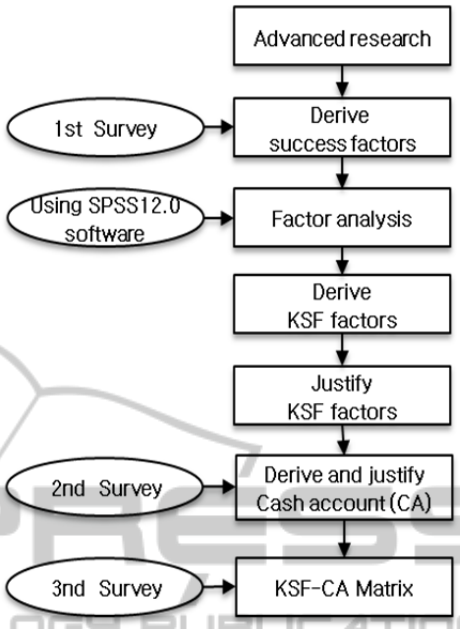


Figure 1: Research progress.

2 IDENTIFYING KEY INFLUNTIAL FACTORS ON SUCCESSUFL PROJECT FINANCING

This study conducted an in-depth data collection of influential factors on PF projects from the previous research. The influential factors on PF projects were also induced from the interviews with PF practitioners on the basis of the aforementioned influential factors in the previous research (Odeyinka et al. 2008). Under the assumption that the key influential factors play a pivotal role in achieving the performance of a particular PF project, a total set of 104 factors were identified and they were classified into five categories: project participants, development plan, business plan, project site, and financial performance.

Each category was further broken down into detail-level classes. For example, “project participants” category has three sub-categories, including participant job performance, financial status of participants, and reliability of a construction company. Likewise, the five categories have 15 sub-categories. The detailed sub-categories are provided in Figure 2, which shows the interrelationship of each influential factor under the relevant sub-or main categories.

3 QUANTIFICATION ANALYSIS OF KEY SUCCESS FACTORS

3.1 Overview of Factor Analysis

This study verified the existing factors by quantifying the level of importance in representing their influence on the performance of PF projects. The total of 104 influential factors was induced from the previous research; some of them were duplicated and interrelated. Thus, it is essential for the authors to recognize the factors with duplicated meaning and/or low-impact. This study employed a factor analysis technique in identifying the overlapped/low-impact influential factors. With the factor analysis, the authors effectively re-organize the key factors and restructured the influential factors into a few meaningful groups.

3.2 Factor Analysis Results

3.2.1 Data Collection

Factor analysis is a statistical method to extract a set of meaningful variables by processing large number of or massive data. This analysis is a type of statistical analysis methodology explaining the characteristics of the entire data by extracting the

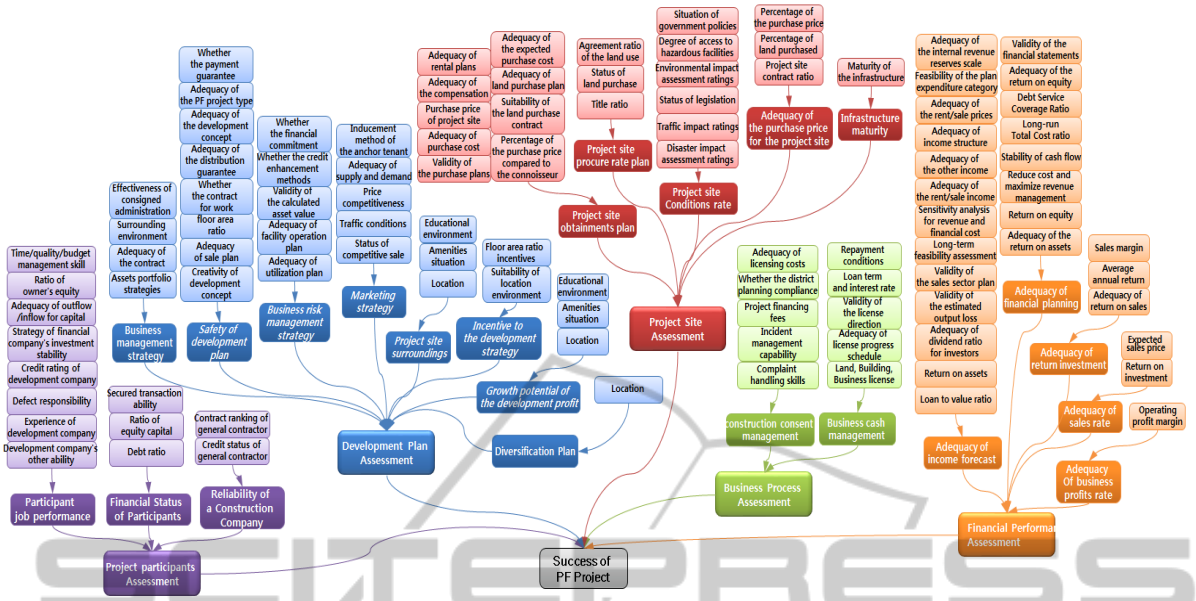


Figure 2: Influence Diagram of Key Success Factor in PF Project.

common variable innate into the variables using the interrelation among the full set of variables.

