IJCRT.ORG ISSN : 2320-2882

INTERNATIONAL JOURNAL OF CREATIVE RESEARCH THOUGHTS (IJCRT)

An International Open Access, Peer-reviewed, Refereed Journal

Incorporating Flexibility In Real Estate Financial Feasibility Analysis

[1]Ashima, [2]Dr.Abhijit Rastogi, [3]Maj. Gen. TS Sidana (Retd.)

[1]PG Student, [2]Assistant Professor, [3]Visiting Professor
[1]Building Engineering and Management,
[1]School of Planning and Architecture, Delhi, India

Abstract: Real estate project analysis has numerous challenges. Since each type of real estate has unique characteristics, an assessment must be carefully adapted to each case. The choices that management has are actually one of a project's most valuable assets. The aim of this research is to incorporate flexibility into financial feasibility analysis using ROA by first critically assessing the various financial feasibility analysis approaches and identifying inherent flaws in traditional DCF analysis, one that only produces a static single point estimate. Subsequently, analyses using more dynamic methods that try to fill in the gaps in DCF approach provide rationale for selecting Real options. Through ROA, the flexibility can be given an objective value, which clarifies why such options should be pursued. The binomial tree is used to do the analysis. The results lend credence to the idea that utilising more dynamic analysis techniques that take into account the uncertainty of sales price and construction expenses in the real estate sector results in more precise forecasts of future profitability.

.

Keywords **- Real estate, financial assessment, Real option analysis**

I. INTRODUCTION

Several distinctive features of real estate development projects in developing nations include high working capital requirements, low liquidity, slow capital returns, investments that cannot be repaid quickly, lengthy construction times, challenges and obstacles from local government regulations, as well as various uncertainties, making real estate investment highly risky. The demand, house selling price, land acquisition cost, unsold inventory, government regulation, and risk of local government (i.e. approval, building permits) are additional real estate development variables that can all raise investor risk. Choosing the appropriate investment valuation method is therefore extremely important.

Discounted Cash Flow (DCF), Net Present Value (NPV) and Internal Rate of Return (IRR) – have been widely accepted tools for any investment analysis. Yet, a number of anecdotal evidences suggest that real estate developers find these tools insufficient for the analyses of their development projects (Jihun Kang,2004). Unfortunately, the DCF technique is inadequate since it will result in inaccurate value computation for investment projects with significant levels of uncertainty. The discount rate reflects the level of risk in a project, but this method oversimplifies risk by relying on single discount rate when there are multiple sources of uncertainty (Keith Chin-Kee Leung, 2007) Due to future uncertainty, this method is also capable of capturing the opportunity value. Additionally, the DCF method lacks decision-making flexibility, which is advantageous given project unpredictability

Since options are applied in practice but those are highly intuitive in nature based on the investors expertise, therefore this research is a step towards filling this gap and establishing need of more quantitative framework which will eliminate the shortcoming of qualitative options to real estate investment. The aim of the paper is to incorporating flexibility in real estate financial assessment through Real Options Analysis

II. NEED OF STUDY

Incorporating uncertainty into real estate pro formas alters the approach taken to real estate valuation issues as well as yielding different conclusions than deterministic models. The emphasis switches from merely optimizing financial returns to modelling and managing uncertainty to improve prior financial and design decisions when uncertainty is taken into consideration. In probabilistic financial modeling, the ability to include optionality can increase returns by minimizing losses during instability and maximizing gains during upswings. A lack of managerial flexibility in decision-making due to future uncertainty is a drawback shared by all of the traditional methodologies described, except the Real Option Analysis. Therefore it is very important to incorporate the flexibility in the evaluation process.

III. AIM OF THE STUDY

The aim of the study is to incorporate flexibility in real estate financial feasibility analysis

IV. OBJECTIVE

1. To critically analyze existing techniques of financial feasibility analysis in real estate industry
2. To identify methodology of incorporating flexibility in financial assessment through Real options analysis
3. To illustrate and validate application of real options through case study

V. RESEARCH METHODOLOGY

Step 1: critically analyzing the available financial feasibility analysis techniques and identifying both static and dynamic tools applied for financial assessment in real estate
Step 2: Justify the advantage of real options over other dynamic assessment tools and understand methodology of incorporating uncertainties in DCF through ROA
Step 3: methodology of incorporating uncertainties through application of ROA
Step 4: Application on case study and comparison of results of ROA and DCF analysis

