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Research Article

Residential Property Development Feasibility Study – A Self-Fulfilling Prophecy?

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Introduction

Property development business is considered one of the most risky corporate activities due to its cyclicality and volatility [1,2]. It involves numerous risk factors [3-5] such as such as macro-economic, social, urban-planning, political-legal, regulatory, environmental, and technological framework conditions [6,7]. Yet property developers are either "knowingly taking risks" [8] or making decisions without sufficiently understanding and analyzing risks [9], resulting in committing to projects based on arbitrary or speculative decisions, and ultimately causing project failures and financial losses [10]. This short article reviews the three mainstream feasibility study methods and finds that the feasibility study adopted by the industry may require some further development. Especially, when the site value is determined by the residual value method, in-depth analysis is required to assess and capture the risk level associated with the future planning, construction, sales, and other key activities. An enhanced model is being developed based on artificial neural network method and empirical evidence to help developers better assess the project feasibility and site value at the time of the acquisition.

Current Feasibility Study Method and Risk Assessment

Feasibility study is defined by Graaskamp [11] a process that 'groups a variety of predevelopment studies by generalists and specialists in a systematic philosophy of inquiry to determine facts that are reliable, assumptions about the future that are consistent with past experience and tactics which will minimize the variance between objectives and realizations [12]. The objective of the study is to verify whether 'there is a reasonable likelihood of satisfying explicit objectives when a selected course of action is tested for fit to a context of specific constraints and limited resources' [12]. Different feasibility study methods and techniques have been developed over the years, which will be reviewed in the following sections. It is firstly worth noting the difference between the term project appraisal and feasibility study. These are the two steps a developer will undertake when being presented a property development opportunity. The term 'appraisal' usually refers to a preliminary and wider review and consideration of social, economic, political, legal, physical, environmental, and financial aspects relating to the site in question [13]. This exercise is to exclude sites that are either unsuitable or too risky for development. This is an efficient step to avoid the company wasting further time and energy on unsuitable sites or opportunities however does not produce a site valuation or projected profit. The second step of the exercise, assuming that this site is not rejected by the 'appraisal' exercise, requires 'a greater sense of precision and implies a calculation conducted for a particular purpose with a resultant figure based upon fixed and predetermined assumptions' [13]. Being referred to as viability or feasibility study, this exercise, generates a single or a range of values attaching to a single site, depending on upon the variability of the variables driving the project's cash flow. Each developer may differ on its preliminary appraisal principle based on its own business principles or strategies. This paper therefore focuses on the feasibility study, to (1) forecast the project's profit (or less) in

a single value or a range of value; and (2) assess the uncertainties and risks associated with forecasted outcome, (3) at the time of site acquisition subject to unknowns and assumptions [14].

Three mainstream feasibility methods, comparable method, residual valuation and DCF (discounted cash flow) method are compared by Ratcliffe [13]. Residual valuation method involves 'the calculation of what can be achieved for a development once completed and let, less what it costs to create' [13]. Specifically, the residual method 'is to ascertain the capital of an estimated future income (sale price of the completed development), and then to deduct from that the cost of all works needed to complete the development to a standard able to command such a future income'. This calculation is formulated as Forlee [15], French & Gabrielli [16], Atherton, French & Gabrielli as: (Table 1)

Table 1

Residual to Land Value (1)
GDV (Value of the completed development) - Total Cost (All construction costs. Interest on construction, professional fees and developer's profit) = Gross Residual (Maximum bid for site includes acquisition costs, professional fee and finance of land purchase)
Residual to Profit (2)
GDV (Value of the completed development)- Total Cost (All construction costs. Interest on construction, professional fees and developer's profit) = Developer's Profit