Accordingly, this study conducted factor analysis on 104 influential factors induced from the previous research. By reviewing the interviews of the previous research and adding additional questionnaire to interview data established, factor analysis was made by performing 28 person-to person interviews in total.

Respondent interviewees consist of contractors (28.57%), developers (7.14%), financial institutions (14.29%), and academic researchers (21.43%). The industry working experience ranges from 3 years (18.52%), 3-5 years (22.22%), 5-10 years (33.33%), to over 10 years (25.93%).

3.2.2 Data Reliability Check

This study conducted credit analysis in order to increase credibility of questions in the interview before carrying out fact analysis. Credit analysis shows how similar the evaluated result are, therefore performed to evaluate continuity and preciseness of the interview result.

One of the credit analysis methods is Cronbach's Alpha analysis method. Cronbach's Alpha Credit coefficient represents the relationship among multiple questions, having the range of value from -1 to +1, which can be interpreted as; values closer to 0 having little relation, values closer to ±1 having significant relationship.

This Study made use of SPSS 12.0 to perform credit analysis. The result of credit analysis reads; 0.886 for "Evaluation for A project participant", 0.952 for "Master Plan Evaluation for B Project", 0.942 for "C site evaluation", 0.887 for "Financial Performance evaluation for E project", meaning that significant level of credibility over 0.6, moreover the entire factor evaluation also reads 0.947, a value of significance.

In order words, influencing factors verified through the credit analysis under this study found out to be structured in order for the interviewee to apply comparatively significant level of credit.

Table 1: Result of analysis reliability.

Category	Cronbach's Alpha	Number of Item
A	0.886	13
B	0.952	31
C	0.942	22
D	0.887	10
E.	0.963	28
Total	0.974	104

3.2.3 Factor Analysis

This study performed factor analysis on the previous influential factors on PF projects in order to group the factors with higher relationship. The method of factor analysis used was Principal Component Analysis (PCA) and Varimax Method for rotation of factors. Items with factor covariance (factor load value) of 0.5 or higher were grouped at this moment.

Factor covariance, which represents the relationship among the factors with variance, is an index showing how close they are interrelated. With the range between 0 and 1, the value closer to 1 can be defined as the most significant in terms of relationship among factors (Li and Zou 2011).

As a result of factor analysis, 104 items in total were integrated into 23 factors by this analysis. The table 2 below represents 23 KSF in a successful PF project.

Table 2: Result of factor analysis.

Category	Key Success Factors
A. Project participants	A1. Participant job performance
	A2. Financial Status of Participants
	A3. Reliability of a Construction Company
B. Development Plan	B1. Business management strategy
	B2. Safety of development plan
	B3. Business risk management strategy
	B4. Marketing strategy
	B5. Project site surroundings
	B6. Incentive to the development
	B7. Growth potential of the development profit
	B8.Diversification Plan
C. Project Site	C1. Project site obtainments plan
	C2. Project site procure rate
	C3. Project site conditions
	C4. Adequacy of the purchase price for the project site
	C5. Infrastructure maturity
D. Business Process	D1. construction consent management
	D2. Business cash management
E. Financial Performance	E1. Adequacy of income forecast
	E2. Adequacy of financial planning
	E3. Adequacy of return investment
	E4. Adequacy of sales rate
	E5. Adequacy of business profits rate

4 CASH ACCOUNT (CA) OF PF PROJECTS

Literature review and Professional Interview were performed to induce the Cash Account which Cash-flow comprises.

