November 2021

Cashflow decision support system for housing developers under uncertain buyer behavior

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Cashflow Decision support system for Housing Developers under Uncertain Buyer Behavior

BY

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(Masters of Architecture, 2005)

A thesis submitted to the School of Science and Engineering
in partial fulfillment of the requirements for the degree of

Master of Science in Engineering

With specialization in:

Construction Engineering

Under the supervision of

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June 2010

APPROVAL SHEET

The American University in Cairo

Thesis Title: Cashflow Decision support system for Housing Developers under Uncertain Buyer Behavior

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DEDICATION

I dedicate this research and the context of its realization to the Eternal Father of creation; My God who established my purpose and future before I was conceived in my mother's womb. Everything that I am is because of your divine enablement. I might not understand the paths which you have chosen to guide me through, but I am eternally grateful for where you have brought me to.

In your awesome wisdom you surrounded me with loving parents, that I may come to understand the concept of paternity, adoption, love, support, provision, understanding, chastising, guidance, and Godly orientation. You give me the privilege of sharing the pleasure of developing and growing within a connubially amalgamated family structure that has been a blessing all the way, through thick and thin I have not been left to weather it alone.

In order to ensure that I would not be alone in pursuit of my life's purpose, You gave me the flesh of my flesh and indeed the bone of my bones, my beloved wife, true friend and confidant. With this eternal bond, You gave me the privilege to understand the individuality of mans eternal relationship with You. To us you gave the privilege of lovingly bringing up the true treasure of Egypt; children who are a constant reminder of Your ability to do 'exceedingly abundantly far above what we can ask or imagine'.

Your love O Lord is indeed better than life. All that I am is by your grace and all that you have bestowed upon me pales away in the light of your eternal love and kindness.

STATEMENT

"Suppose one of you wants to build a house. What is the first thing you will do? Won't you sit down and figure out how much it will cost and if you have enough money to pay for it? Otherwise, you will start building the house, but not be able to finish. Then everyone who sees what is happening will laugh at you. They will say, you started building, but could not finish the job." Luke.

ACKNOWLEDGEMENT

My profound gratitude goes to the following individuals who have been of great help in the conducting of my graduate thesis. My thesis supervisor Dr. Ossama Hosny from whom I have learnt to persevere and persist in the face of research challenges. Dr. Ahmed El Hakeem (American University in Cairo), to whom I owe a debt of gratitude for his assistance in fine tuning the presentation of the research context of this thesis. Dr Khaled Nassar (American University in Cairo), who consistently had confidence in the idea and provided sound direction regarding the prospects of it applicability. Dr. Amr Hassanein (American University in Cairo), who assisted me in understanding the finance schemes used in the real estate sector.

I would also like to express my appreciation to the following individuals and their organizations for assisting me with the machinery, expertise and corporate umbrella from where I could gather information, validate the thinking process and develop the platform that culminated in the developed decision support tool.

Mr. Omoteruwa (Ex. M.D African Finance Corporation)

Dr. Orama (Executive Vice President African Import Export Bank)

Mr. Uzere (African Import Export Bank)

Mr. Godfrey Bageya (Accountant Ugandan Embassy)

Kelessigue Sekongo (Cost Controller Bel Fromagerie)

Mr. Akinmusere (C.E.O CityScape Nigeria)

Mr. Ese Okobia (C.F.O Upstream Finance CityScape Nigeria)

Arch. Henry Banye (Hierarchi Consultants LTD)

Engineer Ahmed El Hady (The American University in Cairo)

Engineer Ayman Thabit Saad (Saad Construction)

Engineer Moatez Omar (Cairo Festival City)

ABSTRACT

This Study presents a cashflow management system that considers the financial interactions between the Developer, Financier and the Buyer. This approach presents a platform for helping the developer determine the confidence level of making an expected profit by simulating the effect of including the possible inflows of cash from the buyer at the inception of the project. This consideration of the financial interplay between the Developer, Financier and the Buyer is a relatively new perspective to project delivery. A major factor to consider in this approach is the variability of buyer behavior. With the availability of different payment options and different payment times, it is impossible to predetermine that buyers will buy in a certain way or at a certain time.

The objective of this study is to develop a decision support system to help developers to determine the percentage with which to mark-up total delivery cost by considering the impact of buyer behavior on the project cashflow. The decision support system will assist the developer in understanding the effects of buyer behavior on the overall profitability of the project. Being able to model and investigate effect of this variation on the cashflow of the potential project will give an understanding of the variations that are inherent in possible range of expected profit (i.e. Interacted Profit)that can be derived from the project. The financial interactions are modeled in a spreadsheet environment and project cashflow data is sourced from industry recognized scheduling applications, a Monte Carlo based simulation tool is employed for simulating buyer behavior.

The level of uncertainty in human behavior makes the system impossible to humanly track, one is not certain as to which payment method the potential buyer will choose or what time he will be willing to engage the developer. As such, this research endeavor proposes a platform for considering and measuring the potential advantage of buyer participation under uncertainty. The approach is executed through employing a developed decision support tool called ARO-META. The proposed Buyer Interacted Cashflow System (ARO-META) imitates the processes of cashflow interaction through three main modules: 1) The Input Module, 2) The Process Module and 3) The Output module. Although the proposed framework consists of the aforementioned three modules, the set of analyses to support developer decisions is described in three analysis stages:

1. The Markup Percentage Analyzer; generates Markup analysis reports
2. Buyer Interacted Cashflow Analyzer; generates a report that outlines the expected confidence level of specified forecasts, and
3. The Marketing Analyzer; generates reports on Marketing approach for attaining selected outcomes.

   The expected outcomes of the decision support system are:

The Markup Analysis Report: is generated to examine the effects of Markup percentage variations on the Internal Rate of Return of the development using what-if analyses (stage 1). As this report will show the impact of a range of markup-percentages on many predefined parameters, decision makers will be able to select a comfortable markup. Once a satisfactory markup is determined, the decision maker

can proceed to the next stage of analysis in which the selected markup percentage represents the input for this stage.

The Buyer Interacted Cashflow Report: is generated to examine the effect of buyer interaction on project cashflow. This report is obtained by simulating a buyer behavior on a set of predefined forecasts (e.g., Interacted Profit). The report considers the nature of uncertainty of buyers and its impact on interacted profit for various confidence levels. Further sensitivity analysis of the effects of different payment methods on the performance of the system is carried out in this module. This will allow for correction of choice of payment options being offered by the developer. Once a satisfactory confidence level is attained, the decision maker can proceed to the final stage of analysis.

Marketing Analysis Report: is generated to track the system behavior (i.e. buyer behavior, etc) that generates specific predefined forecast outcomes. Such reports present the decision maker with a report that allows him to visualize a specified forecast output along with the confidence level that that range of outputs can be achieved. This analysis is then presented in the form of visual outputs that will facilitate decisions in order for the developer to formulate a favorable marketing strategy.

Two case studies are presented for the validation of the proposed model. The first case study presents an International project located in Nigeria at its inception while the second case study is an Egyptian development that is already in Completed. The developed framework is expected to help improve the confidence of potential developers in engaging in housing developments. Developing a project cashflow that includes cash inflows from the buyer, is however complex due to the variability of human behavior. This challenge has been innovatively handled in this research through three successive processes which are 1) Markup Analysis; 2) Simulating the Buyer Interacted Cashflow; and finally 3) Developing a Market Engagement Approach. This approach is practical and can be used as a decision support tool by non-technical decision makers

TABLE OF COTENT

LIST OF TABLES

LIST OF FIGURES

LIST OF SYMBOLS

$A_{(P)}$ = Annual Property Appreciation

$C_{(P)}$ = Total Preliminary Cost

$C_{(P)(B)}$ = Bank Bond/Advanced Performance Guarantee Costs

$C_{(P)(G)}$ = Governmental Costs

$C_{(P)(IL)}$ = Insurance and Legal Costs

$C_{(P)(L)}$ = Land Costs

$C_{(P)(P)}$ = Promotional/Marketing Costs

$E_{(10)}$ = Extra on 10 Year Payment Plan

$E_{(15)}$ = Extra on 15 Year Payment Plan

$E_{(25)}$ = Extra on 25 Year Payment Plan

$E_{(F)}$ = Extra on Full Payment (this is a zero percent value)

$E_{(L)}$ = Extra on Housing Loan Payment Plan

$F_{(C)}$ = Annual Commitment fee

$F_{(E)}$ = Equity Contribution

$F_{(I)}$ = Interest Rate (Fixed)

$F_{(M)}$ = Annual Management Fee

$F_{(O)}$ = Overdraft Facility

$F_{(T)}$ = Cost of Finance

$F_{(U)}$ = Utilization Fee

$F_{(X)}$ = Other Fees /One-off Charges

$H_{(T)}$ = Total Number of Housing Units

$H_{(T)(A)}$ = Total Area of Housing Units

$H_{(T)(T)}$ = Total Number of House Types (T) Available

$H_{(X)}$ = House Type

$H_{(X)(A)}$ = House Type Area

$M_{(0)}$ = Non-Subscription

$M_{(10)}$ = 10 Year Payment Plan

$M_{(15)}$ = 15 Year Payment Plan

$M_{(25)}$ = 25 Year Payment Plan

$M_{(F)}$ = Full Payment

$M_{(L)}$ = Housing Loan Payment Plan

$P_{(0)}$ = Probability of Non-Subscription

$P_{(10)}$ = Probability of 10 Year Payment Plan

$P_{(15)}$ = Probability of 15 Year Payment Plan

$P_{(25)}$ = Probability of 25 Year Payment Plan

$P_{(F)}$ = Probability of Full Payment

$P_{(L)}$ = Probability of Housing Loan Payment Plan

t = Annual time steps

$Z_{(A)}$ = Expected Profit

$Z_{(A)(I)}$ = Interacted Profit

$Z_{(M)}$ = Markup Percentage

CHAPTER 1: INTRODUCTION

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1. General Background of the Study

The annual need for housing in urban areas of developing countries alone is estimated at around 35 million units, most of which are needed to meet the needs of the increasing number of households. The rest is needed to meet the requirements of people who are homeless or living in inadequate housing. Summarily, some 95,000 new housing units are required each day in developing countries in order to alleviate the housing conditions [1]. After World War 2, Public housing in the urban areas of developed countries was government marshaled with the massive provision of infrastructure and finance. But as development progressed, the private sector became more dominant providers of large scale middle income housing which relied on the state provided infrastructure and subsidies.

In contrast, in developing countries, available land for development often lacks state provided infrastructure or concessions thus negatively impacting housing delivery in terms of cost, quality and delivery time. Finance is also developer sought, however, the capital and time intensive nature of construction projects is often a burden that local banks are unable to bear without international finance syndication.

Invariably Bank charges and interest rates are raised to cover potential risks that ensue from inflation and unstable currencies. This raises the overall cost of provided finance and implicatively, the overall cost of the development. As such, projects that starts up as low or middle income housing eventually becomes high income developments, thus, resulting in the abandonment of projects pre-completion or even the abandonment of completed units for lack of affordability. These potential risks are a strong deterrent to private investor’s willingness to engage in large scale housing projects.

1.1 Problem Statement

Financing housing projects with the scale required to meet this housing deficit involves a careful balance between cost of delivery, available finance and the final delivery cost to the buyer all of which are time bound. Although this is traditionally a cashflow management and optimization problem, the buyer is not traditionally factored in as a cash inflow contributor. Instead, the buyer is the end of pipe recipient of the accumulated finance consequences of project delivery. This research endeavor is aimed at investigating the cashflow potential of considering the buyer as a project delivery proponent (Figure 1-1).

This consideration of the financial interplay between the Developer, Financier and the Buyer is a relatively new perspective to project delivery. A major factor to consider in this approach is the variability of buyer behavior. With the availability of different payment options and different payment times, it is impossible to predetermine that buyers will buy in a certain way or at a certain time. As such being able to model and investigate effect of this variation on the cashflow of the potential project will give an understanding of the variations that are inherent in possible range of expected profit that can be derived from the project.

Figure 1-1: Proposed Project Proponents

Typically, the Total Delivery Price to the buyer is a function of the Total Cost of Delivery plus the Expected Profit. However, the Total Cost is the sum of the Direct Costs of Delivery, Indirect Cost of Delivery (overhead costs, marketing costs, administration cost, etc.) and the Cost of Finance (Figure 1-2). The potential for increased profit lies in the possibilities of cash inflow from the buyer. While the Direct Cost of Delivery remains the same, there is a potential for saving on the required external finance and thus Cost of Finance for the project. As such there lies a potential increase in the expected profit from the project.

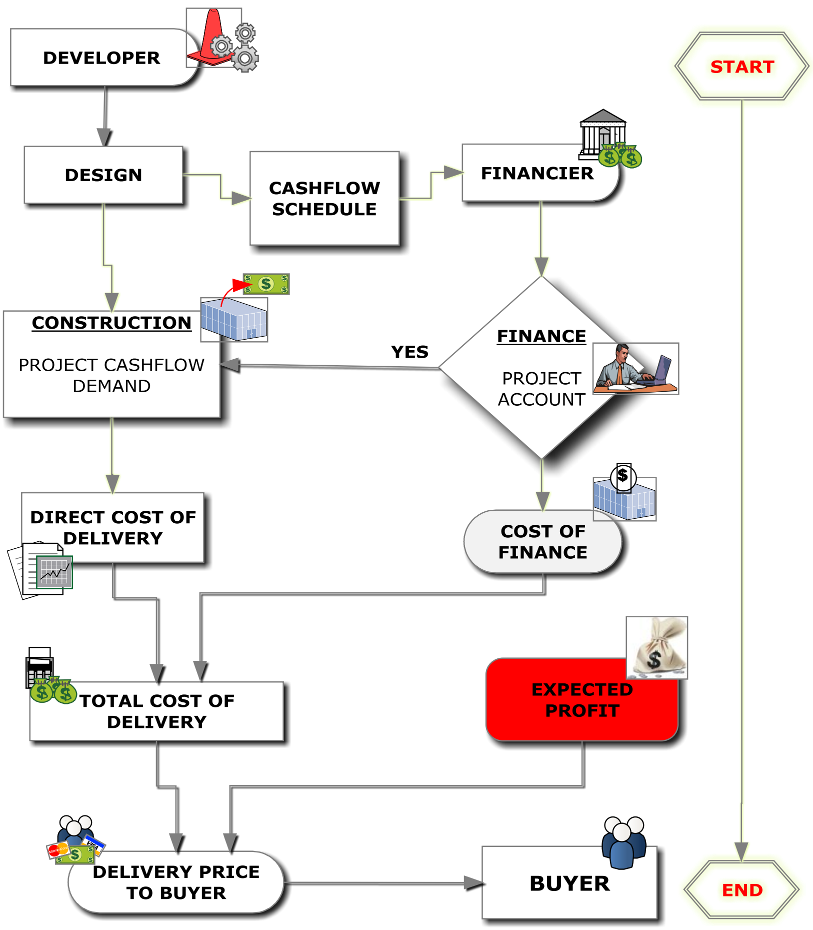

Figure 1-2: Project Delivery Cost Accumulation

It is important to mention that, much research has been carried out to explore alternatives to managing and optimizing project finance in a bid to enhance profit for construction projects. Researchers have explored various approaches to resource management which includes: resource allocation, resource leveling, cashflow management, and time-cost trade-off amongst others. However, traditional resource management and optimization approach becomes inapplicable when considering the randomness and unpredictability of buyer behavior.

Since the developer is not sure of the nature and time of buyer commitment, it becomes more appropriate to explore by simulation, the effects of variations in behavior and how they can inherently affect the projects finances. Simulation presents itself as a more appropriate research direction that captures the nature of the research problem. The curious cue is a contemplation of, how the potential buyer can financially improve the cashflow of the project within the socio economic context of his capacity to be a part of the housing delivery process from its inception.

1.2 Study Objective

This study presents a decision support system to help developers to ascertain the confidence level of attaining a preferred Minimum Attractive Rate of Return (MARR). This is done by presenting the effect of a range of Markup percentages on the Internal Rate of Return (IRR) after considering the possible impacts of buyer behavior on the project cashflow. The developed support system also presents a platform to assist the developer in understanding the effects of buyer behavior on the overall cash flow of the project. A further advantage of this stochastic approach is the ability to deduce the confidence level of the range within which forecasts such as Profit, total Cost of Delivery, etc. will vary at a certain Markup Percentage. Since the variability in buyer behavior and invariably cash inflow from buyers will ultimately affect cashflow and invariably the profit of a project, the decision support system captures and presents the effect of the simulated buyer behavior on the overall project profit. As such the developer is able to determine the confidence level of profit lying within a range.