According to Atherton et al [17], the residual value can either represent the developer's maximum bid for the site as demonstrated in formula (1) or if the land cost has been included in the costs, the expected developer's profit upon completion as presented in formula (2). The application of the residual valuation method has received some doubt and criticism due to manipulability and lack of objectivity. As stated by the Lands Tribunal in First Garden City Ltd v Letchworth Garden City Corporation 200 EG 123 [13] 'once valuers are let loose upon residual valuations, however honest and reasonable their arguments, they can prove almost anything'. Arguably, the outcome of the residual valuation calculation may result in vastly different figure by manipulation of the input values. For instance, in order to secure full funding for clients from banks, some 'negligent, unnerved and occasionally nefarious valuers' can life the site value by 150 per cent by adopting a bullish view of future project revenue, a bearish attitude towards costs and a dismissive approach regarding potential planning problems [13]. Two alternative methods are proposed to address the shortcoming of the residual valuation method, by direct comparable evidence and by discounted cash flow analysis [13]. Comparable method [16] is to evaluate a development site by adopting figures transacted in the marketplace for similar and identical sites. The comparable method assesses 'what is now or has recently been available in the marketplace, make comparisons between them'. This method 'sounds simple and straightforward, there may be many pitfalls to trap the unwary'. A true comparable site or transaction rarely exists, as each site is mostly unique in its location, size, pre-existing condition; each transaction is a reflection of parties of 'personal predilections, tax liabilities and non-property interests' [13,14]; and the timing of the transaction has a significant bearing of the market's perception. Furthermore, as noted by Baun & Mackmin [18], 'a full knowledge of all aspects of each transaction rarely exists in the market for development site. Therefore 'unfortunately, in the real-world actual market evidence is often evidence for is absence.

In addition, as most of the transactions completed might have adopted a residual approach for site valuation in the first place, 'it is surely more credible to construct an explicit and specially prepared residual for the property in question than to rely on the end results other unknown computations. Markets are notoriously aberrant in both space and time [13]. An alternative proposed method to the residual valuation method is the DCF method. The DCF model 'permits a more conscious and sensitive allowance for the effects of time' [13] by spreading "the flow of project expenditure and revenue over the period of development" [9] and discounting back all cash flows to a common point in time to "facilitate an even comparison or analysis" [9]. The application of the DCF method is also subject to wide criticism relating to selection of the discount rate [14]. Riggs contends that 'the discount rate appears to receive inadequate consideration in the real world when irrational behaviour seems to dominate. For some professionals a discount rate analysis is more a gut distinct than a systematic analysis. This is concurred by Gimpelevich [14] stating that the selection of discount rates can be 'sufficiently arbitrary to make results of DCF analysis to be essentially meaningless.

Furthermore, as the DCF method adopting the same formula in determining the project profit and land cost, it is also subject to the same weakness as the residual valuation, that is its accuracy relies heavily on the information and judgment behind every stage and every cash flow component. In essence, DCF model is another form of residual valuation and therefore the former should be not considered a superior method than the latter. In summary, despite the criticism and doubts casted upon the residual valuation method, the method per se is a 'perfectly proper and reliable valuation technique', as long as the technique is 'properly conducted and well researched' Ratcliffe [13]. This article finds the residual valuation method is a sound method, however its application requires further development.

Feasibility Analysis Techniques

Single point analysis

The previous section finds the residual valuation method as a reliable feasibility study method. There is no dispute as to the basic factors that should be considered – GDV, total cost, profit, land cost, and so on. However, the way in which the residual value should calculated is subject to ongoing development. Prior to the application of computer and software for probability simulation analysis, the residual valuation is simply carried out by using the best estimates relying on information available and professional judgment [13]. The calculation generally produces a single figure, which is considered the most likely outcome of the valuation. This single point method is criticized and rejected for failing to reflect the uncertainties of the project variables [16]. The traditional single point looks at all variables 'as a snapshot in time and can be used effectively as a "rough indicator" of a development's viability but is not sufficiently detailed to provide a detailed analysis of the scheme's sensitivity to changes in the input variables [17].