VI. LITERATURE REVIEW

For Long time Indian real estate sector was highly unorganized and lack transparency leading to dissatisfaction among the buyers. Recent policy reforms like demonetization followed by implementation of RERA and GST have had a seminal effect on the way business is conducted with far-reaching ramifications of consolidation (Cushman & Wakefield,2019).While these policy reforms are largely in the goodwill of consumers but it had downside effect on the real estate industry leads to the major financial setback to developers. Drastic fall in the demand due to break in the back money flow registration of projects under RERA has requirements like mandate of operating project finance under escrow account has limited the flow of sales income to other projects.

6.1 Existing Financial Feasibility Tools

Static Tools: These can be categorized into two broad categories methods that didn't account for time value i.e Payback period (PBP), Profitability index (PI), accounting rate of return (ARR), ROI of money and others that considers TVM i.e Net present value (NPV)& Internal Rate of Return (IRR).In Discounted cash flow only risk adjusted discount rate takes risks into the estimate, here investors are more considerate to downside side effect of uncertainties than upside, however both are possible. it ignores the effect of options or possible changes which may occur to the real estate over the life of the investment as owners and managers have flexibility to respond to changes in the economy by making decisions that affect future cash flows (Chin, Leung,2007).
Dynamic tools: Alternative or risk adjusted a financial feasibility method which tries to overcome the limitations of conventional single point estimates having conservative approach to estimating the profitability of the investment. The Alternative techniques take into account opportunities not just the losses on encountering with uncertainty, some of the common methods that are Decision tree analysis (DTA), Sensitivity analysis, Scenario analysis and ROA. The main advantages of Real Options over all the above discussed methods, however, are that they integrate procedures designed for the valuation of financial options, making them a far more reliable valuation instrument. By adopting the arbitrage free procedure and the risk neutral probability, Real Options, as opposed to DTA Real Options, can avoid guessing an appropriate discount rate for each future outcome. Real options are mostly useful for two objectives in practise: valuing flexibility as a complement to the traditional NPV approach and developing proactive plans to seize additional values, market shares, revenues, etc.

6.2 Real Option Analysis (ROA)

ROA is an excellent way of incorporating uncertainty and flexibility into the investment decisions According to (Copeland ,2001) a real option is "the right, but not the obligation, to take an action (e.g., deferring, expanding, contracting, or abandoning) at a predetermined cost called the exercise price, for a predetermined period of time – the life of the option.".
The idea behind it is that we have flexibility that enables us to act appropriately and uncertainty regarding the results of projects. For instance, if markets experience a downturn while the project is still in development (uncertainty), we are still able to limit our losses by, for example, abandoning the project (flexibility).One of the attractive feature of real option is that it can be used as extension of conventional NPV method.

$$NPV = PV\ Benefits - PV\ Costs$$
$$Options\ Value = Benefits\ of\ Options - Cost\ of\ Acquiring\ Options$$
$$expanded\ NPV = NPV + Options\ Value$$

ROA gives the opportunity to value the project with or without option, project with no option has simply zero value signifying the value of option increases with increase in uncertainty and flexibility. Only when there is both uncertainty and flexibility there is option value and the higher the uncertainty, the higher this option value becomes (Johannes Peter,2012).
To apply ROA first uncertainty is to be known then how it can be made flexible is to thought of, followed by comparition of case with flexibility and without one if result is positive we have found our case.

6.3 Key variables to analyize Real Options

6.3.1 The value of the underlying asset: it is fluctuating value in the market (which involves risk). The increase in the value of the underlying asset is positively correlated with the value of the call option, while in the put option the effect is the reverse. This stems from the nature of both types of options and clearly indicates that the correct identification of the type of option is crucial in any analysis. The most significant aspect to be highlighted is that, in the case of real estate assets, as well as in a significant number of projects or real assets, the manager can modify the value of the underlying asset (Ramón Sánchez Vila,2019).

6.3.2 The volatility of the value of the underlying asset: Higher uncertainty increases the value of the risk therefore it is critical factor to determine the value of the option, By placing options like features in a project, investors can put a limit

on downside yet fully exploit the potential upside. For highly risky projects, options strategy can dramatically improve their values (Jihun Kang,2004)

6.3.3 **Exercise price or strike price**: In Real Options, the strike price is equivalent to the present value of all the fixed costs expected over the lifetime of the investment opportunity.