Finally, sensitivity analysis can be conducted to investigate the effects of the various payment methods and the overall markup value on the overall project cashflow and profit performance. This will enable the developer to have a better understanding of these payment methods. As such, the choice of Markup values and what payment method to adopt, promote and what method avoid with become clearer from the inception of the project.

1.3 Scope of the Study

This Research will present decision support tool that considers the financial interactions between the Developer, Financier and the Buyer. The time frame of this inquest will span the project delivery and the post delivery facilities management periods. In the context of developing countries, the research refers to the inception of the whole project as the inception of the infrastructure that precedes the development of the eventual houses. With a fixed delivery time, overdraft facilities and the predefined loan servicing period, the model will present useful information that will help the developer determine the confidence level of making a Rate of Return. To model interactions involved, a systematic approach as suggested by AbouRiz [2] was employed (Figure 1-3) to guide the process of development and validation. The financial interactions are modeled in Microsoft© Excel and project cashflow data is sourced from Primavera©. Crystal Ball© a Monte Carlo based simulation tool is employed for simulating buyer behavior.

Monte Carlo Simulation is a system that uses random numbers to measure the effects of uncertainty in a spreadsheet model. The model is designed to be applied by developers for cashflow simulation for intended projects. It will enable the developer to make better judgment on how to take advantage of finance availability in a manner that maximizes his profit.

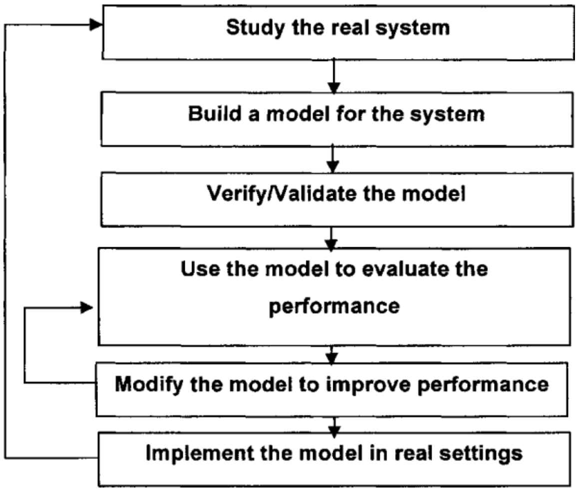

Figure 1-3: Generic steps for improving a construction system [2]

1.4 Significance of Study

This study intends to introduce a new approach for deducing profitability; it also intends to promote a better understanding of the effect of buyer behavior on the cashflow of a project. A spread sheet model is designed to model the financial interactions between the developer, financier and the buyer. This is not typically the approach to determining the potentials for profit from a housing project. This novel methodology will benefit from the developers knowledge and historical data regarding buyer behavior, inflation and property appreciation. Other project management practices such as scheduling approaches, invoicing periods, retentions, overheads, etc are captured in the cashflow picture of the project thus increasing the potentials for applying the approach to any project regardless of scheduling approach or contractual obligations.

Furthermore, ability to analyze the potentials for improved profitability for a housing development can be a useful piece of information for potential developers who are hesitant about engaging in developments in developing countries, it can also be a case for arguments when seeking finance partnership for such projects. Potential developers can utilize this information to decide on which project to undertake, what expected profit to allocate, what payment methods to adopt and what marketing strategy to promote. The findings of this research endeavor will hopefully increase the contribution of the private sector in the provision of much needed housing in the developing countries of the world.

1.5 Methodology of Study

This study aims to analyze the effect of integrating inflow from the potential buyer into the project account from the inception of the project. In order to model the system being investigated two scenarios are considered in parallel. On one hand the system modeled does not consider inflow from the buyer, this allows for the accumulation of the delivery cost to the buyer based on the project delivery relationship between the developer and the financier. Typically, the finance entity creates a project account which is enabled with an overdraft facility; this account is then charged for the amount of overdraft facility that is utilized by the account holding entity. As such delivery price to the buyer is a summation of the total cost of delivery and the requisite cost of finance.

This accumulated delivery price to the buyer is then taken as an input in the second scenario fed into the project account based on the parameters of the simulation as illustrated in Figure 1-4. The idea is that finance as a resource is drawn from the account of the special purpose vehicle created to run the project. As such the buyer contribution to this account is simulated as resource inflow. Since the inflow is into the project account, there lies a potential for reduction in required overdraft facility, thus, a reduction in the cost of finance for the project.

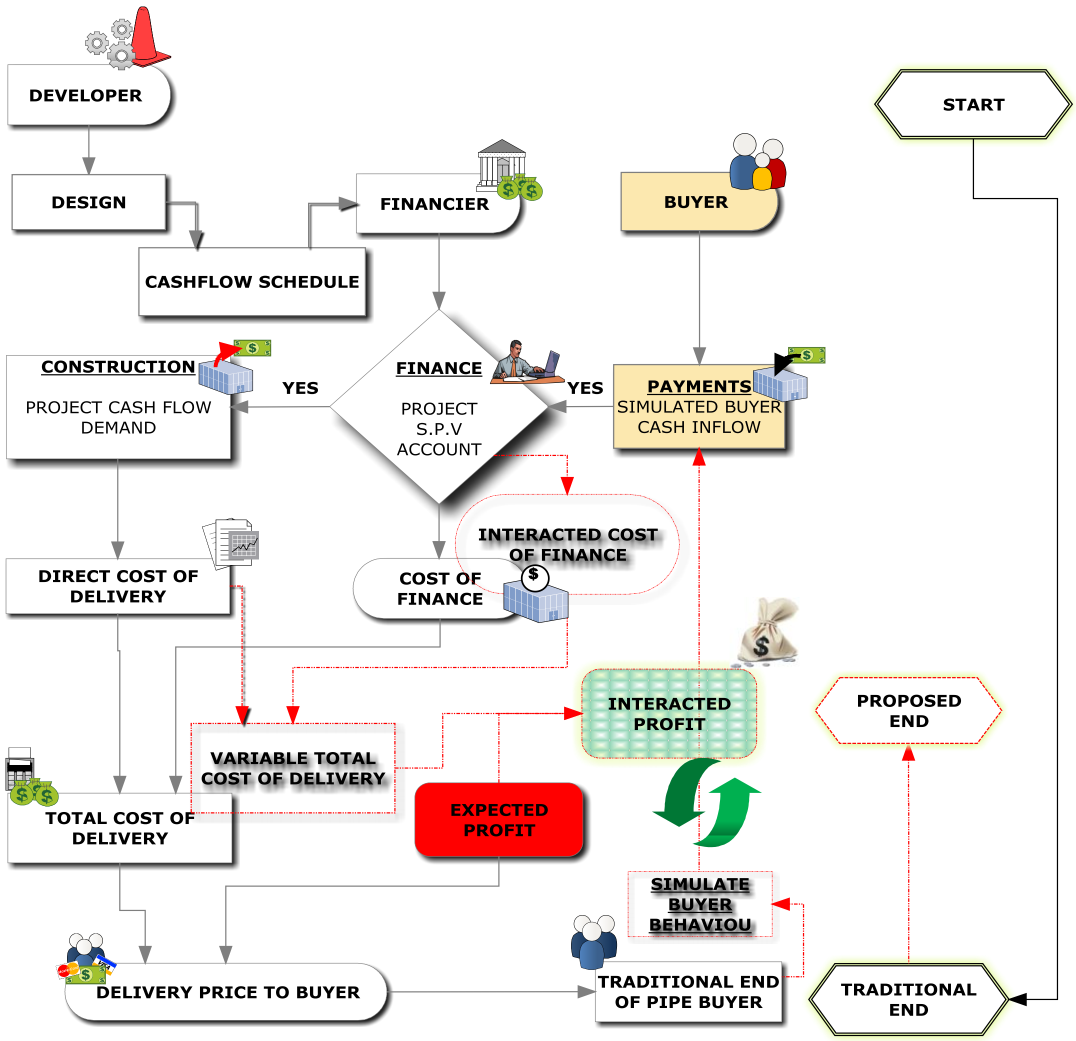

Figure 1-4: Outline of Research Objective

In order to achieve the research objectives, the following methodology is employed:

- Conducting a literature review of the techniques and approaches to cashflow management and the techniques used to determine delivery price to the buyer.

- Developing a flexible spread sheet model based on the proposed approach. This model will help the decision maker with determining the expected profit, payment approaches and the sales strategy to employ for increased profitability.
- Validating the proposed approach through applying it to two case studies and the results are then evaluated by members of the project management team of the real estate development entities.

1.6 Organization of Chapters

The research will consist of four other sections outlined as follows:

Chapter 2: Presents a review of literature regarding Financial Models, Monte Carlo Simulation; the general nature of their formation and a presentation of a generalized pseudo code for the execution of these Algorithms. Other research attempts towards cashflow optimization, management and simulation are also presented in this Chapter. The salient guide lines gotten from the literature review are presented as the baseline for this research work. Finally this Chapter details the progress this research intends to make from the baseline.

Chapter 3: Highlights the proposed approach and illustrates the methodology used in developing this technique. A Buyer Interacted Cashflow approach is proposed with the following six main principles: 1) The Buyer is considered as a resource contributor from project inception; 2) Cash inflow from the buyer will be contributed to the project S.P.V account; 3) Buyer inflow can positively impact Cost of Finance; 4) Cost of Finance savings will constitute additional profit (i.e. Interacted Profit); 5)

Potential increase in profit can translate to a potential reduction in Markup; 6) A reduction in Markup will translate to Lower prices

The three modules (Input, Process and Output) of the proposed Buyer Interacted Cashflow System, which are developed to imitate the modeled environment are also presented along with detail of the three stage analysis processes (Markup, Buyer Interacted Cashflow and Marketing) utilized to generate the research outcomes.

Chapter 4: Presents the results of validating the model by applying it to two case studies in the real estate industry; one international and one local. This validation is drawn from the records of the models performance and evaluation by persons involved in the field of housing finance and delivery

Chapter 5: Conclusions and Recommendations are presented in this Chapter of the research work. A conclusion is drawn from the results of the validation process and further, recommendations are outlined for further pursuits that will be beneficial in advancing the approach introduced by this research endeavor.

CHAPTER 2: LITERATURE REVIEW

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2. Introduction

Traditional cashflow management operations in the past few decades were based on mathematical methods or heuristic techniques, such as, methods such as integer, linear, or dynamic programming. Mathematical methods are however, computationally non-tractable when applied to any large real-life project [3]. Other disadvantages include their complexity, formulation and the possibility of their being trapped in local optimums [4]. On the other hand heuristic search methods use experience and rules-of-thumb while applying search algorithms thus presenting a solution that is hoped to be close to the optimum [5].

Despite their simplicity, the performance of heuristic methods vary in effectiveness applied on different project networks, and there are rules that help in selecting the best heuristic approach, as such, they cannot guarantee optimum solutions [5]. It is well established that the inconsistency of their solutions have contributed to large discrepancies in the resource-constrained capabilities of commercial project management software [6].

Results derived from running heuristic algorithms are termed deterministic because they present a crisp value as the output (solution). This is because there lies no randomness in the inputs of the system [7]. However, there are some problems that by their nature are more stochastic than deterministic in solution. This is due to the randomness of the inputs of the system such as is inherent in modeling of buyer behavior. The inherent randomness in the behavior of the potential buyer suggests that the output of such an investigation will be a range of values along with the corresponding confidence level of achieving these results. This inherently suggests that a stochastic approach will be appropriate for pursuing the research. Simulation is a stochastic approach that has been widely applied in the construction industry.

2.1 Approaches to Cashflow Management in the Construction Industry

Cash is the most important of a construction company's resources [8]. The failure of more construction companies has been ascertained to be due to a lack of liquidity for supporting their daily activities than because of inadequate management of other resources. More than 60% of construction contractor failures are due mainly to economic factors [9]. In an attempt to analyze the real business environment in the construction industry, various forecasting methods have been applied to cash flow management [8]. Techniques for cash flow forecasting and management differ in their levels of accuracy and detail, the degree of automation in compiling them, and the method to integrate the time and money elements; some of the techniques are stochastic, but most of them are deterministic [8].

Most construction projects are individual profit centers, each with its own cash cycle based on the costs of activities related to the project and on payments from a client, both of which are prescribed by a contract [8]. Typical cash flow on a construction project consists of:

1. Cash out such as bid costs, preconstruction costs engineering, design, mobilization, materials and supplies, equipment and equipment rentals, payments of subcontracts, labor and overhead; and
2. Cash in such as billings (less retentions), retentions, claims and change orders.

The factors that typically considered as affecting cash flows are the duration of the project, the retention conditions, the times for receiving payments from the client, credit arrangement with suppliers or vendors, equipment rentals, and times of payments to subcontractors, etc [8]. Cash flow at the project level consists of a complete history of all cash disbursement and all earnings received as a result of project execution. Many construction projects have negative net cash flows until the very end of construction when the final payment is received or advanced payment is received before starting the project or within benchmarks. In the typical situation of housing developments, the payments for intended dwellings constitute these partial payments [8]. However the nature of these payments is stochastic and cannot be easily predicted. As such the potential developer does not have an easy task when considering the transition from positive cashflows [9].

For over three decades now, computer simulation has been introduced as a decision support tool for more efficient use of construction resources [5]. Though its ability to mimic real world construction processes has interested researchers, construction practitioners may find it difficult to master because many of existing tools require knowledge of computer programming and simulation language, and lack integration with existing project management software and with optimization algorithms [5].

One approach to simulation that has also received attention in the construction industry is the Monte Carlo Simulation. "Monte Carlo method" is actually very general expression used for stochastic techniques (i.e. based on the use of random numbers and probability statistics to investigate problems) [10]. They exist in many facets of life such as economics, nuclear physics, engineering, design, regulating the flow of traffic, etc. Thought the methods of application may vary, strictly speaking, all you need to do is use random numbers to examine some problem to call something a "Monte Carlo" experiment [10].

The beauty of this “experimental” approach is the ease with which it can and is executed with simple platforms like Microsoft excel. Simulation modeling has been implemented by enterprises throughout the world to improve the design and operation of complex systems [11]. They are often used when simulating physical and mathematical systems. Being computational algorithms that rely on repeated random sampling to compute their results, they are most suited for computerized operations. This is due to this reliance on repeated computation of random or pseudo-random numbers. Monte Carlo methods tend to be used when it is unfeasible or impossible to compute an exact result with a deterministic algorithm [12].

They are especially useful in studying systems with a large number of coupled degrees of freedom and are also useful for modeling phenomena with significant uncertainty in inputs, such; calculation of risk in business, in mathematics: evaluation of definite integrals, particularly multidimensional integrals with complicated boundary conditions [12]. Monte Carlo simulations have been applied in space exploration and oil exploration, actual observations of failures, cost overruns and schedule overruns are routinely better predicted by the simulations than by human intuition or alternative "soft" methods [13]. The term "Monte Carlo method" was coined in the 1940s by physicists working on nuclear weapon projects in the Los Alamos National Laboratory [14].

2.2 Monte Carlo Simulation and Optimization in the Construction Industry

Models created in general programming languages or general purpose simulation tools can, in principle, represent almost any real-life process and as such can be tailored to the very precise requirements of any model in question [15]. Though Simulation presents itself as a powerful tool for planning and scheduling highly repetitive tasks in a construction project, it usually requires a tremendous amount of effort even in developing a very simple model [16]. However, variables of the simulation model, such as the task duration and different resource combinations, can be evaluated in terms of the operation's production and cost.

A resource allocation and assignment example examining the impact of assigning different resource like cash inflow on the project's duration and cost highlighted that though conventional approaches would have required relying on human judgment by 'going blind' into the project, simulation provides a easier platform from which the project planner can perform sensitivity analysis to tests all resource alternatives for the simulation model to determine which resource combinations will produce the highest or the lowest unit cost/total cost [15].

Although computer simulation techniques have been applied to the field of construction engineering and management for nearly three decades, it is important to mention that the tools by which the simulation processes have been delivered have also varied over the years especially in their specific requirements as illustrated in Figure 2-1. Some of these simulation tools, such as RESQUE©, UM-CYCLONE©, COOPS©, STROBOSCOPE©, and COST©, are based on CYCLONE© (Cyclic

Operation Network) modeling format because of its clear and simple symbolic structure compared to other simulation techniques [15].