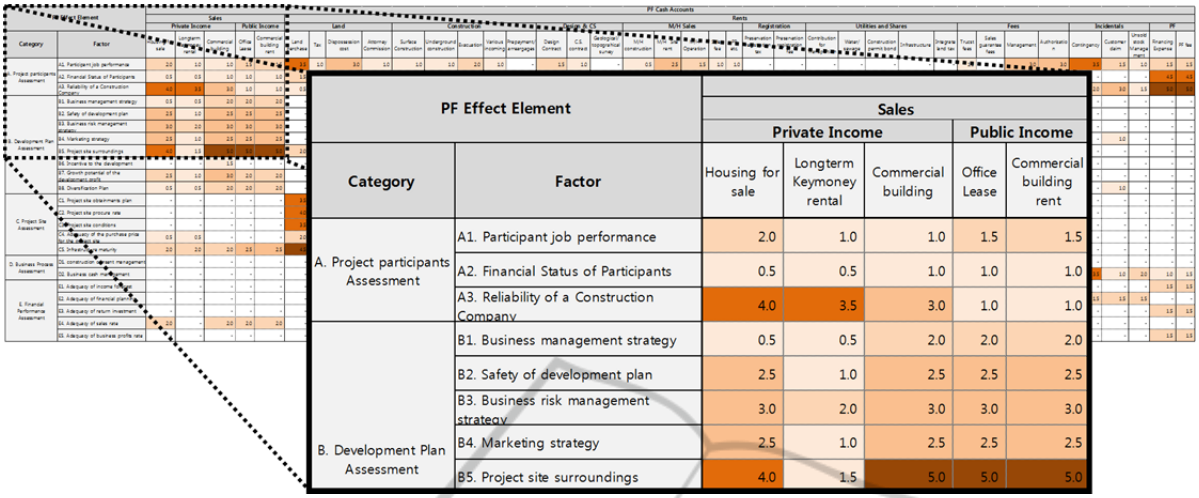
From a PF project for a mixed-purpose building of residential and commercial uses, the induced Cost Account was largely subdivided into revenue and expenses. Items for revenue were sub-categorized into the revenue from sales and rent, whereas items for expenditure were deduced the expense for land, construction, design and CS, sales fee, registration, utilities and shares, incidentals, others, PF etc. Each of Cost Account items deduced are being explained in the Table 3.

Table 3: Cash Accounts of PF Project.

Revenue	Sales	Housing for Sale, Long-term Key-money rental, Commercial buildings
	Rents	Office rent, commercial building rent
Expense	Land	Land purchase, Tax, legal fees etc.
	Constrct'n	Surface Construction, underground construction, Excavation, Various incoming Prepayment/arrearages
	Design & Customer Service	Design Contract, C.S. contract, Geological and topographical survey etc.
	Marketing Sales	M/H construction, M/H Site rent, M/H operation, Sales fee, PR etc.
	Registrat'n	Registration tax and fee
	Utilities and Shares	Contribution for Transportation, water/ sewage, Construction permit bond, Infrastructure, Integrated Land tax etc.
	Fees	Trust fees, Sales Guarantee fees, Management, Authorization
	Incidentals	Contingency, Customer claim, Unsold stock Management etc.
	Financial Service	Financing Expense, PF fee

5 ESTABLISHING KSF-CA MATRIX

This study established the matrix that has the items for PF expenditures (CA) as X(vertical axis) and 23 KSFs induced from the factor analysis as Y (horizontal). Also, industry practitioners in the field work were asked to be interviewed on the subject of the given matrix. This interview was focused on asking for reviews on the interrelationship of the two items; the items on the X and the blanks made by the items on the Y crossing the X. The level of interrelation was described as; blanks if there's no relationship, whereas the range was given from 1 to 5 according to the level of relationship they have so



PF Effect Element		Sales				
		Private Income			Public Income	
Category	Factor	Housing for sale	Longterm Keymoney rental	Commercial building	Office Lease	Commercial building rent
A. Project participants Assessment	A1. Participant job performance	2.0	1.0	1.0	1.5	1.5
	A2. Financial Status of Participants	0.5	0.5	1.0	1.0	1.0
	A3. Reliability of a Construction Company	4.0	3.5	3.0	1.0	1.0
B. Development Plan Assessment	B1. Business management strategy	0.5	0.5	2.0	2.0	2.0
	B2. Safety of development plan	2.5	1.0	2.5	2.5	2.5
	B3. Business risk management strategy	3.0	2.0	3.0	3.0	3.0
	B4. Marketing strategy	2.5	1.0	2.5	2.5	2.5
	B5. Project site surroundings	4.0	1.5	5.0	5.0	5.0

Figure 3 KSF-CA Matrix.

as to be used as an Input.

Then respective expert interview results were used to revise the matrix by putting the mean value of the input already established in each cell. For example, "A.1. Participants job performance" in the category A, has an influence on "Housing Sales," "Long term Key-money Rental Sales (SHIFT)," and "Commercial Building Sales," and also has an influence on the items of expenditure such as "Land (Site) Purchase," ""Taxes for Land Acquisition" and "Legal fees." By using this matrix, one can easily identify which risk factors have higher influence on the revenue-expenditure structure on the cash-flow, and also it is possible for one to develop cash-flow model predicting the future with the consideration for the risk structures of a particular PF project. Figure 4 presents the conceptual model for cash flow analysis using this matrix.