6.3.4 **The duration of the option or time to expiration**: Whether it is a purchase or a sale, the value of an option increases with the length of the time before it expires since there is a greater likelihood that it will eventually be converted into value (in money). In Real Options, managers can extend the opportunity's duration using strategies such as acquiring renewable licensing (Jihun Kang,2004).

6.3.5 **Risk-free interest rate**: An option has a connection to the cost of money, just like any asset with implicit risk. A higher risk-free interest rate makes money more expensive overall, increasing the value of a call option while decreasing the value of a put option (whoever must buy has to pay the money at a more expensive rate). Over the course of the option's life, this interest rate will be assessed using an average estimate.

6.4 Methodology of Real Options Analysis

6.4.1 **Computing the cost of the asset in every stage:** In order to know the cost of the asset in each of the possible subsequent states , we must add the transformation costs of all types and the capital cost of investing the total amount of the investment until the building is transformed. This includes all the construction cost, management fees and stamps, Insurances, Procedures and charges and cost of capital

6.4.2 **Analysis of Timing:** This stages is essentially to determine the time duration of exercise any particular option The longer the term before an option expires, the higher the value of the option, whether it is a purchase or a sale (call or put), since the probability that it will eventually be put into value (in money) is higher. This is valid for any option, whether it is European (with a fixed exercise date) or American (with the flexibility to choose the exercise date). It is true that this has a different influence depending on the type of option, although the sign of the relationship is the same in both cases.).

6.4.3 **Identification of each variable**: To calculate the exercise price of the option (K), this is the cost at the time of exercising the option, it will be the sum of the cost of acquisition plus the transformation cost plus financial cost and Determination of risk free discount rate,

6.4.4 **Determination of the standard deviation**: the importance of the correct determination of the annual standard deviation that the costs can suffer (also the price). Part of the cost of each of the transformed assets will vary with the rental market prices of the area, let us call that year-on-year variation Part of the cost will vary with the variation of construction/promotion costs Finally part of the costs are due to the cost of capital in an investment of this level of risk The intention should be to make a conservative estimate of such data. Recall that higher volatilities increase the value of the option

6.4.5 **Pricing the different options**: Obtaining the values of the options with various method like Black and Scholes formula, Binomial options method, decision tree etc. Higher is the value of any option more preferable it is.For the purpose of the study Binomial Tree analysis is used.

ROA can be applied in three ways: Binomial Approach, Closed form Approach, Monte-Carlo simulation, among these three Binomial approach is used due to its graphical representation and simple to interpret the options values

VII. Case Study

Baani Center Point is located near NH-8. A food court and restaurants are located on the lower floors of the retail arcade at Baani Center Point, while the multiplex is located on the upper levels. On the main highway between Gurugram and Manesar, this mixed-use commercial development will serve as a destination for food, entertainment, and shopping. This contemporary modern structure, which is constructed of concrete, stone, steel, and glass, is situated on the 150 M wide NH8 lifeline. It is being developed by Green Height Projects pvt. Ltd.

Table 7.1: Project Description

Project Name	Baani Center Point
Developers	Green Height Projects pvt. Ltd.
Project Address	NH8, Sector M1D, Manesar, Gurugram, Haryana
Project Typology	retail commercial shops, Food Courts, Anchor Store, Entertainment Zone & Multiplex
Land Area	2.68 Acres
Permissible FAR	1.5

Table 7.2: Expenditure breakup of project

Cost of Land	18.29 Cr
Estimated Cost of construction	61.76 Cr
Estimated Cost of Infrastructure	2.75 Cr
Other Cost (EDC/Taxes & levies)	20.39 Cr
Total	103.2 Cr
Cost of Land	18.29 Cr

7.1 DCF Analysis

Step 1: First step involved is performing the basic DCF analysis with having conservative input variables. All the information gathered from the Haryana RERA website and initial assumptions were made from reports and data available in literature in order to perform DCF analysis, at the end come up with NPV and IRR of the project