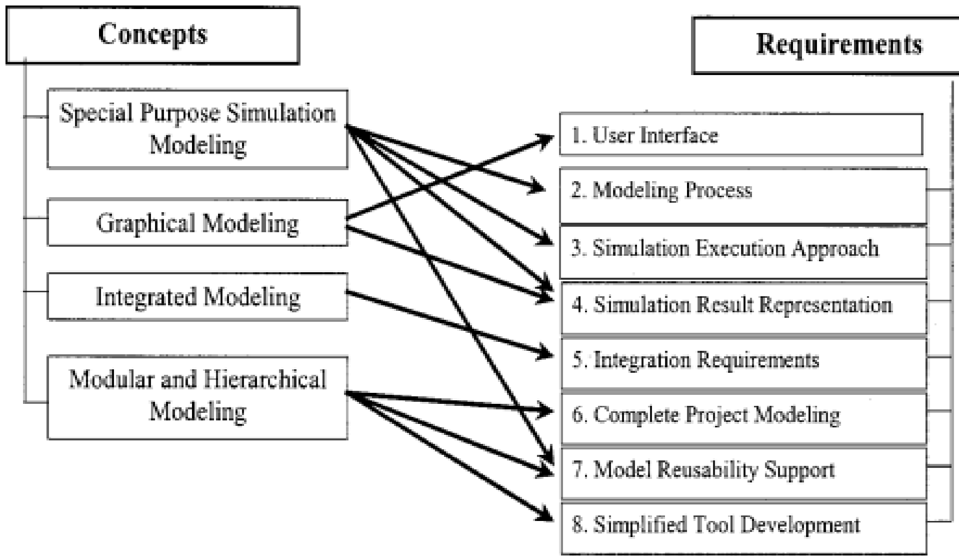


Figure 2-1: Formulated simulation concepts and requirements [17]

These Simulation tools present a physical modeling platform for simulation construction activities often with the use of activity on arrow diagrams [16]. Although most approaches focus on analyzing the construction operation in terms of system performances, such as the production rate or the unit cost [17]. Besides analyzing the system performances, searching for the optimal resource combination that produces the best performance is another important issue of the construction simulation. However, to achieve this aim, these systems take the sensitivity analysis approach, which exhaustively enumerates all resource combinations to find the optimal resource allocation. The deficiency lies in the number of resources to be combined, if a large number of resource combinations are present as illustrated in Figure 2-2, the sensitivity analysis approach becomes inefficient in terms of computation efforts [15].

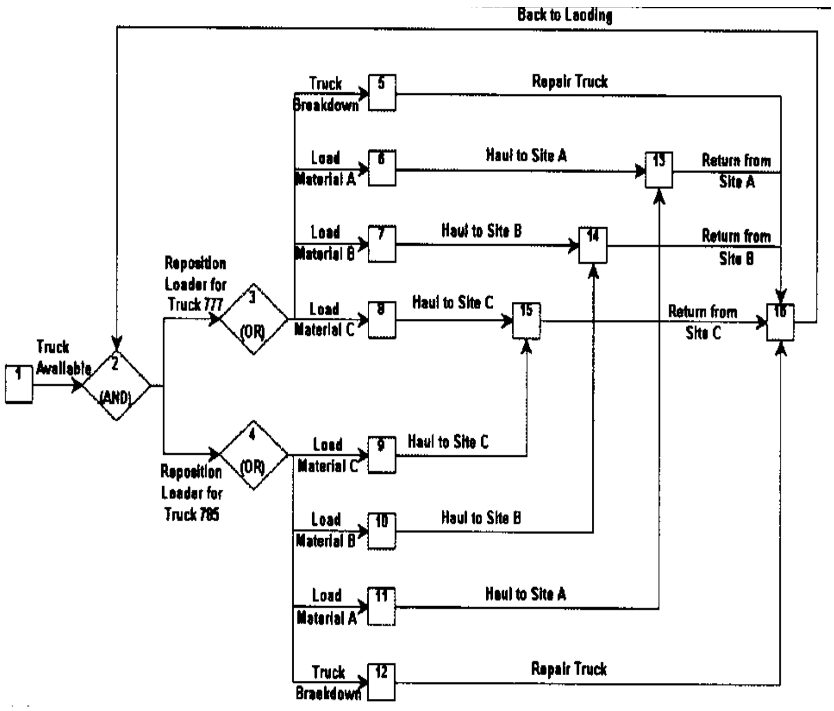


Figure 2-2: Sample Graphic Simulation model of an earth moving operation [5]

However, a discrete event approach to simulating resource combinations will better monitor the dynamic and stochastic behaviors of resources over time, thus enabling the evaluation and analysis alternative system configurations because discrete events are those events whose occurrences are distinct, isolated and disconnected from one another [18]. These characteristics are common in most construction operations as such, understanding the approach of simulating discrete events will be of great benefit when developing models of construction processes.

2.2.1 Simulating Discrete Events

Discrete distributions arise in the mathematical description of probabilistic and statistical problems in which the values that might be observed are restricted to being within a pre-defined list of possible values. This list of values is either finite or at most countable [18]. Discrete-event simulation (DES) is a powerful approach to investigating an operational system. This is done through modeling dynamic and stochastic behaviors over time, in a bid to evaluating and analyzing alternative system configurations. Some applications of DES have proven effective in analyzing the system configurations of a construction operation, including resource planning, scheduling, and site planning [19].

Traditional DES is a tool to answer “What if” questions (*i.e. descriptive modeling*) and provide only possible solutions to the problems at hand, and lacks the power to provide optimal solutions automatically (*i.e. prescriptive modeling*) [20]. Subsequently, large amounts of simulation experiments are needed to examine all the alternative configurations in order to attain more concrete solutions. Such a sensitivity analysis that requires exhaustive enumeration is generally used when applying DES to analyze resource combinations for a construction operation [19]. However, it is important to note that the number of alternative configurations (*e.g., resource combinations*) may increase exponentially [21].

An example of this exponential behavior of alternatives is presented in a hypothetical construction operation which requires five types of resources and each of which can be given the quantity from 1 to 8, then the number of the alternatives to be examined is up to: 8x8x8x8x8=32,768, an exhaustive examination of all the alternatives may be time consuming and affect the efficiency of the DES [19]. As such, engineering understanding and judgment of the operations analysis can be used to determine and adjust candidate solutions so as to avoid exhaustive examination of all the alternatives. However, this method requires reasonable knowledge about the operations being studied and relevant statistics, so it is not applicable to general simulation users [19].

2.3 The Application of Special Purpose Simulation Models in Construction Finance

Due to the general applications of simulation in various industries, there exists a myriad of possibilities for adapting the already available tools for application in the construction industry. However, rather than developing a general-purpose simulation framework which will inevitably requiring a high degree of abstraction, developing a special-purpose tool for a specific sector of the industry may be more effective (Figure 2-3). Special-purpose simulation averts the need for accurate modeling and fulfils the desire for a reduced level of effort and the lowers the complexity of simulating within a specialized environment [16].

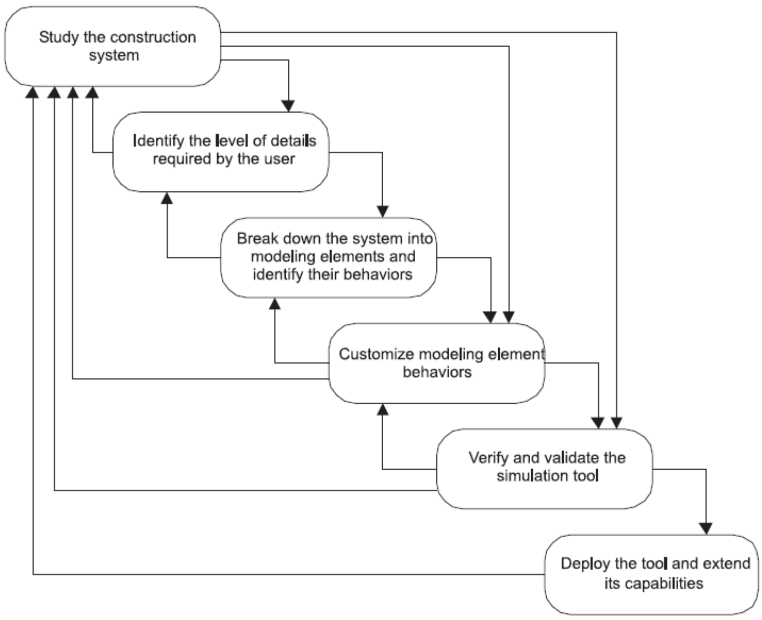


Figure 2-3: Special Purpose Simulation Model Development [22]

Examples of the special-purpose simulators for specific types of construction projects include STEPS by McCahill and Bernold (1993), RBS by Shi and AbouRizk (1997), and those developed by Oloufa et al. (1998) and Martinez (1998) [16]. Special-purpose simulation tools are usually nonprogrammable and easy to learn and might only be used to effectively model simple operations [16]. Since a construction operation is a collection of processes which interact through certain strategies to complete tasks, the interdependence and inter linkage of the processes can be used as a basis for the operation logic and utilization of common resources. Such a representation of this relationship in simulation modeling (Figure 2-4); can be termed as process-oriented simulation [16].

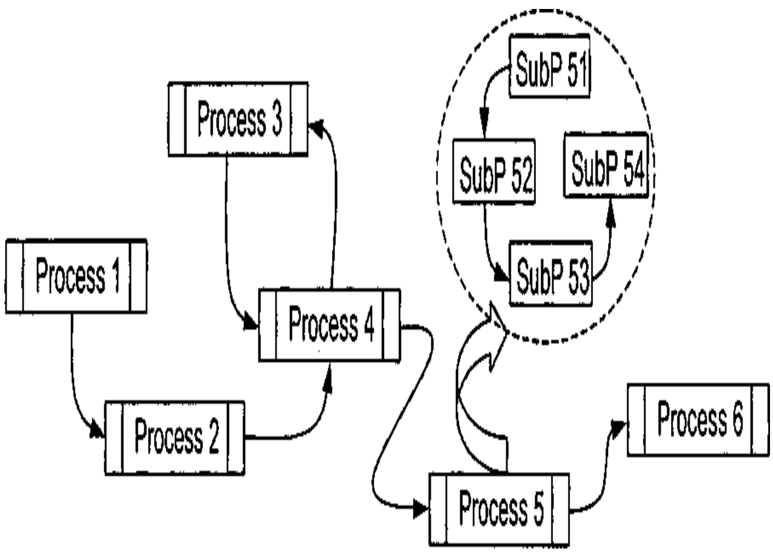


Figure 2-4: Sample architecture of process-oriented simulation [16]

Figure 2-4 depicts a typical architecture of a process-oriented simulation model, wherein processes and the interdependence between processes are respectively denoted by rectangles and arcs. Processes and their linkages are connected with shared and well-defined interaction points [17]. Depending on the objective of the study, a process can be further decomposed into sub-processes, as depicted by process 5 in Figure 2-4 [16].

CYCLONE, RESQUE, CIPROS, STEPS, RBS, and STROBOSCOPE are several process-oriented simulation systems in construction. CYCLONE developed by Halpin and Woodhead in 1976, was specially designed for construction modeling [16]. It models construction processes, resource constraints, and resource flows as activity elements, waiting elements, and linking elements, respectively. In CYCLONE, cyclic resource flows and resource constraints of processes can be formulated and simulated. However, the properties of resources and process elements cannot be defined [16].

RESQUE developed by Chang in 1986 models construction processes in a way similar to that of CYCLONE, but adds a process description language (PDL) to define resource characteristics and to enhance simulation control. However, RESQUE still has the limitation in its resource representation, and is restrictive in resource assembly and disassembly. CIPROS [16] extends the capability of resource characterization beyond that of RESQUE by allowing multiple properties for resources as well as more complex resource selection schemes while STEPS [16] support the notion of different resource sizes in the same queue and provides facilities for the rule-based release of resources from queues. However, it lacks a graphical model display and has limitations when modeling complex operations [16].

STROBOSCOPE developed by Martinez (1996) is a general-purpose construction simulation programming language which provides essential capabilities that enable it to model almost all types of construction projects. These capabilities include for example access to simulation state, resource characterization, programmability, etc. It is a powerful simulation tool, but is not easy to learn and apply due to its complexity [16].

In contrast to process-oriented simulation, a construction operation can also be considered as an integration of various resources and the operation logic can then be correspondingly represented by interactions between these resources. This can be termed resource oriented simulation [16]. Figure 2-5 illustrates the basic scheme of a resource-oriented simulation model where rounded rectangles and arcs denote the resources and their interactions, respectively.

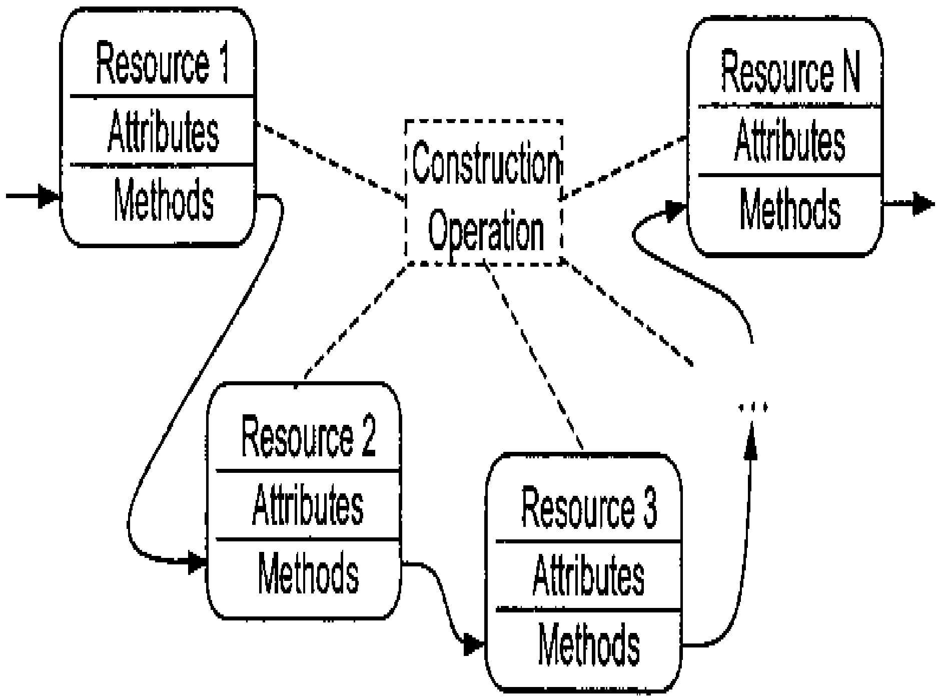


Figure 2-5: Structure of resource-oriented simulation models [16]

Each resource may have its own attributes and methods while all of the resources constitute a resource pool. Methods for each resource constitute its activities and information such as the number and various attributes of resources is associated with each resource in the pool [16]. Two systems taking more or less advantage of the methodology of resource-oriented simulation have been designed specifically for construction operations. COOPS developed by Liu (1991) focuses on resource flows of construction operations is an object oriented system in which all resources are treated as individually identifiable objects to provide statistics from the viewpoint of each individual resource [16]. However, It is weak in resource representation and It does not model resources completely from the object-oriented viewpoint; thus, it inherits some of CYCLONE's modeling difficulties [16].

The other system is a library-based simulation modeling method developed by Oloufa and Ikeda in 1997 and further developed by Oloufa et al in 1998. The library was developed by simulation programmers, comprises a set of preprogrammed construction resources and targets a specific category of project. However, the fixed structure of resources in the library constrains the model application. Another possible deficiency lies in the complicated interactions between resources [16]. Resource representation and modeling the interaction between resources are some of the major shortfalls of most of the approaches mentioned.

As such besides the general ease of use and programming differences between the reviewed Special Purpose Simulation approaches, it will be a major leap forward to look into the concept of resource interaction. One way to start might be to better define and understand the nature and characteristics of resources. This approach to better characterization of project resource is presented in a Resource Interacted Simulation (RISim) approach.

2.3.1 Types of Project Resources

A project can be conceived as a collection of resources and their interactions and resources can be classified as either simple resources or complex resources with their own attributes, such as quantity and capacity, but a complex resource also possesses its own methods (in object-oriented modeling terms) [16]. An analogy of the definition of simple and complex resources in an earth-moving operation highlighted that earth could have quantity and density as its attributes, while truck not only has number and capacity as its attributes, but also has loading, moving to dump, dumping, and moving to load as its methods. In their example, earth is a simple resource, and truck is a complex resource [16].