Effort is made to address the single point method's failure to gauge project uncertainties, for instance, the sensitivity and scenario analysis. The sensitivity analysis measures the impact on project's NPV or IRR by changing one or two variables of the project while holding all other variables constant. It measures the key variables to which the outcome of the appraisal is most sensitive and the impact to the project's outcome when single or multiple project variables fluctuate within the range of possibilities [3,9]. Developers may vary one or more factors in the evaluation or appraisal to observe the effect on viability measured and recorded [3,9]. For instance, the analysis may show that the outcome of the appraisal is most sensitive to changes in discount rate, gross realization and construction cost. A sensitivity table then can be compiled by comparing the project outcomes, when possible, events occur, such as what if building cost goes up by 5 per cent, 10 per cent or what if gross project revenue lowers by 2 per cent, 3 per cent or 5 per cent. Sensitivity analysis will produce a range of project possible outcomes, based on which the developer can weigh up the possible outcomes by assigning 'either objectively or subjectively some probability to risk factors that are considered significant [3,9]. An extension of sensitivity analysis is also developed to form a scenario, which consists of a set of variable values modelling a particular decision situation. Three combinations are often examined for this kind of analysis, a pessimistic situation, the most likely situation and an optimistic situation. Scenario analysis shows "the decision-maker that the effect of quite small changes in one particular sensitive variable can be dramatic" [2]. Although the sensitivity and scenario analysis are "intuitively acceptable, it suffers from several technical shortcomings" [2]. The assumptions made on the possible outcomes and combination of variables could be subjective and arbitrary which "could colour the decision maker's attitude to the outcomes" [2]. In addition, despite the range of possible project outcomes produced by sensitivity analysis could be used to gauge the project's tolerance level to possible risks and uncertainties, it offers little guidance to determine the most likely project outcome or return to which the site pricing is fixed.

Monte carlo simulation

With the advent of computers, software packages developed and applied for the purpose of risk analysis and assessment. Sophisticated probability analysis and simulations can be carried out by a computer in very little time and very little expense and are applied to test the robustness of the single point estimate and produce a range of possible outcomes [17]. Hertz proposed a 3-step computer-based simulation technique to measure the impact of assumptions and assess the risks involved in capital investment. The process involves estimating the range of values for each of the factors and assumptions, selecting at random from the distribution of values for each factor on a particular value, and repeating this process to define and evaluate the odds of the occurrence of each possible rate of return. Concurring with the finding of Kellier & Mahoney also identified the failure of the single point method to capture and assess project uncertainties and propose to apply Monte Carlo Simulation for risk analysis assessment, to better estimate the impact of uncertainty. 'A probabilistic model better analyze the interactions between uncertain inputs that are represented by a range of possible values, or by data that may not be normally distributed. The output can show the entire range of possible outcomes and the possibilities of achieving them'.

The simulation technique has been reviewed and developed by French, Gabrielli, Artherton and Loizou [16,17,19] for specific application for risk assessment and feasibility study for property development projects. Their techniques a probability-based valuation model using Crystal Ball to incorporate project uncertainty into the analysis and address the shortcomings of the single point model. Crystal Ball is 'a simulation model (using the Monte Carlo technique), that instead of taking into one defined set one defined set of input figures and producing a single point answer (value), carries out multiple calculation via an iterative re-sampling process. Each simulation chooses an input variable from within the probability distribution chosen for each variable and marries these with other randomly chosen inputs to produce a value. It then recalculates another value by the same process and records that value. This is then repeated, normally several thousand times, until the simulation is complete. The output is expressed as a range of possible values with the single point estimate being the mean of all the calculated values' [16]. Compared to Hert'z simulation model, the Crystal Ball model is a more advanced and mature model tailored for property development project appraisals. Firstly, it draws the distinction between uncertainty and variability, which are treated differently in the simulation process. 'Inputs can be uncertain due to insufficient information about a true but unknown value while some inputs are variable because they describe a population with

different values. Theoretically, uncertainty can be eliminated with sufficient data, whereas variability is inherent' [16].