Table 7.3 Intial assumption for analysis

S.No	Description	Value	Unit
1	Cost of construction	1860	Per Sqft
2	Inflation rate	4.4%	Y-o-Y
3	Risk free interest rate	4.84%	Per annum
4	Interest rate on Debt (Commercial land acquisition)	18%	Per annum
5	Interest rate on Debt (Construction Phase)	12%	Per annum

Table 7.4 Weightage average cost of capital

S.No	Description	Value
1	Equity Value-40%	7.32
2	Cost of Equity	9.50%
3	Debt Value-60%	10.97
4	Cost of Debt	18%
5	Current Tax rate	0.30
6	WACC(1)	11.36%
7	Equity Value-30%	18.53
8	Cost of Equity	9.50%
9	Debt Value-70%	43.23
10	Cost of Debt	12%
11	Current Tax rate	0.3
12	WACC(2)	8.73%
Average WACC		**10.05%**

Figure 7.1 DCF analysis without applying options (All figures in crores)

Source of Fund	2015-16	2016-17	2017-18	2018-19	2019-20	2020-21
Y-O-Y Sales	0%	10%	15%	20%	25%	30%
sales sqft		21,764	32,646	43,528	54,409	65,291
market rate INR/sft		10187	10,511	10,853	11,313	11,126
Revenue	-	22.17	34.31	47.24	61.55	72.64
others	-	-	-	-	-	-
Total Revenues	-	**22.17**	**34.31**	**47.24**	**61.55**	**72.64**
Expenditure						
Land cost	18.29	-	-	-	-	-
CONSTRUCTION PROGRESS		10%	20%	30%	40%	-
Construction cost		6.18	12.35	18.53	24.70	-
Development cost	2.75	-	-	-	-	-
EDC/TAXES ETC.	20.39	-	-	-	-	-
Estimated cost of project	**41.43**	**6.28**	**12.55**	**18.83**	**25.10**	-
Gross margin	**(41.43)**	**15.89**	**21.76**	**28.41**	**36.45**	**72.64**
Operating expenses	-	-	-	-	-	
EBITDA	**(41.43)**	**15.89**	**21.76**	**28.41**	**36.45**	**72.64**
D&A	-	-	-	-	-	
EBIT	**(41.43)**	**15.89**	**21.76**	**28.41**	**36.45**	**72.64**
Interest expense-land			1.97	1.59	1.15	0.62
Interest expense-construction			5.18	4.10	2.88	1.52
EBT	**(41.43)**	**15.89**	**14.61**	**22.72**	**32.42**	**70.50**
Tax rates	-		0.30	0.30	0.30	0.30
taxes	-		4.38	4.38	6.82	9.73
NOPAT	**(41.43)**	**15.89**	**10.23**	**18.34**	**25.60**	**60.78**
Free cash flow	**(41.43)**	**15.89**	**10.23**	**18.34**	**25.60**	**60.78**
cummulative FCF	(41.43)	(25.54)	(15.31)	3.03	28.63	89.41

As result of the DCF analysis the NPV=₹ 40.77Cr IRR is 38% and payback period is more tha 2 years

7.2 Determine uncertainties

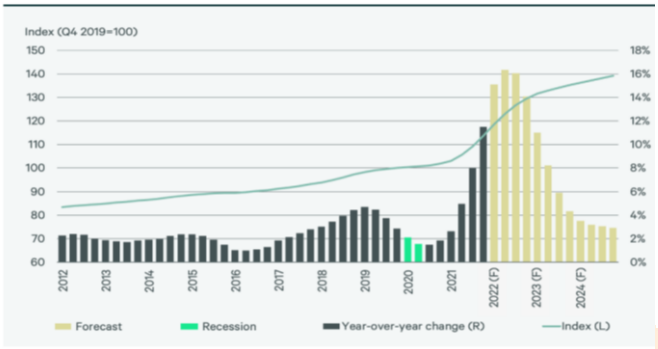
Step 2: input variables like revenues and expenses are estimated which will an impact onto the NPV and IRR. For the purpose of case study Sales prices per unit area is assessed from the market as well as construction cost inflation is too studied

Table 7.5 neighboring retail project sales prices in Rs/sqft

Year	upper limit	most likely	lowest value
2015	13,542	10,829	8,115
2016	12,727	10,187	7,647
2017	12,900	10,511	8,121
2018	13,286	10,853	8,420
2019	14,065	11,313	8,562
2020	13,907	11,126	8,344
2021	17,582	13,933	0,284