They highlighted that resource identification relies both on their attributes and methods, rather than their names. For example, worker (designer) is probably modeled as a complex resource in labor intensive projects such as design and management [16]. They further highlighted that, in a project, the same kind of resource can play different roles giving the example that, one worker may be assigned to operate a single piece of equipment, while another may be assigned to several operations. The former can be represented as a simple resource, while the latter should be represented as a complex resource. Hence, how a particular resource is modeled will depend on its role and significance in the project, as well as the objectives of the study [16].

2.3.2 Resource Level and Process Level Abstraction

Models are usually developed at several levels of abstraction, with each level containing part of the total information for the model though the choice of abstraction levels is not absolutely right or wrong, but a good solution may largely simplify the modeling process [16]. In Resource Interacted Simulation (RISim), the levels of abstraction are resource level and the process level. The resource level abstraction deals with various resources and their relationship. At this level, the modeler determines which resources should be included in the model, depending on the objectives of the study. Once a resource is identified, its attributes are determined. The same kinds of resources have the same attribute types, but may have different attribute values. This so-called ‘‘sub-kind-of’’ relationship between resources is used to represent the generalization-specialization relationships between objects [16] as illustrated in Figure 2-6 where they gave the example that a truck has several attributes, such as operating weight, flywheel power, truck capacity, maximum speed, hourly cost, and transfer efficiency.

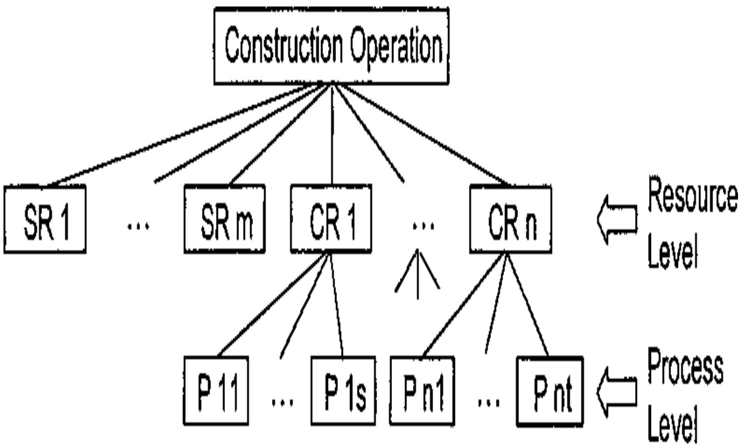


Figure 2-6: Levels of Resource Abstraction [16]

Besides these attributes, complex resources also have their own methods. Each method corresponds to one of the resource's activities or statuses. Typically, activities represent processing events. Therefore, under the resource level, each complex resource has a process-level abstraction to represent its activities (Figure 2-6). Commonly, in an operation, the same resource type may serve different functions Figure 2-7 [16]. Associated with each process is the logic necessary to describe the actions taken in this process. The logic ranges from a simple time delay to a complicated logical statement that chooses a processing duration over another, based on the attribute values of the resource [16].

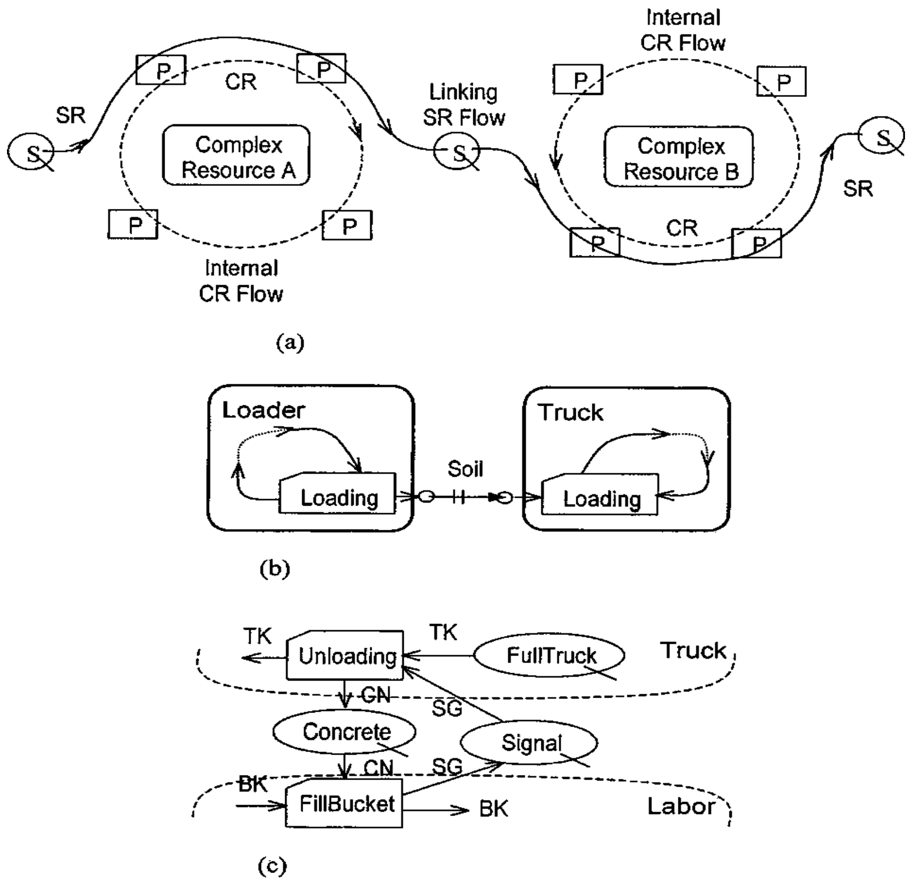


Figure 2-7: Interaction with resources: (a) interaction with resource flow; (b) interaction with common processes; (c) interaction with interactive signal [16]

2.4 Applications of Simulation in Finance

In the field of finance, Monte Carlo simulation is fast becoming the technology of choice for evaluating and analyzing assets, be it pure financial derivatives or investments in real assets [23]. Two of the main virtues of simulation that are explored in finance as in other fields of application are flexibility and simplicity. This is because simulation does not constrain the type of uncertainty that can be modeled while allowing for incorporating any type of decision rule [23]. Simulation is also easy to implement and models can easily be constructed in spreadsheet packages and, with the surge in computing power, computations are seamless except perhaps in the most extreme applications [19].

Typically, in such real investment projects we have an idea about the range values such as changes in the estimates of future prices, demand, or research outcomes should fall within but we do not know the exact numbers by any means especially where project plans are often adjusted [23]. The inherent advantage is that Simulation allows for generating any number of likely forecasts from a general specification of the overall cashflow distribution. Another financial advantage of Simulation is that it allows for creating management policies that define what should happen where there are fluctuating values that might be triggered by delivery cost of the product or an appreciation in its value [23]. As such simulation provides a good platform for modeling possible cashflows for a project.

2.4.1 Financial Cashflow modeling

The cashflow model consists of all current and future cashflows that result from undertaking the project. Cashflows for most projects include sales, cost of goods sold, taxes, and initial capital costs. An analogy that explains this definitive approach to cashflow is, suppose your company wants to analyze the prospect of a development project. The project requires months of development at a cost of about $100,000, of which about $50,000 is used for equipment. The sales department provides an expected sales forecast while the manufacturing group estimates that the cost of goods sold is about 30% of sales. The manufacturing group also estimates the capital equipment costs. A cashflow analysis of the project is presented in Figure 2-8.

	2002:H1	2002:H2	2003:H1	2003:H2	2004:H1
Sales		600	1000	600	200
Cost Of Goods Sold		180	300	180	60
R&D Cost	50				
Other Costs		100	100	100	100
Tax at 30%	-15	92.25	76.25	-7.75	-91.75
Operation Cash Flow	-35	227.75	523.75	327.75	131.75
Capital Investment	50	1000			
Profit	-85	-772.25	523.75	327.75	131.75

Figure 2-8: Example R&D project expected Cashflows [23]

There is some degree of uncertainty in the above presented cashflow. Modeling these uncertainties will definitely require the inclusion of more parameters to cater for the probabilistic assumptions of the values that may affect this probability [23]. As such, it is important to consider the complexities of modeling uncertain cashflow. The process of modeling these uncertain cashflow is presented in the preceding section.

2.4.2 Modeling Uncertain Cashflows

Though the impacts on the profit of the uncertainty of the cashflow vary significantly, most cashflow are to some extent uncertain though the degrees of uncertainty generally differ considerably [23]. He proposed that, it is best to focus on the one or two cashflow whose uncertainty has the most impact on the profit. While accepting that the project value will be affected by some uncertainties with little impact on profit, his approach is avast to the inherent risks that may creep in when trying to model every minute detail. Following up every minute detail may result in the developed model becoming confusing, and simulation runs will take much longer than necessary to run [23].

After identifying the uncertain cashflow components we choose models that match the uncertainty characteristics of the components. There are quite a number of different models of which many have been designed to fit a particular circumstance. Two models that are particularly useful because of their versatility are the geometric growth model [1] and the mean reverting model [2] [23]. In the sample 10/50/90 distribution plot in Figure 2-9, there is a 10% chance that at a particular point in time the process could be below the red area, a 50 % chance that the process could be

[1] Also called Geometric Brownian Motion
[2] Also called Ornstein Uhlenbeck Model

below the border between the red and green areas, and a 10% chance that the process could be above the green area [23].

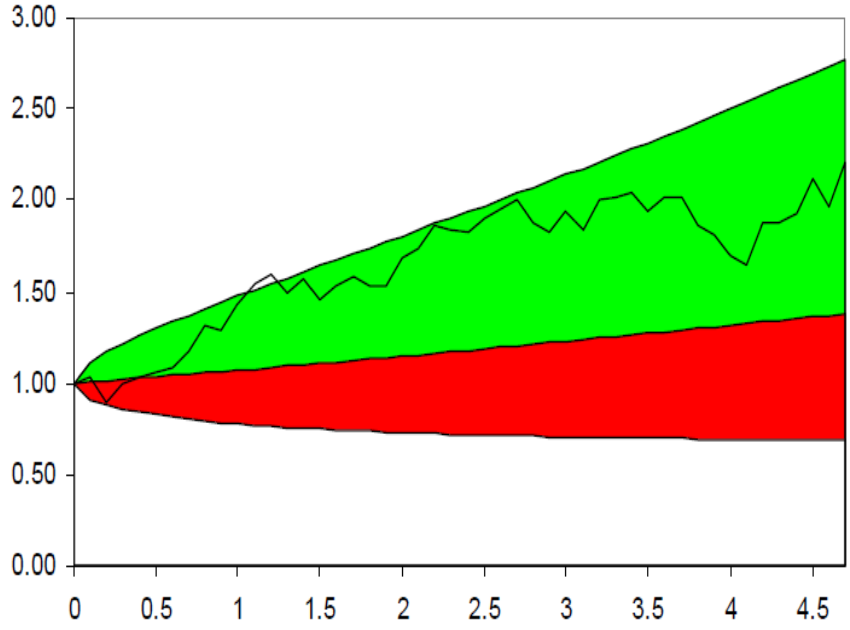


Figure 2-9: Distribution and sample path for a geometric growth model [23].

Thus, there is an 80% chance that the process at a point in time could be in either the green or the red areas. The geometric growth model is useful for capturing processes whose growth is typically thought of in percentage terms. Examples of such processes include stock prices, GDP, and demand for general product categories such as energy, cars, or computers [23]. In order to construct the geometric growth model it is necessary to specify a forecast of the expected rate of growth over time and the standard deviation of the rate of growth. The geometric growth model presents a clearer approach to modeling the uncertainties of payment method and payment time for the potential buyers. Based on industry experience and historical data, the potential developer can ascribe probable distributions to the available payment methods and time distributions [23].

The example in Figure 2-10 is a project development example that the future sales is uncertain with expected sales growing according to the forecast but with a 20% standard deviation of the annual rate of growth. This figure shows the 10/50/90 distribution under these assumptions [23].

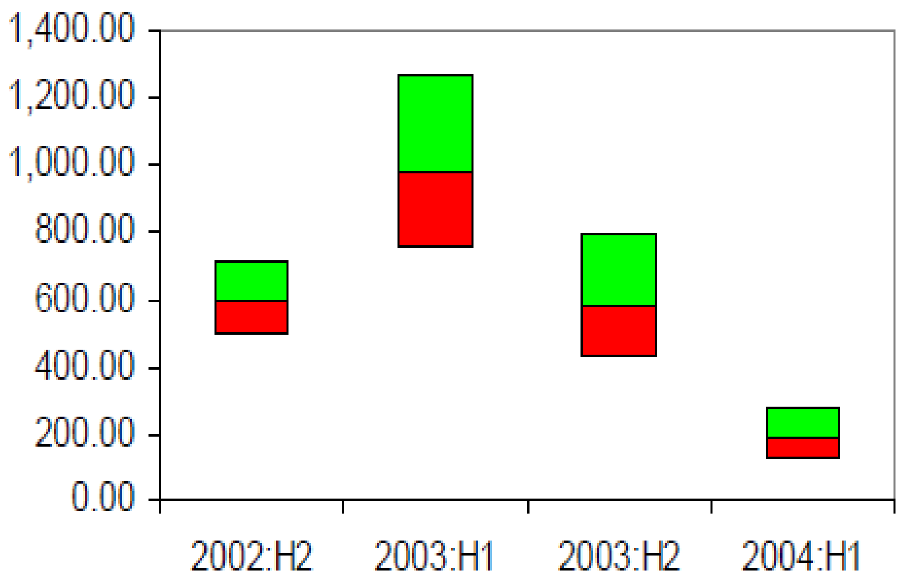


Figure 2-10: Geometric growth distribution for the sales forecast.

Other parameters that are valuable to simulating cashflow are submitted as input parameters. In general, the entire process that will be involved in this research endeavor tends towards finance scheduling rather than the scheduling of the construction activities themselves. Finance based scheduling is not a new approach to project scheduling though research approaches have tended towards optimization rather than simulation [24]. It is however pertinent to gain some insight into the philosophy that governs this approach to scheduling.

2.5 Classification and Distribution of Costs

Costs that may arise from the execution of construction activities will be outlined in this section with regards to their type and distribution. Some costs are directly ascribed to the cost of executing the activities inherent in construction, while, other costs are ascribed to the non-construction activities that make construction and other project obligations possible. These costs are referred to as direct and indirect costs respectively.

2.5.1 Direct Costs

Direct costs are those costs directly related to the production of the product. This is in contrast to indirect costs and overheads and can be directly deduced on an activity or work basis. They include: direct labor cost, direct material, direct equipment, and direct subcontractors cost [25].

2.5.2 Indirect Costs

These are costs that are not directly attributed to project activities. These include Overhead, Finance Cost, Etc.

Overheads: Overheads costs have been defined by as all costs incurred by the contractor that cannot be attributed directly to specific functions, which usually include all costs other than direct labor, materials and equipment. They include such charges as rent, heat, and light, bank interest on overheads and other expenses which are not directly related to the purchase of goods or services being sold by the business [25]. The amount of overhead cost incurred is determined and can be reduced by the decision of management. Overhead costs are classified into two categories:

1. Project overheads
2. General overheads

Project Overheads: The job overheads are caused directly by the individual job. They cannot be charged against any specific phase of the work. These costs include many items such as: Site management and supervision, plant procurement, transport, miscellaneous labor, accommodation, temporary works and services, general items, commissioning and handing over, sundry requirements, insurance, finance cost, etc.

The project overheads can be handled in two ways [25]:

1. As a percentage of the estimated direct cost to be added to the cost estimates. This method is satisfactory for contractors who maintain a stable workload.
2. In the case where costs can be identified and attributed directly to a certain job, they should be estimated with the same care and accuracy as other direct job costs and included as such in the bid. This method is more accurate and satisfactory for the contractors.

General Overheads: This term refers to overhead costs that are not directly associated with the production of goods or services (e.g. office expenses, telephone expenses, R&D) [26]. They are generally attributed to the general running of activities of the establishment as a whole.

2.5.3 Finance Cost as an Indirect Cost Component

The finance cost of a venture is the accumulation of total cost of accessed external finance utilized in executing the project. Cost of finance refers to the charges levied by the source of finance to cover their intended profit for the service provided [27]. As such the total cost of the project becomes the cost reflected by the cashflow picture in addition to the indirect cost of the provided financial resource [28]. It is to this that the final mark-up for profit are added.

2.5.4 Mark-up

Markup is the percentage or amount difference between the delivery cost of a good or service and its selling price. The total cost reflects the total amount of both direct and indirect cost of delivery. A markup is added on the total cost to create a profit and can be expressed as a fixed amount or as a percentage of the total cost [29]. Though some researchers consider mark up to consider only contingencies, others see mark up as a sum of contingencies and profit. The latter definition is adopted as the definition of mark up in this research.