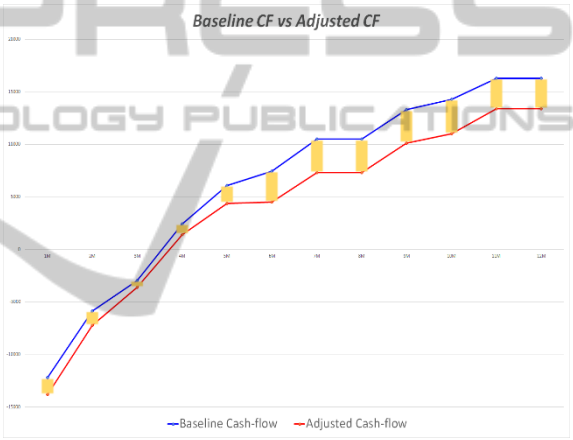


Figure 4: Concept model of Forecasting Cash flow.

6 CONCLUSIONS

This study has demonstrated that it is possible to ascertain how significantly the key factors in the PF projects can influence on certain CAs by establishing the matrix on KSF-CA relationships.

Although the Matrix developed in this study is in the process of verification, the authors firmly believe that it will be surely of help to the decision makers in the process of investment or project development by preventing PFs from expended with indiscretion as well as offering helps to discern sound projects, and also providing more reliable prediction for PF cash-flows in an objective way.

ACKNOWLEDGEMENTS

This research was supported by the Basic Science Research Program, through the National Research Foundation of Korea (NRF), which is funded by the Ministry of Education (No. 2012R1A1B3001009). This work was also partially supported by the Ajou University Research Fund.

REFERENCES

Badu, E., Edwards, D. J, and Owusu-Manu, D. M. (2012)," Barriers to the implementation of innovative financing (IF) of infrastructure", Journal of Financial Management of Property and Construction, pp.253-273.

Cheng, C. H. (1996), "Evaluating naval tactical missile

systems by fuzzy AHP based on the grade value of membership function", European Journal of Operational Research 96, pp .343-350.

Jafarizadeh, B. (2010), “Financial factor models for correlated inputs in the simulation of project cash flows”, Journal of Petroleum Science and Engineering, 54-57.

Kishore, V., Abraham, D. M., and Sinfield, J. V. (2011), "Portfolio Cash Assessment Using Fuzzy Systems Theory", Journal of Construction Engineering and Management, 2011.137:333-343.

Kong, D., Tiong, R. L. K, Cheah, C. Y. J., Permana, A., and Ehrlich, M. (2008), "Assessment of Credit Risk in Project Finance", Journal of Construction Engineering and Management, 2008.134:876-884.

Lam, K. C. Wang, D. and Lam, M. C. K.(2008), "Practices of Hong Kong building contractors in strategic asset allocation process: longitudinal approach", Journal of Financial Management of Property and Construction, pp. 176-186.

Lee, D., Li, T., Arditi, D. (2012), "Stochastic Project Financing Analysis System for construction", Journal of Construction Engineering and Management, 2012.138:376-389.

Li, J., and Zou, P. (2011), "Fuzzy AHP-Based Risk Assessment Methodology for PPP Projects", Journal of Construction Engineering and Management, 2011.137:1205-209.

Lucko, G. (2011), "Optimizing Cash Flows for Linear Schedules Model with Singularity Functions by Simulated Annealing", Journal of Construction Engineering and Management, 2011.137:523-535.

Odeyinka, H. A., Lowe, J., and.Kaka,,A. (2008), "An evaluation of risk factors impacting construction cash flow forecast", Journal of Financial Management of Property and Construction, pp. 5-17.

Odeyinka, H. A., Lowe, J., and.Kaka,,A. (2012), "Regression modelling of risk impacts on construction cost flow forecast", Journal of Financial Management of Property and Construction, pp.203-221.

Wibowo, A.and Kochendörfer, B. (2005), "Financial Risk Analysis of Project Finance in Indonesian Toll Roads, Journal of Construction Engineering and Management, 2005.131:963-972.

Xu, Y., Chan, A. P. C., and Yeung, J. F. Y. (2010), "Developing a Fuzzy Risk Allocation Model for PPP Projects in china", Journal of Construction Engineering and Management 2010.136:894-903.

Ye, S., Tiong, R. L. K. (2000), "NPV-at-Risk Method in Infrastructure Project Investment Evaluation", Journal of Construction Engineering and Management, 126(3), pp. 227-233.