Second input variable is Construction cost and its early changes which will impact the cash flow negatively

Figure 7.2 Construction cost performance index source: CBRE Economic advisors



These input variables are later modeled into monte-carlo simulation with 10,000 iterations to determine the volatility of the input variables upon the NPV and estimate expected NPV

7.3 Input uncertainties into proforma

Step 2: Perform Monte carlo simulation with help of above range of input variable to have several sets of NPV generated

Table7.6 Dynamic DCF analysis with Monte carlo simulation

Source of Fund	2015-16	2016-17	2017-18	2018-19	2019-20	2020-21
Y-O-Y Sales	0%	10%	15%	20%	25%	30%
sales sqft		21764	32646	43528	54409	65291
INR/SQFT		8727	11696	10279	8767	13579
AREA*PRICE		19	38	45	48	89
others	-	-	-	-	-	-
Total Revenues	-	**18.99**	**38.18**	**44.74**	**47.70**	**88.66**
Expenditure						
Land cost	18.29	-	-	-	-	-
CONSTRUCTION PROGRESS		10%	20%	30%	40%	-
Construction cost-before cost index		6.18	12.35	18.53	24.70	-
Growth in construction cost		0.01	0.02	0.04	0.03	-
Construction cost-after cost index		6.23	12.58	19.28	25.54	-
Development cost	2.75	-	-	-	-	-
EDC/TAXES ETC.	20.39	-	-	-	-	-
Estimated cost of project	**41.43**	**6.23**	**12.58**	**19.28**	**25.54**	-
Gross margin	**(41.43)**	**12.77**	**25.60**	**25.46**	**22.16**	**88.66**
	-	-	-	-	-	
EBITDA	**(41.43)**	**12.77**	**25.60**	**25.46**	**22.16**	**88.66**
D&A	-	-	-	-	-	
EBIT	**(41.43)**	**12.77**	**25.60**	**25.46**	**22.16**	**88.66**
Interest expense-land			1.97	1.59	1.15	0.62
Interest expense-construction			5.18	4.10	2.88	1.52
EBT	**(41.43)**	**12.77**	**18.45**	**19.77**	**18.13**	**86.52**
Tax rates	-		0.30	0.30	0.30	0.30
taxes	-		3.83	5.53	5.93	5.44
NOPAT	**(41.43)**	**12.77**	**14.62**	**14.23**	**12.20**	**81.08**
	-	-	-	-	-	-
	-	-	-	-	-	-
Free cash flow	**(41.43)**	**12.77**	**14.62**	**14.23**	**12.20**	**81.08**
cummulative FCF	(41.43)	(28.66)	(14.05)	0.19	12.38	93.47

Table7.7 Result from Simulation

Expected Net Present Value (eNPV)	₹ 45.07Cr
Standard deviation STDEV	8.4 Cr
Max NPV	71 Cr
Min NPV	21.1 Cr
Volatility (eNPV/STDEV)	5.47%
No. of simulations	10,000

7.4 Step 4: Consider type of option

Now after performing static DCF analysis and the volatilities of the variables , investors has to decide the options to be considered depending upon the situation, Here since pandemic happened before the completion of the construction and environment turned out to be highly uncertain market sentiment is also not good which may have downward graph of demand of retail sector. Keeping in mind the above scenario either construction has to be deferred for max of 1 year until the uncertainty are clear or project has to be completely abandoned depending on the cost of options.

7.5 Step 5: Determine ROA input variables

The above discussed options are now to evaluated by first determine variables of analysis and prepare a binomial tree to get PV of option.