Markup as a fixed amount

Price = Delivery Cost + Fixed Profit

Markup as a percentage

Price = Delivery Cost + (Delivery Cost x Mark-up Percentage)

2.5.5 Markup and Price Elasticity of Demand

The choice of selected markup percentage has an effect on the sales value of any proposed development and this effect on price affects the responsiveness of buyer. As the price deviates from the market average, so would the response of the potential buyer to the available choices. A cheaper pricing would attract more buyers, but at the peak of sales, this would have no negative effect on the volume of sales since the maximum has been attained. On the other hand, as price exceeds the market average, there is a possibility of selling fewer units; though at a higher amount of return. This scenario is described in economics as the Price Elasticity of Demand.

Price elasticity of demand is a measure used in economics to show the responsiveness of the quantity demanded of a good or service to a change in its price (Figure 2-11). More precisely, it gives the percentage change in quantity demanded in response to a one percent change in price holding constant all the other determinants of demand, such as income [30].

$$Elasticity_{(demand)} = \frac{Price_1 + Price_2}{Quantity_{d1} + Quantity_{d2}} + \frac{\Delta Quantity_{demand}}{\Delta Price}$$

Figure 2-11: Price Elasticity of Demand

While the elasticity of demand can be captured for a minimum to maximum price range, the price at a certain point requires that the slope (m) of the demand function is determined. The change in quantity demanded can then be deduces for every successive change in pricing. [30].

2.5.6 Break-even point

The costs of a business are made up of two elements; fixed costs, plus mainly overheads and variable costs), chiefly related to the level of productive activity. As each unit of the product is produced and sold the difference between the selling price and the variable cost of production is the contribution towards the fixed costs [25]. As activity increases this contribution reaches a point where it exactly equals the fixed costs the break-even point. Beyond this activity level the business will run in profit: below that point it will incur losses [25].

2.5.7 The Internal Rate of Return

This term refers to the discount rate often used in capital budgeting that makes the net present value of all cash flows from a particular project equal to zero. Generally speaking, the higher a project's internal rate of return, the more desirable it is to undertake the project. As such, IRR can be used to rank several prospective projects a firm is considering [31].

Assuming all other factors are equal among the various projects, the project with the highest IRR would probably be considered the best and undertaken first. You can think of IRR as the rate of growth a project is expected to generate. While the actual rate of return that a given project ends up generating will often differ from its estimated IRR rate, a project with a substantially higher IRR value than other available options would still provide a much better chance of strong growth [27]. The rate if return is calculates with the use of the formula in Figure 2-12. As indicated, IRR is derived based on the Net Present Values of a cashflow. In finance, the net present value (NPV) or net present worth (NPW) of a time series of cash flows, both incoming and outgoing, is defined as the sum of the present values (PVs) of the individual cash flows [32].

$$\text{LOWER RATE}+\frac{\text{NPV at lower rate}}{\text{NPV at lower rate-NPV at higher rate}}\text{X}(\text{Higher Rate-Lower Rate})$$

Figure 2-12: Calculating the Internal Rate of Return

2.5.8 The Cashflow picture

Cashflow as a term consists of the flows of cash into and out of a business; typical cash out flows on a construction project include interest, material, labor cost, etc., and cash inflows include various payments, such as bonuses [33]. In context, the cashflow picture refers to the static view of potential cash outflow requirements of executing a process. The outflow component of a cashflow, cash outflow, is defined as the net amount of cash that flows out from a project operator based on the ongoing operations and tasks required to complete the project an obvious example of which is expenses tied to project activities [34].

2.6 Finance Options and Cost of Finance

The cost of capital is the cost of obtaining funds for, or, conversely, the required return necessary to meet its cost of financing a capital budgeting project. Definitively it is "the minimum return that a company should make on its own investments, to earn the cashflow out of which investors can be paid their return" [35]. Cost of capital encompasses the two fundamental sources of financing: the cost of debt (i.e. bonds and loans) and the cost of equity. Capital Investment should earn returns for the capital providers who risk their capital.

As such, the expected return on capital must be greater than the cost of capital for an investment to be worthwhile. In other words, the risk-adjusted return on capital (that is, incorporating not just the projected returns, but the probabilities of those projections) must be higher than the cost of capital [35].

2.6.1 Cost of Debt

The cost of debt is relatively simple to calculate, as it is composed of the rate of interest paid. In practice, the interest-rate paid by the company will include the risk-free rate plus a risk component (risk premium), which itself incorporates a probable rate of default (and amount of recovery given default). For companies with similar risk or credit ratings, the interest rate is largely exogenous [36].

2.6.2 Cost of Equity

The cost of equity is more challenging to calculate as equity does not pay a set return to its investors. Equity represents an investors share in the proceeds of an investment venture after all the liabilities have been paid. Similar to the cost of debt, the cost of equity is broadly defined as the risk-weighted projected return required by investors, where the return is largely unknown [36]. The cost of equity is therefore inferred by comparing the investment to other investments (comparables) with similar risk profiles to determine the "market" cost of equity. The cost of capital is often used as the discount rate, the rate at which projected cashflows will be discounted to give a present value or net present value [35].

2.6.3 Line of Credit

An arrangement in which a bank or vendor extends a specified amount of unsecured or secured credit to a specified borrower for a specified time period also called credit line [37]. It implies a maximum loan balance that the bank will permit the borrower to maintain. As such, draw down on the line of credit at any time, as long as it not exceeds the maximum set in the agreement is permitted so long as there are no other preconditions. Compared to a loan, interest is not usually charged on the part of the line of credit that is unused, and the borrower can draw on the line of credit at any time that he or she needs to. A line of credit may also be classified as a demand loan, meaning that outstanding balance will have to be paid immediately at the financial institution's request [38].

2.7 The Use of Special Purpose vehicles in Housing Projects

Special Purpose Vehicles (SPV) also referred to as a "bankruptcy-remote entity" have their operations limited to the acquisition and financing of specific projects or assets (Figure 2-13). Usually a subsidiary company, an SPV has an asset/liability structure and legal status that makes its obligations secure even if the parent company goes bankrupt [39]. As such, an SPV can be used to finance a large project without putting the entire firm at risk. These factors have made the use of SPVs in the real estate industry very attractive.

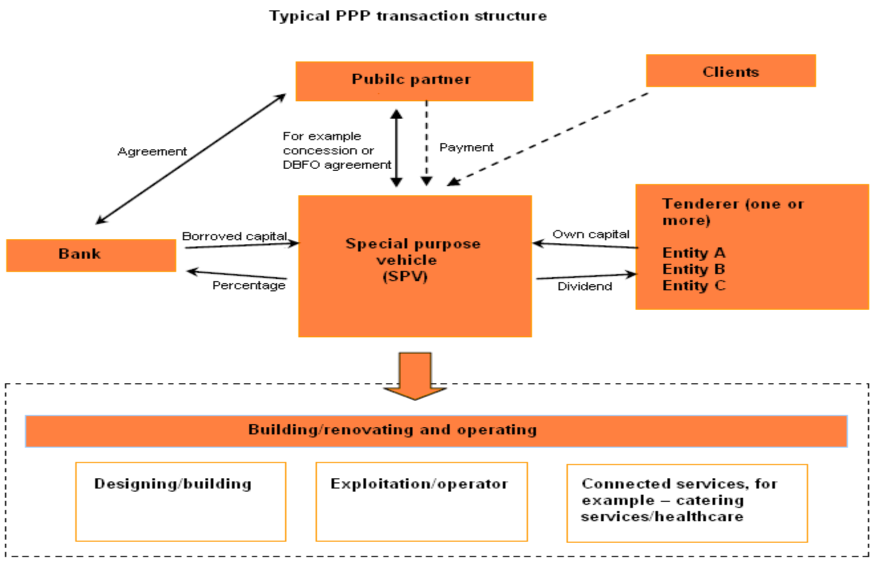


Figure 2-13: SPV application in a Private Public Partnership [40]

Due to the time and resource requirements of construction projects it is deemed important to delineate definitively, the cashflow for a particular project especially where more than one project could be undertaken in concurrence.

SPVs are essentially:

- Legal Entity liable for delivery of the purpose for which they are established
- Legal entity liable for Cost of Finance obligations
- SPV account for project allows for Clarity of Cashflow
- Outflow of Cash goes directly from the SPV account
- Payments are made directly into the SPV account by buyers

Since an SPV is essentially an entity defined to serve a specific task, at the end of the legal tenure of the SPV which is usually tied to the project delivery or post delivery obligations, the SPV is liquidated and ceases to exist as a legal entity and all accounts are subsequently closed [41].

2.8 Elements that make up the cost of finance

This section presents generic layout of the general nature of charges that accompany a financial commitment from financiers. While they may come under different names as was discovered in the interviews conducted, the principles are generally the same. Another point gathered from the interview and online surveys of international finance entities like the International Finance Corporation was that the implementation of these charges was to the context of the finance package and project type.

While some finance packages required a higher level of insurance (i.e. charges) other are constrained or sometimes guaranteed by law. The charges are outlined in Figure 2-14.

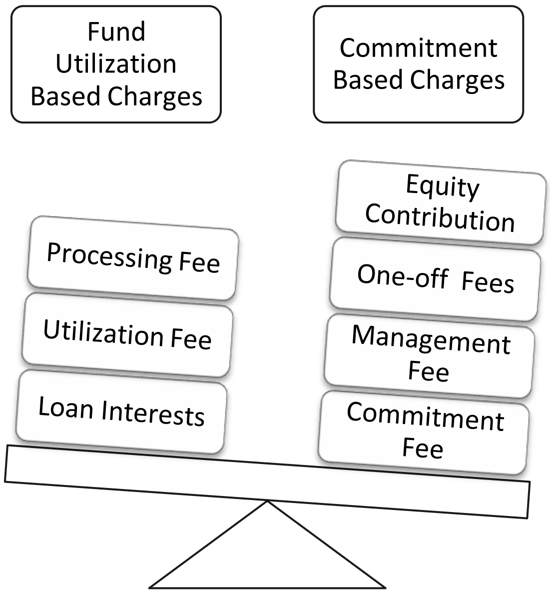


Figure 2-14: Elements that make up cost of finance

2.8.1 Fund Utilization Based Charges

A Fund utilization charge is a colloquial term that describes the charges that accrue upon withdrawal from the facility provided by the financier. This is usually an annual percentile charge which accrues over a monthly cycle time.

2.8.2 Loan Interests

A rate, often expressed as an annual percentage of the principal, which is charged or paid for the use of money. It is calculated by dividing the amount of interest by the amount of principal. Compounding of interest allows a principal amount to grow at a faster rate than simple interest, which is calculated as a percentage of only the principal amount. The more frequently interest is added to the principal, the faster the principal grows and the higher the compound interest will be. The frequency at which the interest is compounded is established at the initial stages of securing the loan. Generally, interest tends to be calculated on an annual basis, although other terms may be established at the time of the loan [27].

2.8.3 Utilization Fee

Under some loan agreements, the bank or financier charges a small percentage of the facility being drawn is from the account as fees for utilization of the facility.

2.8.4 Processing Fee

Processing fees are charges on the same basis as utilization fees. However they usually apply in the cases of loans that cut across different currencies. As such the processing fee is not charged based on the drawdown but as the currency transaction fees of the drawdown

2.8.5 Commitment Based Charges

These are charges that are based on a committed facility agreement. A committed credit agreement is one in which terms and conditions are clearly defined by the lending institution and imposed upon the borrowing company. In committed facilities; the borrowing companies must meet specific requirements set forth by the lending institution in order to receive the stated funds. In congress the lending company is under obligation to meet the full capacity of the funds that it has committed to the lender if other requirements are found in compliance. In contrast, an uncommitted facility agreement does not commit the lending institution on the amount to be lent.

2.8.6 Commitment Fees

A commitment fee is different from interest; although, the two are often confused. A lender charges a borrower a commitment fee to keep a line of credit open, or to guarantee a loan at a certain future date even though the credit is not being used at that particular time. This fee is usually charged at on an annual basis.

2.8.7 Management Fees

An annual management fee is charged by the lending institution for the running of the client account. This fee is usually a fixed amount regardless of the account traffic.

2.8.8 One off Fees

These are fees that are charged only once during the transaction. They usually include fee that cover legal charges and other setting up charges and cost for the transaction.

2.8.9 Equity Contribution

This is the owner's financial contribution towards the project delivery. This is sometimes a financier mandated contribution or a condition precedent for facility approval.

2.9 Summary

The following abstractions were made from the literature review and interview of practitioners in the real estate industry presented in this chapter:

1. Cash; the most important resource for housing developments is not easily forecasted due to the uncertain nature of buyer response.
2. Simulation presents an appropriate platform for modeling the level of uncertainties that are inherent in buyer interacted cashflow.
3. Simulation being virtual representation of reality can be visual or statistical; as such Monte Carlo approach being a statistical approach will allow better management of the statistical content of the research approach.
4. The processes to be simulated would be the cashflow interactions between the project delivery parties i.e. the Developer, the Financier and the Buyer.

5. An overview of the literature presents the buyer as a complex and discrete resource. This is because, in addition to the quantities (Cash), the cash inflow from the buyer also has methods (payment time and payment methods) of inflow.
6. A strong platform for analyzing such an uncertain scenario is the use of requisite cashflow model which will consist of all current and future cashflows that result from undertaking the project.
7. At the First instance, the project would be considered to be fully financed between the Developer and Financier; the cost or burden of the finance is then transferred to the Buyer on a per square meter cost basis.
8. Potential Buyer payments will then be included into the project cashflow with considerations that the sales will commence at the inception of the project. This will effectively reduce the negative balance on the project (S.P.V) account.
9. The assumptions of the simulation will be the payment method and year of the buyer, the decision variable will be the expected profit and the forecasts will be the variations in profit and the requisite buyer behavior that produces them.
10. The end product of simulating the buyer interacted cashflow would be the confidence level of achieving a range of interacted profit alone with the possible approaches to sales and marketing that will generate such earnings.

CHAPTER 3: THE PROPOSED BUYER INTERACTED CASHFLOW SIMULATOR

CHAPTER 3: THE PROPOSED BUYER INTERACTED CASHFLOW SIMULATOR APPROACH

3. Introduction

This chapter proposes an approach to simulating buyer interacted cashflow. The proposed approach aims at supporting the real estate developer by introducing a decision support system that helps in making better informed decisions regarding the percentage of profit with which to markup the direct delivery cost, the level of achieving a certain range of buyer interacted profit and finally the best approach to sales and marketing.

This novel approach presents a platform which facilitates various analyses such as optimization, simulation, sensitivity and what-if analysis. The implicit objective of the explored relationship is a Win-Win situation between the developer and the buyer in which case; the buyer is a measurable resource contributor towards project delivery from its inception (Figure 3-1). While the developer is able to potentially reduce the cost of finance burden for potential housing developments, the buyer is able to potentially reduce the delivery price of such developments.

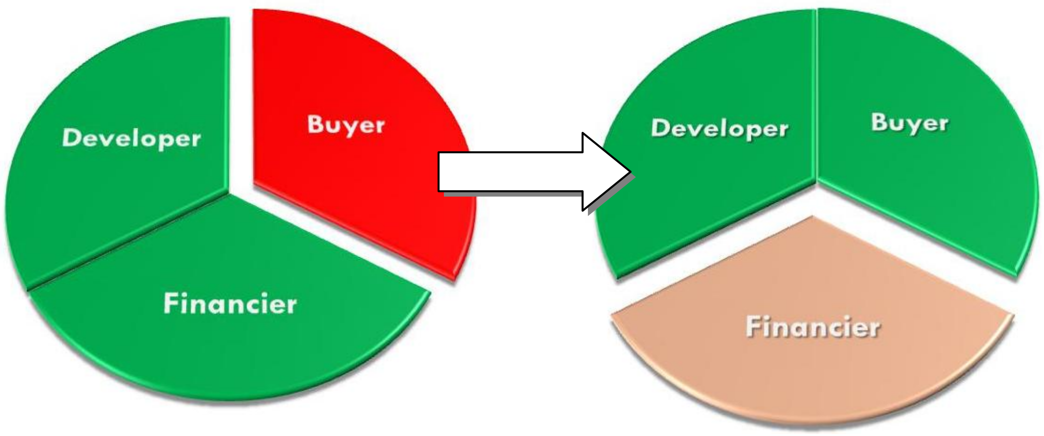


Figure 3-1: Traditional Practice versus Proposed Approach

The level of uncertainty inherent in attempting to measure the possible effect of interacting buyer inflows into project cashflows is humanly impossible without the assistance of a decision support tool. Human behavior presents a large degree of possible rates and volumes of inflow because one is not certain as to which payment method the potential buyer will choose or what time he will be willing to engage the developer. As such, this research endeavor proposes a platform for considering and measuring the potential advantage of buyer participation under uncertainty.