This distinction is also referred to as the Type A uncertainty and Type B uncertainty by Hoffman and Hammonds, defined by the endpoint value of the variable. Type B uncertainty refers to variables with the end point fixed but unknown, usually due to lack of knowledge. Type A uncertainty refers to variables with an unknown distribution of value, generally due to stochastic variation. When Type A uncertainty arises, 'Monte Carlo calculations are performed in two dimensions producing numerous alternative representations of the true but unknown distribution'. Applying the two-dimensional simulation technique by the Crystal Ball model, it 'allows the appraisers to distinguish between the two concepts by running one randomization to simulate the uncertainty inputs, and then freezing the uncertainty values while running a second simulation (of the whole model) to simulate the variability' [16]. Crystal Ball model also attempted to address capture the correlation between the variables in the simulation analysis. Assumptions on the dependency of the factors could have a material impact to the analysis outcome [17] propose to address the interrelationship between the chosen variables by way of incorporating a correlation setting in the simulation process, as presented in Table [x] (Table VII page 175 of Atherton [17]). 'These correlations are obviously influenced by observed historic correlations of the same variables suitably adjusted to reflect the developer's view on how they might interrelate in the future' [17].

Fuzzy logic

Fuzzy method, as an alternative technique to Monte Carlo Simulation, is also examined and compared by Byrne [2], to deal with uncertainty in real estate analysis. Fuzzy logic was considered a new way of expressing uncertainty for qualitative judgments and dealing with vagueness in risk analysis [20]. "Unlike probabilistic method, Fuzzy Logic allows for representation mathematically, through a calculation system, judgments without exact and univocal definition… It assumes, therefore, that uncertainty presents possibilistic character rather than probabilistic, and that uncertainty could depend on the perception of eligibility for a certain event, rather than from its degree of statistical confidence." In the fuzzified world, each set of possible values for a risk variable forms a fuzzy set and its possibilistic value can be measured by way of membership. The value of membership is a measurement of 'degree of truth', which attempts to mimic the human brain function in answering questions with vagueness and ambiguity [21]. The membership of fuzzy objects can be any value between 0 and 1, measuring the possibility of each object being a member of this fuzzy set. Different to the conventional model, there are no probabilities in the fuzzy method. Any membership value between 0 to 1 can be applied to a possible value of the fuzzy set and sum of these membership scores need not to be 1.

The difference between the possibilistic value and probabilistic value, which is the key distinction between the fuzzy logic method and the Monte Carol simulation method, is succinctly illustrated by the bottle-water example by Abdo & Flaus [22]. When two bottles of 1 liter filled with unknown liquid, are both assigned with 0.9 for membership value and probability value to measure its drinkability. Despite the equal value of 0.9, the membership value and probability value represent completely different measurement. The Bottle A, with a membership value of 0.9, indicates that 90% of the liquid, i.e., 900ml of the liquid is drinkable or potable water, leaving the drinkability of the remaining 100ml unknown. The Bottle B, with a probability value of 0.9, represents that there is a 1 in 10 chances that bottle may contain undrinkable or toxic liquid. Conceptually, the membership value underpinning the fuzzy logic method may better reflect the way in which the uncertainties are evaluated and forecasted in property development projects. The property developers, relying on the information available at the time of the appraisal, is capable of identifying the 'best estimate' for the cash flow variables. This estimate is either subject to future market fluctuation (for instance, future sales price and total construction cost) or future discovery of information (for instance, ground conditions and design revision relating to building construction, and council feedback to the development approval application). This 'future change' mostly constitutes a variation to the 'best estimate' value adopted for the site appraisal. Similar to the bottle water example, the original 'best estimate' resembles to the concept of the drinkable water and the 'future change' resembles to the concept of the remaining unknown liquid. The concept of membership measures or signifies the level of certainties or uncertainties to this variable.