Table 7.8 Variables for ROA-Defering Option

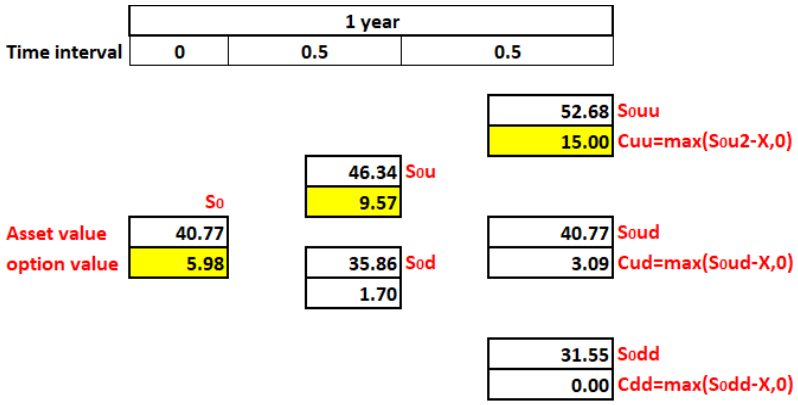
Variable	Value	Source
underlying asset price (S_0)	40.77 Cr	NPV from the base case
Risk free interest rate (r)	4.84%	10 year govt. bond interest rate
Volatility (σ)	5.47%	From table 4.10
cost of exercising the option (X)	37.88 Cr	Indirect cost of the project plus sales lost in the duration
duration of the option (T)	1 year	

7.6 Step 6: Determine variables for Binomial analysis

Table 7.9 Input for binomial analysis

Variable	Expression	Value
Up factor (u)	$u = e^{\sigma\sqrt{\delta t}}$	1.15
Down factor (d)	$e^{-\sigma\sqrt{\delta t}} = \frac{1}{u}$	0.87
risk-neutral up-side probability (q)	$\frac{e^{(r-y)\cdot\delta t} - d}{u - d}$	0.55
risk-neutral down-side probability (1-q)		0.45
Time interval (t)		0.5

Figure 7.3 Binomial tree analysis for Option to defer



The option value at each step is determined by equation

$$C_{uu} = Max\{e^{-r\delta t}[qC_{uuu} + (1-q)\cdot C_{uud}], S_{uu} - X, 0\}$$

The final value of payoff is calculated by discounted it back with equation: $\frac{qCuu+(1-q)Cud}{(1+rf)T}$

$$expanded\ NPV = NPV + Options\ Value$$

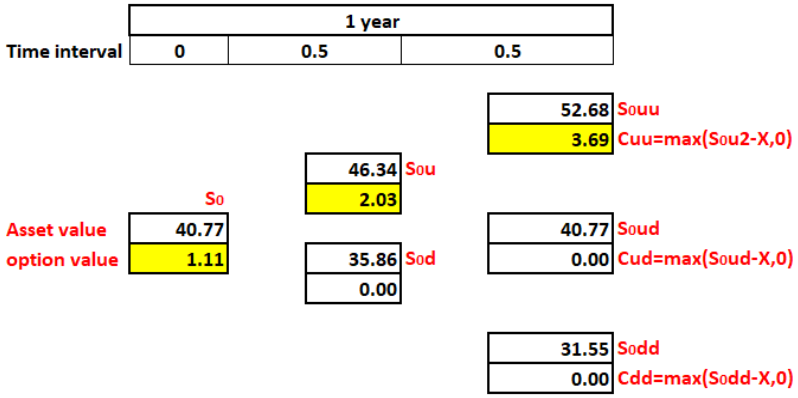
ENPV=40.77+5.98= **46.75 Cr**

Similarly repeat the steps with Option of abandon with set of variables

Table 7.10 Variables for ROA-Abandoning Option

Variable	Value	Source
underlying asset price (S_0)	40.77 Cr	NPV from the base case
Risk free interest rate (r)	4.84%	10 year govt. bond interest rate
Volatility (σ)	5.47%	From table 4.10
cost of exercising the option (X)	49 Cr	Cost overrun due to abandoning plus sales lost in the duration
duration of the option (T)	1 yr	

Figure 7.4 Binomial tree analysis for option to abandon



$$expanded\ NPV = NPV + Options\ Value$$

ENPV=40.77+1.11= **41.88 Cr**

Since value of Option to defer is greater than the abandoning option as well as asset value therefore differing construction for 1 year will be profitable under the given consideration. I practical also construction activity was deferred by the period of uncertainty is gone thus this ROA gives a rational decision making to back up the decisions made by the managers. Also the binomial tree gives great deal of flexibility to analysts to customize the payoffs.