The approach is executed through employing a developed decision support tool called ARO-META. Details of the proposed decision support system are presented in this chapter.

3.1 Methodology of the Proposed Buyer Interacted Cashflow Approach

As concluded from Chapter 2, the drawbacks of existing housing delivery approaches are:

1. Cost of Finance constitutes a substantial part of the Total Cost of Delivery. This affects the overall Cost and Profitability of housing developments;
2. The Buyer is the end recipient of the Financial consequences of delivery;
3. Profitability of housing ventures are less certain;
4. Volume of delivery is far lower that the volume of demand; and
5. Competitive pricing infers a higher level of risk for the developer.

To overcome these drawbacks, a Buyer Interacted Cashflow approach has been proposed with the following six main principles:

1. The Buyer will be considered as a resource contributor from project inception

2. Cash inflow from the buyer will be contributed to the project S.P.V account
3. Buyer inflow can positively impact the S.P.V account balance and invariable Cost of Finance
4. Cost of Finance savings will constitute additional profit (i.e. Interacted Profit)
5. Potential increase in profit can translate to a potential reduction in Markup
6. A reduction in Markup will translate to Lower Sales Prices and as such a more competitive stance for the developer.

The proposed Buyer Interacted Cashflow System imitates the processes illustrated in Figure 3-2 through three main modules:

1) The Input Module;

2) The Process Module; and

3) The Output module.

Although the proposed framework consists of the aforementioned three modules, the set of analyses to support developer decisions is described in three analysis stages:

1) The Markup Percentage Analyzer; generates Markup analysis reports

2) Buyer Interacted Cashflow Analyzer; generates a report that outlines the expected confidence level of specified forecasts, and

3) The Marketing Analyzer; generates reports on Marketing approach for attaining selected outcomes.

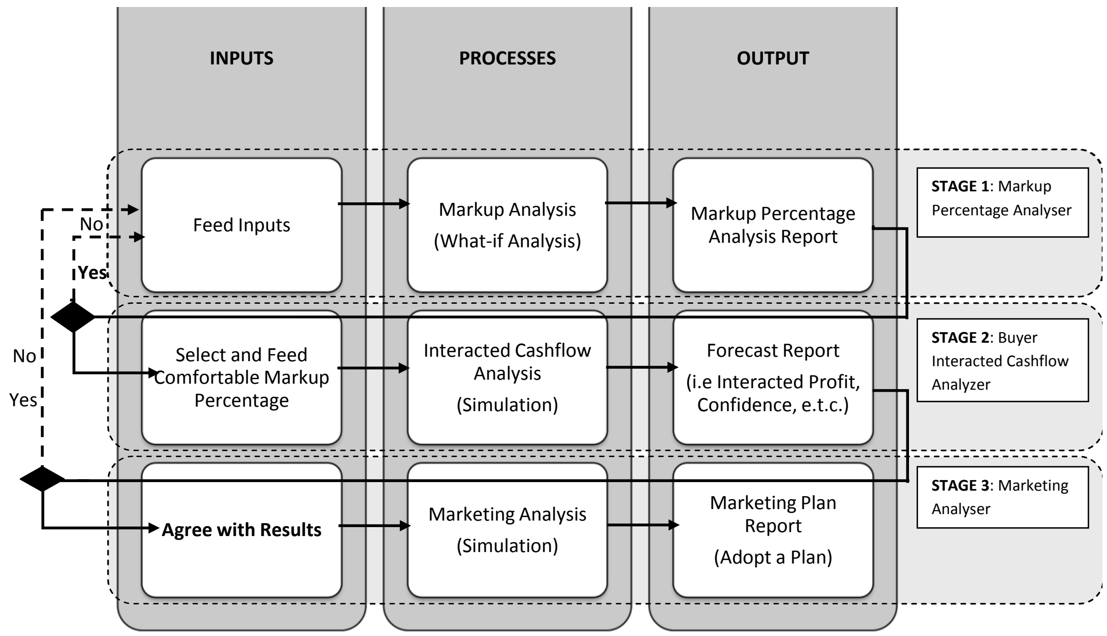


Figure 3-2: Process outline of the proposed Buyer Interacted Cashflow Simulator

The following sections will present the outlined modules (Input, Process and Output) in detail covering their sub-modules, required data sets and the nature of computations within them. First, an overview of the expected decision support outputs and their relevance to the decision requirements of the developer will be presented. This will be followed by an overview of the data set required to constructively and realistically generate the expected outputs. The processes by which the data is utilized to generate the required outcomes will be outlined based on the two levels of abstraction detailed in section 2.3.2. Finally, the output modules of the system will be presented with illustrations of the three stages of analysis detailed in Figure 3-2.

3.2 Framework Expected Outcomes

The expected outcomes of the decision support system are 1) Markup Analysis Reports, 2) Buyer Interacted Cashflow Reports, and 3) Marketing Analysis Reports.

The Markup Analysis Report: is generated to examine the effects of Markup percentage variations using what-if analyses (stage 1). As this report will show the impact of a range of markup-percentages on the Internal Rate of Return of the project, decision makers will be able to select a comfortable markup (Figure 3-3). Once a satisfactory markup is determined, the decision maker can proceed to the next stage of analysis in which the selected markup percentage represents the input for this stage.

The usefulness of this operation (outcome) is to enable the developer measure the possible effect of buyer interaction on a projects internal rate of return. This allows a measurable understanding of what Markup percentage will be required in order to provide a balance between a desired rate of return and the overall confidence of achieving them.

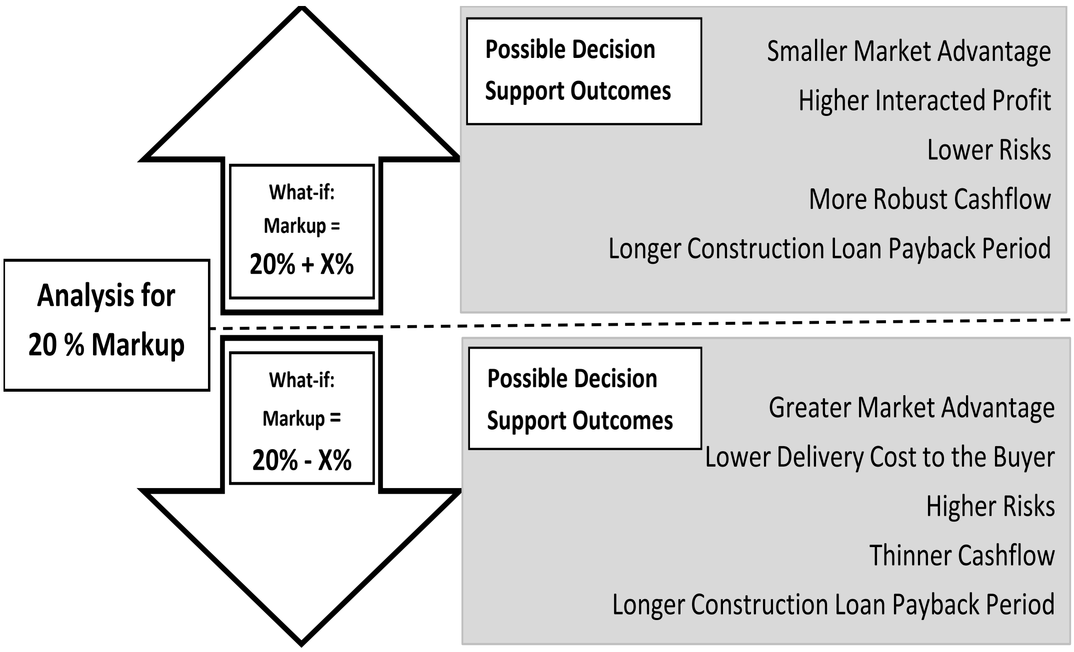


Figure 3-3: Example: Decision Support for the Choice of Markup

The Buyer Interacted Cashflow Report: is generated to examine the effect of buyer interaction on project cashflow. This report is obtained by simulating a buyer behavior on a set of predefined forecasts (e.g., Interacted Profit) (Figure 3-4).

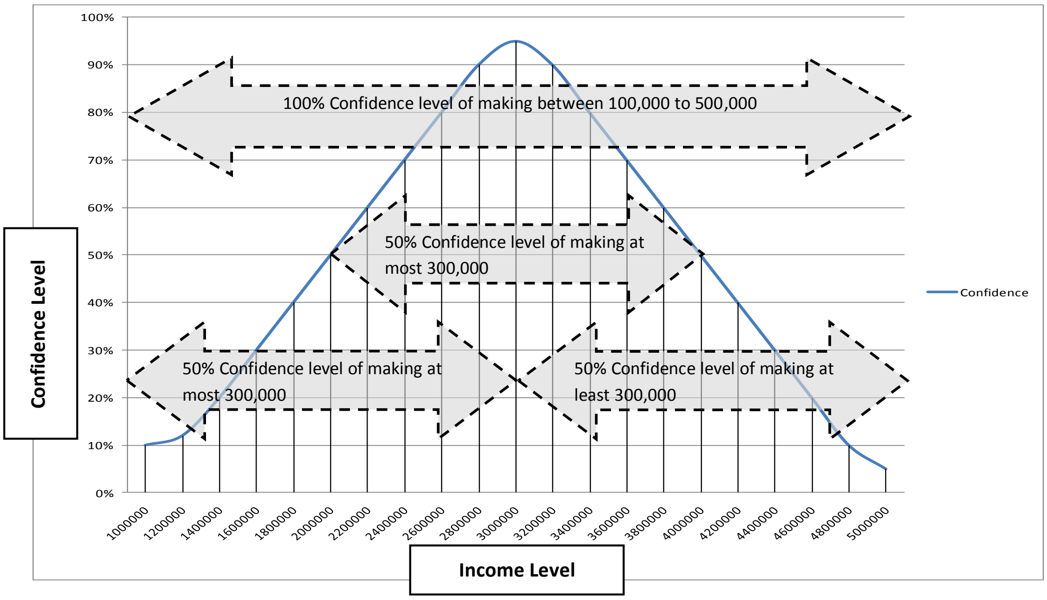


Figure 3-4: Example; Confidence level of expected outcomes

The report considers the nature of uncertainty of buyers and its impact on the overall project cashflow looking at its effect on predefined outcomes with measures for various confidence levels. Further sensitivity analysis of the effects of different payment methods on the performance of the system is carried out in this module. This will allow for correction of choice of payment options being offered by the developer. The usefulness of the outputs of the buyer interacted cashflow report is the enhancing of developers decisions with regards to the confidence level; and implicitly the risk factor associated with the Payment options with the selected Markup percentage. On evidence that a payment option has negative effects on the system, the developer can make pricing adjustments to the affected payment options or even choose not to employ them. Additionally, if the confidence level of attaining a comfortable set of forecast outcomes is not attained, adjustments can be made and a new process of Markup analysis can be initiated. Once a satisfactory confidence level is attained, the decision maker can proceed to the final stage of analysis.

Then Marketing Analysis Report: is generated to track the system behavior (i.e. buyer behavior, etc) that generates specific predefined forecast outcomes (Figure 3-5). Such reports present the decision maker with a report that allows him to visualize a specified forecast output along with the confidence level that a range of outputs can be achieved. This analysis is then presented in the form of visual outputs that will facilitate decisions in order for the developer to formulate a favorable marketing strategy.

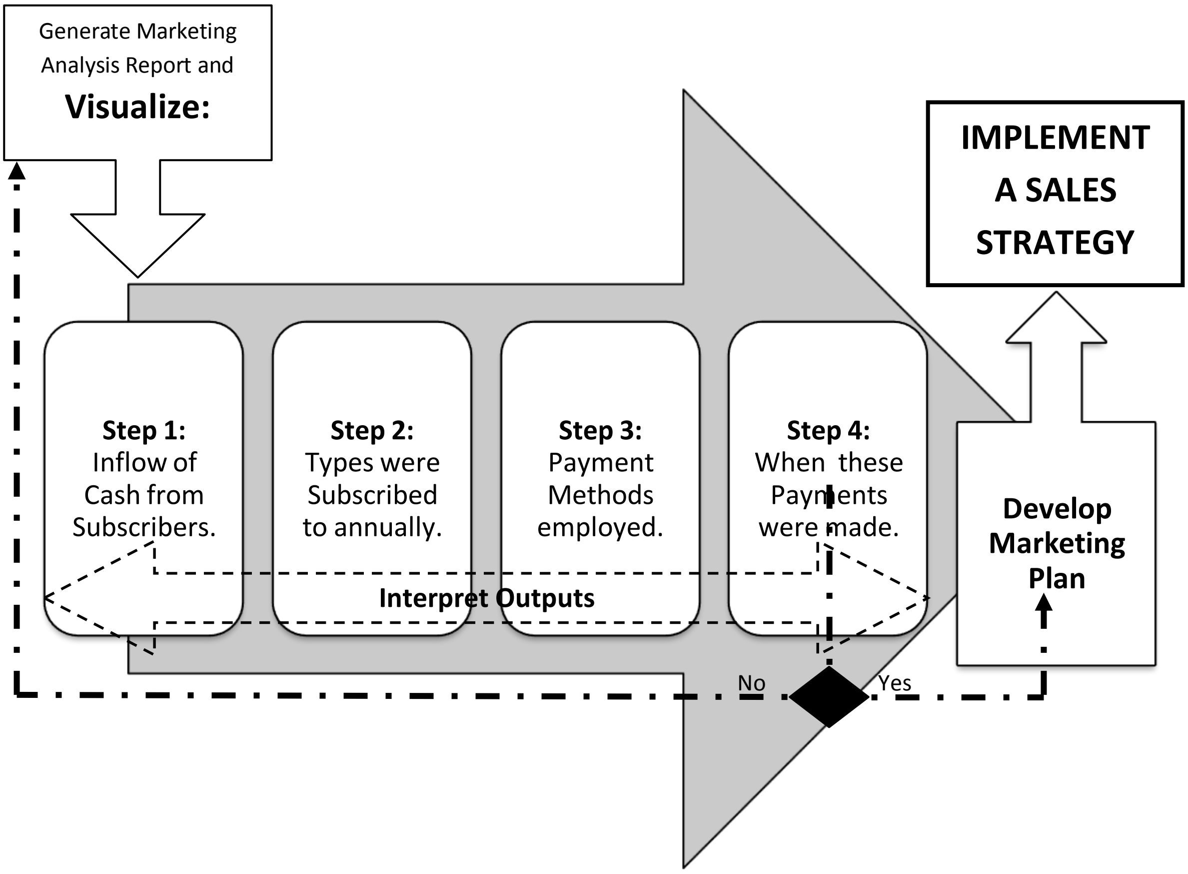


Figure 3-5: Process Outline for Marketing Analysis Report

The next section will introduce the sets of inputs that will be required in order to generate the outputs highlighted under the Output Module. These inputs are an overview of the required information with regards to the three project proponents (i.e. the developer, buyer and financier). As such these sets of required information have been simplified into three categories as will be discussed in the following section.

3.3 The Input Module

There are three input categories in this module (Figure 3-6) which are: 1) Project Related Information, 2) Buyer Related Information, and 3) Finance Related Information.