A direct comparison between the fuzzy logic method and the Monte Carlo Simulation process was conducted by Bryne [5], utilizing the Mollart's example [23]. The key difference lies in how the variable's uncertainties and variations are elicited and expressed. The MCS method uses a structured questioning of the expert. The expert identifies the extreme values of the variable and then assigned probabilities to as many intermediate values as make sense in the circumstances and state of knowledge that exist at the time when the analysis is made. For the fuzzy analysis, three values, the best estimate, lowest, highest, are identified for producing a triangular fuzzy number and a belief graph. The belief graph maps the membership score, or the belief values of the possible values. Bryne's [5] was not able to conclude which of the two methods is more superior, as they share a few similarities. 'Both certainly require that the decision maker, using whatever technical support is available, can:

1. determine the structure of the problem.
2. determine the variable types in the problem.
3. elicit values for all these variable types.

In the case of the state variables this will mean,

1. using the appropriate method (subjectivity probability assessment or construction of belief graphs), to then

2. construct a model of the problem, using either a conventional or fuzzy spreadsheet' [5].

Both the fuzzy logic method and MCS method are criticized for this subjective approach of assigning probability or possibility, and the transient nature of the measurement. It is argued that a probability or membership value, which is subjectively measured today, could open to different expert's individual opinion and could well be different tomorrow. This is defended by the protagonists of both MCS and fuzzy logic as 'it is precisely those changes in the performance of the uncertain variables in the model which they seek to be able to capture, albeit in different ways' [5]. Thus, subjectivity in the process of project's appraisal cannot be eliminated. Rather, subjectivity and expert's opinion in estimating project variables need to be embraced. This is also supported and explained by the application of decision theory to development project appraisal [17].

Discussion and Further Study

Having identified the nature, method, and technique of current site appraisal analysis process as a prescriptive analysis by applying residual value with Crystal Ball technique, this section will continue assessing and evaluating the adequacy of this practice by further analysis and industry interview. One fundamental weakness of the residual valuation method and Crystal Ball technique is identified and discussed in the following section. When undertaking the feasibility study, developers' decision and judgment on site value are based on the following three questions: 1) whether the project is likely to deliver a profit level that exceeds the required IRR, i.e. expected return [quote]; 2) whether the project return is sufficiently high to compensate the developers for the risk they are going to be exposed, i.e. the risks associated with realizing the expected return or the risk/return ratio [quote]; 3) whether this project offers a superior risk/return ratio than other opportunities in the market [quote]. When the developers are faced with multiple site acquisition opportunities, it is critical to choose the ones with optimum or superior risk return ratio. The outcome of the Crystal Ball technique, based on the residual valuation method, providing a forecast of project's outcome in a dynamic manner, only answer the first of the three questions. The other two remaining questions also need to be addressed, as they are as important and as significant to the first question. For instance, if the Crystal Ball analysis shows a expected return of 15% and 30% for two sites with the first site being the less risky project. It is still inconclusive as to which is the more superior site and therefore it offers little guidance to the developers to make the rational decision.

Similar theories of risk and return analysis developed in the asset valuation and investment decisions area should be adopted for the site acquisition decision based on the following perimeters: 1) the site price and value should be dictated by the risk level of the site when it is acquired; 2) the developer, when acquiring the site, intends to commence the development process straightaway. It will be a completely different analysis if the developer wishes to land bank the site. Timing of the development is a critical factor in this analysis and the longer the time elapses, the more difficult to capture the uncertainties in the feasibility study analysis. 3) the risk return ratio of development sites should be reflected, in an efficient and transparent market, in the market prices paid by rational buyers and this should be used as a benchmark to determine the market price of future sites. Therefore, further study of feasibility study can be undertaken to identify the market risk return ratio by collecting market information on land transaction price (and term), and the risk level of each project key variables and respective subset factors. This analysis, rather than providing an analysis outcome for the individual site as provided by the Crystal Ball technique, can provides a market insight of the site value based on its risk level at the time of site acquisition.

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Conflict of Interest

No conflict of interest.

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