VIII. Conclusion

Application of ROA on the real time case study has validated the results that the NPV from the DCF analysis was unable to depict the true picture when nationwide lockdown during first wave of Covid 2020 occurred, leaving the extremely poor market conditions. Application of Option analysis lead to evaluate deferring and abandoning options the results obtained from binomial approach indicates that the present value of deferring the construction by 1 year is 8.79 Cr which is significantly greater than the 2.63 Cr for abandoning both depending on the cost of exercising the option. Postponing option was in real exercised by the developer however that was merely based upon the gut feeling of the investor. Application of real option analysis would be helpful to give wider perspective and strong ground for taking profitable investment decisions nevertheless reliability of results options are very sensitive to the input data. More realistic and accurate being input variable greater is the accuracy of results, its dependence on the correct calculation of the volatility of the underlying asset and its complexity for the calculation (Ramón, 2019).

IX. Acknowledgment

I am thankful to Professor. Maj. Gen. TS Sidana (Retd.), Professor (Dr.) Virendra Kumar Paul and Professor (Dr.) Abhijit Rastogi for their valuable inputs and guidance during this study.

References

[1] Ramón Sánchez Vila (2019), Real Options Analysis in Real Estate Investments and Developments, A PhD Thesis

[2] Copeland, T. and P. Kennan (1998a). "How Much is Flexibility Worth?", *The McKinseyQuarterly*, no. 2, pp. 39-49

[3] Keith Chin-Kee Leung (2014),Masters thesis at MIT University, Beyond DCF Analysis in Real Estate Financial Modeling: Probabilistic Evaluation of Real Estate Ventures

[4] Jihun Kang (2004), Valuing Flexibilities in Large-Scale Real Estate Development Projects, Master thesis at MIT University

[5] Paul, V. K., Solanki, S., & Dasgupta, R. (2021). Post Pandemic Impact on Planning Of District Hospitals in India. *International Journal of the Built Environment and Asset Management*, *2*(1), 1. https://doi.org/10.1504/IJBEAM.2021.10043515

[6] Kapoor, E., Solanki, S.K & Paul, V. K. (2022). *Cost benefit analysis for rehabilitation of buildings: case of Indian Medical Association, New Delhi*. *International Journal of Structural Engineering, 10.1504/IJSTRUCTE.2021.10043508.*

[7] Sushil Kumar Solanki; VK Paul; Comparison between service life prediction methods for building rehabilitation: application on a case study; *Journal of Building Pathology and Rehabilitation (2022) 7:51* https://doi.org/10.1007/s41024-022-00194-x

[8] Moza, Amit., Paul, V. K., & Solanki, S.,(2022). Methodology for Establishing a Model for Assessing Performance of Public Projects in India. *International Journal of the Built Environment and Asset Management*, Inderscience publisher.

[9] Rastogi, Risabh., Paul, V. K., & Solanki, S.,(2022). Analyzing the Impact of Challenges in Prefabricated Building Construction Supply Chains. *Journal of Engineering Research and Sciences*, JENRS;DOI: https://dx.doi.org/10.55708/js0105008

[10] Amit Moza, Virendra Kumar Paul, Sushil Kumar Solanki, *Evaluating Project Complexity in Construction Sector in India; Journal of Engineering Research and Sciences, 1(5): 198-212, 2022;* DOI: https://dx.doi.org/10.55708/js0105021.

[11] Nidhi Gupta, Sushil Kumar Solanki, Manoj Mittal; Effectiveness of Amendment of GCC on Claims by CPWD in 2019; *International Journal for Research in Applied Science & Engineering Technology (IJRASET) volume issue on pages 3130-3146; doi.org/10.22214/ijraset.2022.41946*

[12] Rahul Kumar Gupta, V. K Paul, Sushil Kumar Solanki; Optimization Of Project Progress Using 3d Laser Scanning Technique; International Journal Of Architecture And Infrastructure Planning; Volume 8, Issue 1, 2022 DOI (Journal): 10.37628/IJAIP

[13] SK Solanki, R Rastogi, VK Paul; Cost Analysis of Functional Retrofitting Measures in Buildings *Journal of The Institution of Engineers (India): Series A (2022, 103 (3), 725-732*

[14] Rastogi, R., Paul, V. K., & Solanki, S. (2022). Analyzing the Impact of Challenges in Prefabricated Building Construction Supply Chains. *Journal of Engineering Research and Sciences, JENRS*.

[15] Singh, V., Paul, V. K., & Solanki, S. K. (2022). Feasibility Study of Adaptive Reuse of Old Buildings. *International Journal of Housing and Human Settlement Planning*, *8*(1), 10-31p.