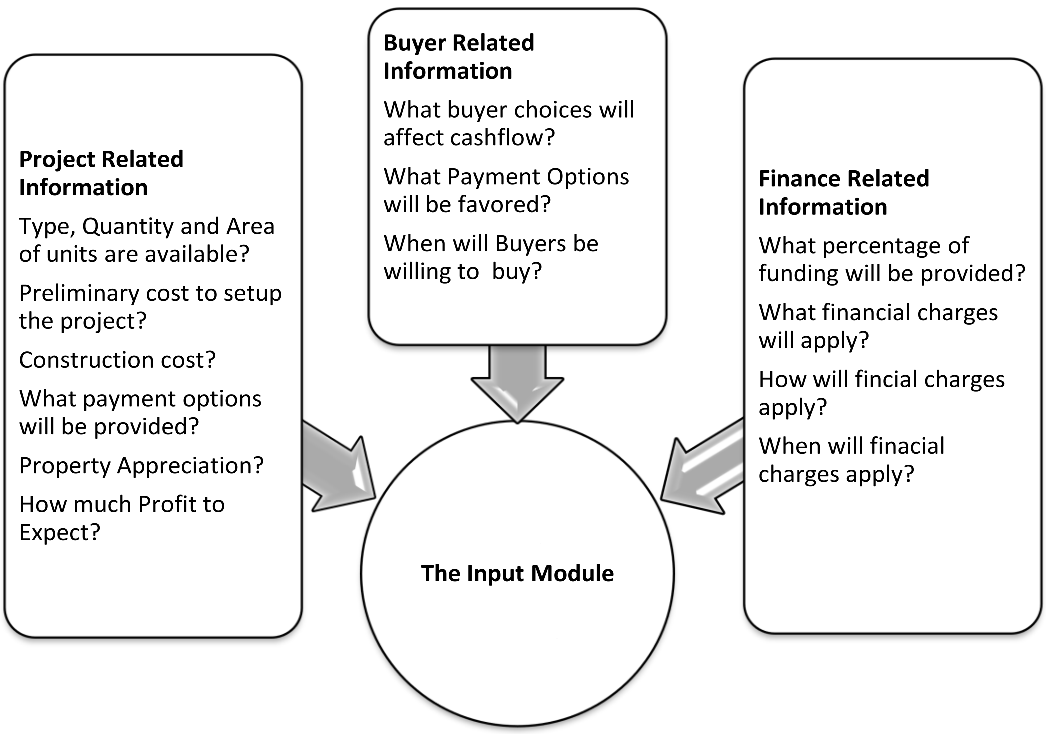


Figure 3-6: Data Grouping of the Input Module

3.3.1 Project Related Information:

The project related information includes 1) Project Physical Description, 2) Project Cashflow Information, and 3) Project Market study related inputs. These categories of Project related Information is presented as follows:

3.3.1.1 Project Physical Description

This includes the physical description information for the project covering:

1. **Location of development;** In order to contextualize the assumptions;
2. **Possible types of housing units available;** in order to classify costing and
3. **Quantities and the area of their plans;** in order to quantify available space for sale.

This data set allows the developer to input the number of available housing unit over different house types, along with the area of each floor plan. The input values are illustrated as:

- Total Number of Housing Units ($H_{(T)}$)
- Total Area of Housing Units ($H_{(T)(A)}$)
- House Type ($H_{(X)}$)
- Total Number of House Types (T) Available ($H_{(T)(T)}$)
- House Type Area ($H_{(X)(A)}$)

3.3.1.2 Project Cashflow Description

There are two categories of cashflow inputs that are required. These are 1) the project cashout and 2) the preliminary costs.

Cashout is a reflection of the cash requirements as accumulated from the project schedule. This reflects the direct cash requirements for executing project activities on a time stepped basis. The cashout is an indication of what amount will be required as drawdown from resource (cash) pool in order to successfully complete the development. Preliminary Costs add up to the overall cost of delivery of a project. As such, provision is made to allow for preliminary input within this module. They include:

- Land Costs
- Insurance and Legal Costs
- Bank Bond/Advanced Performance Guarantee Costs
- Governmental Costs
- Promotional/Marketing Costs, etc.

3.3.1.3 Project Market Survey Related Input:

Though market surveys are indispensible, in this research effort, the scope does not include the actual conducting of a market study. In contrast, data regarding such market surveys are supplied by the developer. In order to ensure ease of use, the developed approach has provided for the data categories acquired in the field research. Project market survey related input allows the user to input the following:

1. **Preliminary Cost**; incurred in setting up the project along with
2. **Projected Property Appreciation Rate**; assumption for the annual property appreciation
3. **Markup Percentage**; the initial Markup percentage that generates a comfortable expected profit for the developer relative to the market average.

4. **Available Payment Options**; how buyers are supposed to pay their probable distribution and the additional charges that accrue to each option.
5. **Possibility of Sales**; possible distribution of unsold units based on average market pricing comparative.

The inputs parameters are further classified and illustrated in the preceding sections.

1. Payment Options

There are two payment methods being investigated in this research; the full payments, and the monthly installments (Figure 3-7). This category of inputs allows the developer to make indications of the duration and down payments to be considered for which ever payment method is chosen. Additionally, as was discovered in practice, developers usually consider withholding a certain percentage of the development in order to create a form of artificial scarcity and provide for some units to be sold for additional profit in the secondary market. This input value also overlaps with the possibility of not being able to make sale of some housing units. Consequently, the developer is also able to input assumptions of the possibility of having unsold units in customizing the distributions.

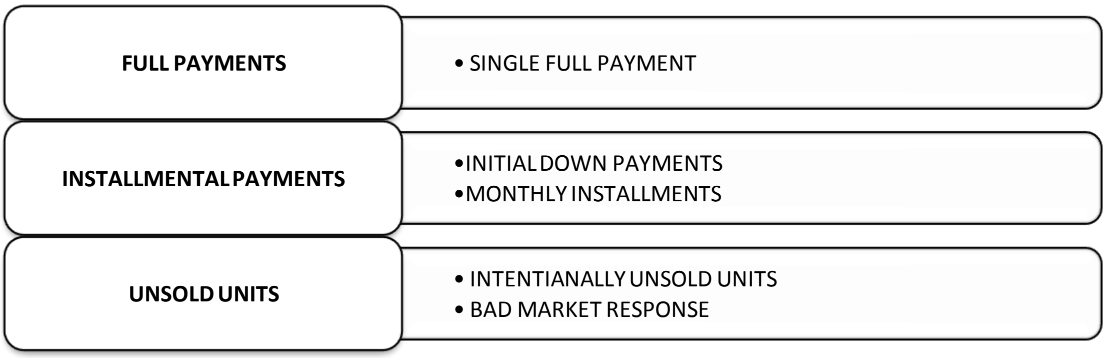


Figure 3-7: Available Payment Options

The available payment methods for this study are illustrated as follows, however, payment options can be configures to the context of any intended study:

- Full Payment $M_{(F)}$
- X Year Payment Plan ($M_{(X)}$)
- Non-Subscription (Unsold Units) ($M_{(0)}$)

The developer would also require input values with regards to the possible down payment charges that may accrue to payments. The down payments are illustrated as:

- Down Payment on Full Payment ($E_{(F)}$)
- Down Payment on Y Year Payment Plan ($E_{(Y)}$)

2. Property Appreciation and Markup

The last sets of inputs found in this data set are the assumptions of annual property appreciation and the expected Markup value which are illustrated as:

Annual Property Appreciation ($A_{(P)}$)

Markup Percentage ($Z_{(M)}$)

The Markup Percentage ($Z_{(M)}$) is used to derive the Markup Value ($Z_{(A)}$) illustrated by:

$$Z_{(A)} = (T_{(D)} + C_{(P)})\, Z_{(M)}) \qquad \text{...(1)}$$

Where:

$T_{(D)}$ = Total Direct Cost of Delivery

$C_{(P)}$ = Preliminary Costs

3.3.2 Buyer Related Inputs

Inputs regarding buyer behavior are required in order to measure the effect of buyer inflow. However, buyer behavior cannot be predicted with certainty, as such assumptions of probable behavioral outcomes will suffice. Assumptions allow for the customizing of distributions of buyer behavior within the simulation process. The effect of which is the achievement of a more realistic set of scenarios with lesser volume of simulation runs (Figure 3-8). This is much like the process of applying constraints in an optimization process. Constraints govern the domain of solutions for optimizations processes much as a custom distribution constrains the probable (realistic) region of possible predicted scenarios. The two assumptions of the developed system are:

1. **Payment Distributions**; the probable distribution of buyer over the available payment options. This is indicative of a preliminary market survey, historical data regarding buyer behavior in terms of popular payment options, experiential projections from an experienced developer or it can be an input based on pessimistic or optimistic preferences; and
2. **Annual Percentage of Participation**; the probable distribution of buyers over the sales period. It was deduced from field research that buyer response is directly affected by the perceived success of the development which reflects in the rate of project completion (all things being equal). As such, the developer can rely on the annual projected rate of completion for the expected input values for this parameter. This can be deduced from the project schedule. This is required to create a parallel between project progress and user enthusiasm.

As highlighted earlier, assumptions of the probable distribution of the buyers over the available payment methods, along with the assumptions of annual distribution of buyers, are used to customize the distribution of the simulation. Together they are combined to form the envelope within which the simulation is constrained as illustrated in the example in Figure 3-8.

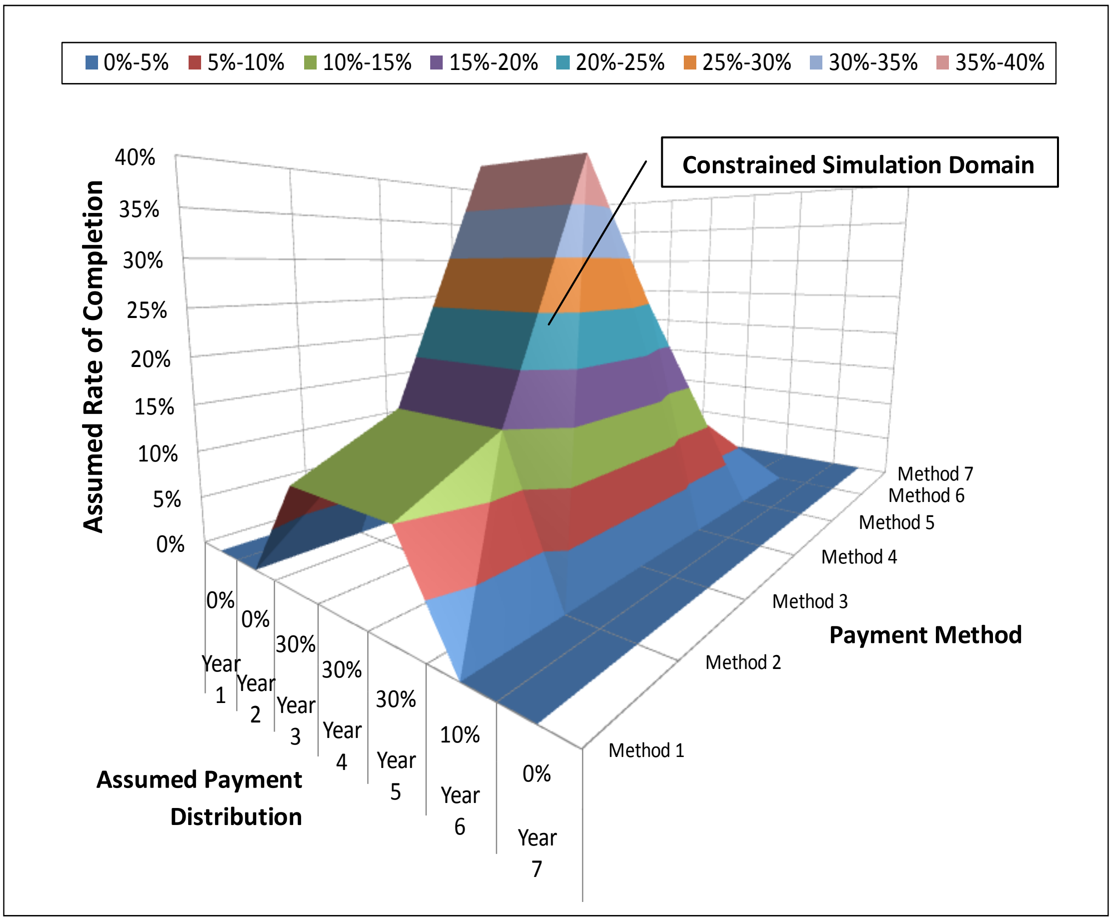


Figure 3-8: Constraining Effect of Assumptions

This custom distribution is affected by the choice of Markup; i.e. Sales Price as discussed in section 2.5.5. As such, the initial price P_{min} can is derived by providing a Markup Value that matches the average market price. The equivalent sales quantity at this price is based on the intended policy or market experience of the developer.

P_{max} will be the sales price based on the maximum markup value; a sales price that is lower than the market value will be considered as selling at maximum expected sales for less profit.

While a sales value that exceeds the market average will vary the possibility of sales (i.e. fewer sales). As such Q_{max} is the maximum expected sales while Q_{min} is derived from the price sensitivity indicated from market survey or industry experience. This provides use with the demand function for the case in question. Based on this function the price determined demand, Q_2 can be determined. The determining of the possible demand, the custom distribution is adjusted in ration to the preferred payment options indicated.

3.3.3 Finance Related Inputs

In this module, the developer is required to supply data (in percentage value) regarding the cost of finance charges. This module can be customized to cater for the contractual bases of cost of finance charges and the timing. These charges culminate into the total cost of finance $F_{(T)}$ and The general nature of finance charges have been explained in section 2.8. Illustrations of some of these input values are:

- Equity Contribution ($F_{(E)}$)
- Overdraft Facility ($F_{(O)}$)
- Interest Rate (Fixed) ($F_{(I)}$)
- Annual Management Fee ($F_{(M)}$)
- Annual Commitment fee ($F_{(C)}$)
- Utilization Fee ($F_{(U)}$)
- Other Fees ($F_{(X)}$)

After all the required data sets are inputted, some sequential processes are required in order to generate the expected outcomes. These processes, their sequences, the data set they require, their computations and the output they generate all culminate into the machinery that generates the expected outputs of the decision support system. These processes are presented in the following sections.

3.4 The Process Module

There are four processes executed in the process module. They are; 1) Project Cashflow Accumulation 2) Subscription Simulation, 3) Buyer Inflow Accumulation and 4) The Buyer Interacted Cashflow Accumulation. These modules are the platform with which the resource-interacted processes between the Buyer, Developer and the Financier towards delivery cost accumulation are modeled (Figure 3-9). The processes of this layer are described in the following sections.

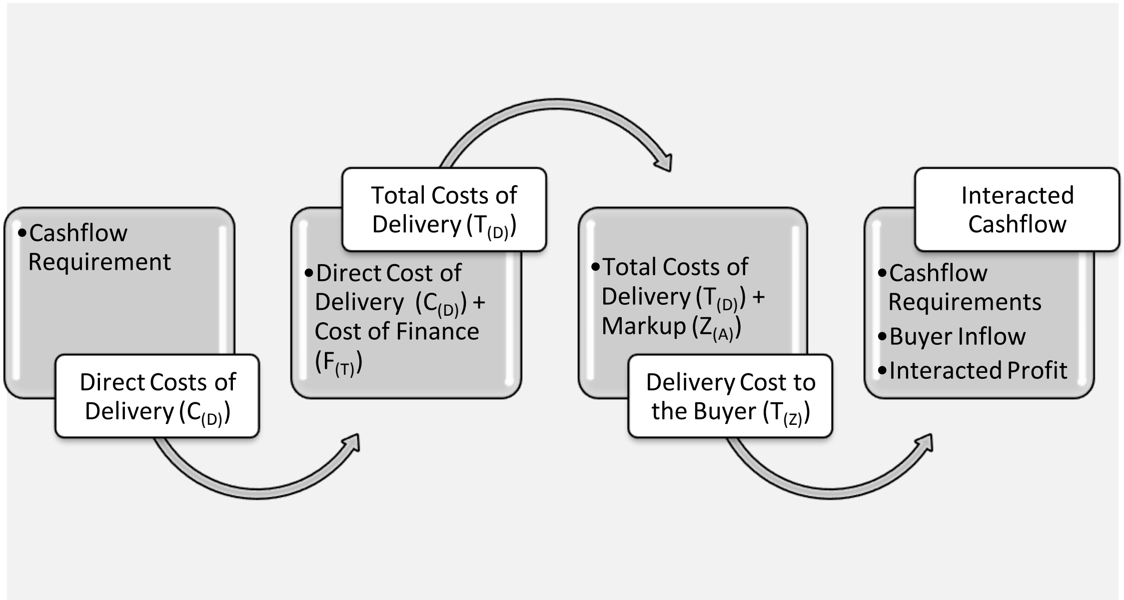


Figure 3-9: Delivery Cost Accumulation Process

3.4.1 Project Cashflow Accumulation

This process makes use of the project cashout schedule. The project cashout schedule is a reflection of whatever project scheduling approach or contractual obligations are required to complete the project. Most importantly, this cashout input provides a time stepped finance requirement and it presents us with the total direct cost of delivery ($T_{(D)}$).

The process considers that finance provided for the project is offered in an overdraft account which provides a resource pool from where the developer can access finance towards project delivery. This resource pool is referred to as the S.P.V account. An S.P.V is described in section 2.7. The output of the processes in this module is the Total Delivery Cost to the buyer ($T_{(Z)}$) which is calculated as follows:

$$T_{(Z)} = T_{(D)} + F_{(T)} + C_{(P)} + (T_{(D)} + C_{(P)})\, Z_{(M)} \quad \text{.............................}(2)$$

$T_{(D)} =$ Total Direct Cost of Delivery = $\sum$ Cashout

$$F_{(T)} = \sum F_{(I)} + \sum F_{(M)} + \sum F_{(C)} + \sum F_{(U)} + F_{(X)} \quad \text{.............................}(3)$$

$$\sum F_{(I)} = F_{(I)t} + F_{(I)t+1} + F_{(I)t+2} + \ldots F_{(I)t+n} \quad \text{...........................}(4)$$

Where t= monthly time steps

$$F_{(I)} = \text{Account Balance X (Annual Interest Rate/12)} \quad \text{...........}(4i)$$

$F_{(I)}$ is only calculated on the negative account balance on the overdraft account.

$$\sum F_{(M)} = F_{(M)t} + F_{(M)t+1} + F_{(M)t+2} + \ldots F_{(M)t+n} \quad \text{.....................}(5)$$

Where t= Annual time steps

$$F_{(M)} = \text{Account Balance X Annual Management Rate} \quad \text{.........................}(5i)$$

$F_{(M)}$ is only calculated on the negative account balance on the overdraft account.

$$\sum F_{(C)} = F_{(C)t} + F_{(C)t+1} + F_{(C)t+2} + \ldots + F_{(C)t+n} \ldots\ldots\ldots\ldots\ldots\ldots\ldots (6)$$

Where t= Annual time steps

$F_{(C)}$ = Undrawn Account Balance X Annual Commitment Rate …………...(6i)

$F_{(C)}$ is only calculated on the undrawn facility of the overdraft account.

$$\sum F_{(U)} = F_{(U)t} + F_{(U)t+1} + F_{(U)t+2} + \ldots + F_{(U)t+n} \ldots\ldots\ldots\ldots\ldots\ldots\ldots (7)$$

Where t= monthly time steps

$F_{(U)}$ = Utilized/Drawn Amount X Annual Utilization Rate/12) …………...(7i)

$F_{(U)}$ is only calculated on utilization of fees on the overdraft account.

$F_{(X)}$ = Refers to one-off charges

3.4.2 Subscription Simulation

This module simulates the probable buyer behavior for the project. It utilizes data gotten from project related information. This information regarding house type, number of units and total available number of units are used to simulate the distribution of buyers over specific house types. The total number of active buyer subscriptions is deduced from the maximum number of units being developed. The assumptions for payment year and payment method for each buyer are the variables that are simulated with an additional payment method used to account for unsubscribed housing. The probable distribution of the assumptions is derived from project market survey related inputs as described in section 3.3.2.

3.4.3 Buyer Inflow Accumulation

The buyer inflow accumulation module calculates the inflow from the buyer based on the cost per square meter ($C_{(sq)}$) at the time (t) of buyer engagement ($C_{(sq)t}$) multiplied by the Area of the plan ($H_{(X)(A)}$). While the area of the plan is an input, the baseline cost per square meter ($C_{(sq)}$) is derived as:

$C_{(sq)}$ = Total Delivery Cost/Total Area of Housing Units

$C_{(sq)} = T_{(Z)}) / H_{(T)(A)}$ ………………………………………………………..…..(8)

However, the cost at the time of buyer engagement is a function of the appreciated value of the development, the selected payment method and the time of engagement. As such the buyer inflow module calculates this variance in cost through a cost per square meter matrix using the values Annual Property Appreciation $A_{(P)}$ and the Cost per square meter $C_{(sq)}$. These values are retrieved based on the simulated payment method and year. The generic loan payment amortization equation of the Cost per Square Meter matrix is given as [42]:

$$C_{(sq)(m)(t)} = C_{(sq)(B)(t)} \cdot \frac{R(1+R)^n}{(1+R)^n - 1} \quad \text{(9)}$$

Where:

m represents method of payment

t represents time of payment (Year)

B represents baseline cost for full payments at year t

n represents maximum loan servicing period for payment method

R represents the interest rate for the loan

As such the delivery cost to buyer (B) paying with Method (y) in year (x) is given by:

Inflow from buyer (B) = Area of House Type Plan x Cost per square meter

$$I_{(B)} = H_{(X)(A)(B)} \times C_{(sq)x(B)y(B)} \quad \text{...(10)}$$

The Buyer Inflow Module outputs the total annual inflows ($\sum I_{(A)}$) over the construction duration these are represented as $\sum I_{(A)1}, \sum I_{(A)2,\ldots} \sum I_{(A)n}$. The total monthly inflows ($\sum I_{(M)}$) over the period of construction are also represented as $\sum I_{(M)1}, \sum I_{(M)2,\ldots}$, $\sum I_{(M)5}$. Finally, the total monthly post delivery inflows ($\sum I_{(P)}$) are outputted as $\sum I_{(Y)1}$, $\sum I_{(Y)2,\ldots}$, $\sum I_{(Y)n}$. These total costs represent the total of all buyer inflows that fall under their category. This approach to inflow accumulation allows for a more realistic reflection of inflow into the project cashflow as will be presented in the Buyer Interacted Cashflow Accumulation Processes section.

3.4.4 Buyer Interacted Cashflow Accumulation

The Buyer Interacted Cashflow accumulation processes, introduces the buyer inflow to the project cashflow. Though all the operations of the Project Cashflow Demand Module are repeated in the Interacted Project Cashflow Module, the major difference is the introduction of inflow (payments) from the buyers which leads to a difference in the account balance of the S.P.V account. As illustrated in earlier sections, the S.P.V account acts as a resource pool for the project. Finance charges that accrue from the operation of this account are based on the committed amount, account balance and the consequent withdrawals. The inflow from the buyer reduces the required finance facility; as such Cost of Finance is minimized. The Cost of Finance saving is what is added to the Expected Profit to constitute what is defined as Buyer Interacted Profit/Interacted Profit.

Total Interacted Total Delivery Cost is calculated as follows:

$$T_{(Z)(I)} = T_{(D)} + F_{(T)(I)} + C_{(P)} + (T_{(D)} + C_{(P)})\, Z_{(M)} \quad \text{...(11)}$$

$T_{(D)} =$ Total Direct Cost of Delivery = ∑ Cashout………....………………….....(12)

$$F_{(T)(I)} = \sum F_{(I)(I)} + \sum F_{(M)(I)} + \sum F_{(C)(I)} + \sum F_{(U)(I)} + F_{(X)} \quad \text{……………….(13)}$$

$$\sum F_{(I)(I)} = F_{(I)(I)t} + F_{(I)(I)t+1} + F_{(I)(I)t+2} + \ldots\ F_{(I)(I)t+n} \quad \text{……………(14)}$$

Where t= monthly time steps

$F_{(I)(I)}$ = Interacted Account Balance X (Annual Interest Rate/12) ………..(14i)

$F_{(I)(I)}$ is only calculated on the negative account balance on the overdraft account.

$$\sum F_{(M)(I)} = F_{(M)(I)t} + F_{(M)(I)t+1} + F_{(M)(I)t+2} + \ldots\ F_{(M)(I)t+n} \quad \text{……….(15)}$$

Where t= Annual time steps

$F_{(M)(I)}$ = Interacted Account Balance X Annual Management Rate ……….(15i)

$F_{(M)(I)}$ is only calculated on the negative account balance on the overdraft account.

$$\sum F_{(C)(I)} = F_{(C)(I)t} + F_{(C)(I)t+1} + F_{(C)(I)t+2} + \ldots + F_{(C)(I)t+n} \quad \text{……….(16)}$$

Where t= Annual time steps

$F_{(C)(I)}$ = Interacted Undrawn Account Balance X Annual Commitment Rate………………………………………………………………………...(16i)

$F_{(C)(I)}$ is only calculated on the undrawn facility of the overdraft account.

$$\sum F_{(U)(I)} = F_{(U)(I)t} + F_{(U)(I)t+1} + F_{(U)(I)t+2} + \ldots + F_{(U)(I)t+n} \quad \text{……....(17)}$$

Where t= monthly time steps

$F_{(U)(I)}$ = Interacted Utilized/Drawn Amount X Annual Utilization Rate/12)……………………………………………………………………....(17i)

$F_{(U)(I)}$ is only calculated on utilization of fees on the overdraft account.

$F_{(X)}$ = Refers to one-off charges

The Interacted Profit $Z_{(A)(I)}$ expected by the Developer is given by

Interacted Profit = Expected Profit + (Cost of Finance - Interacted Cost of Finance)

$$Z_{(A)(I)} = Z_{(A)} + (F_{(T)} - F_{(T)(I)}) \quad \ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots (18)$$

3.5 Output Generation (The Analysis Stages)

The three stages of analysis illustrated in section 3.1 are presented in this section.

3.5.1 Markup Percentage Analyzer (Stage 1 Analysis):

The Markup Analysis sub-module generates report of the effect of varying Markup percentage within a range. The number of trials, range and the step sizes of each variation are all user preferences. Conducting Markup analysis will allow the developer to visually comprehend the probable effects of varying Markup values on internal rate of return of the development as illustrated in Figure 3-10.

In the illustrated example of Markup selection, a desire to attain an 80% internal rate of return can be tracked on the outputted graph to determine that the desired confidence level will be achieved within a markup range of 35% to 64%. Selling at a markup percentage that is lower than the 50% markup indicates a willingness to sell cheaper than the market average probably to improve competitiveness. While selling at a markup percentage higher than the 50% markup indicates a desire to sell at a price greater than the market average. This will imply that less units will be sold. However, there would be the advantage of having more units to sell in the secondary market. On choosing a markup percentage that makes this level of confidence for a return is acceptable to the decision maker, the process of analysis can then proceed to the second stage with the newly selected Markup percentage as an input value.

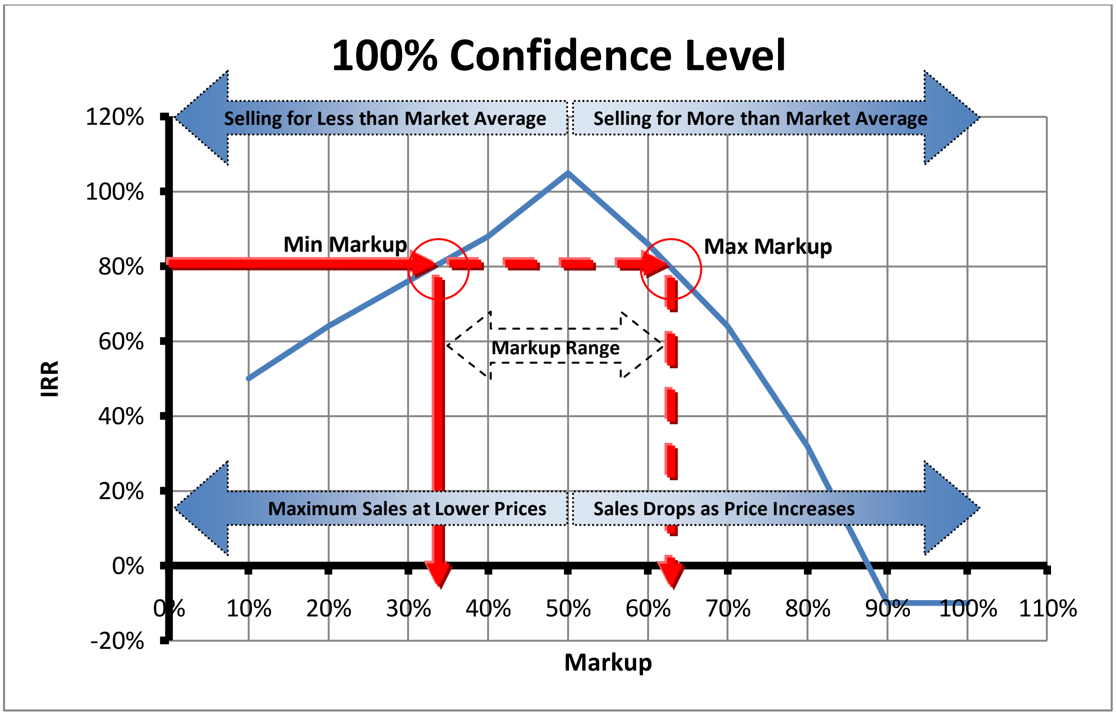


Figure 3-10: Example: Output Graph of Markup Analysis

3.5.2 The Buyer Interacted Cashflow Analyzer (Stage 2 Analysis):

The Buyer Interacted Cashflow Analyzer generates reports on the range within which preselected forecasts (i.e. Total Construction Cost, Interacted Profit, etc) will lie along with the requisite confidence level of achieving these values. This analysis makes use of the selected Markup decision derived from the Markup Analyzer. An indebt analysis of the preselected forecasts is conducted, implicitly considering the risk, through indications of the confidence level of achieving an outputted range of results. If after running this analysis, the confidence level of achieving desired outcomes are low (i.e. risks are high), the developer can then return to the Markup Analyzer to select a preferred Markup percentage and then run the Markup Analyzer again.

In contrast to going by gut feeling, the developer can actually exhaust all possibilities in measurable sets of outputs. An illustration is given in Figure 3-11where the confidence level of achieving forecasts is set at 80%. This implies an 80% risk factor for expecting these forecasts to exceed that value.

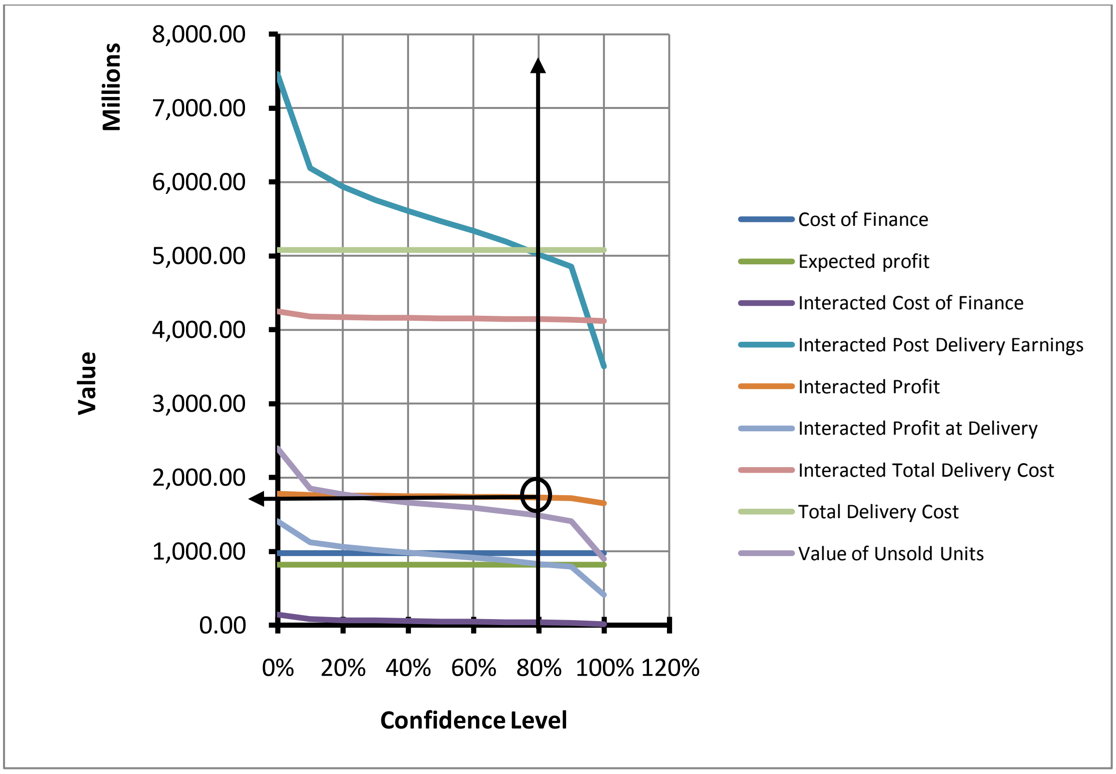


Figure 3-11: Example: Report on 80% Confidence Level of Achieving a (at least) Range of Outputs

3.5.3 Marketing Analyzer (Stage 3 Analysis):

The output of the Marketing Analyzer is a report which itemizes a user defined expected outcome showing the requisite system behavior (i.e. buyer behavior) that generates them. The outputs of this process can be used to analyze the effect of buyer behavior on the profitability of the project. As such a requisite marketing plan can be developed to propel sales towards the more profitable buyer scenario. In order to ease the interpretations of the buyer behavior, a set of visual outputs are incorporated. These outputs present a graphical representation (analysis) of the recalled scenario of system for the following:

1. Inflow Analysis: A bar chart representation of the volume and distribution of payments over the construction duration (Figure 3-12); this allows the decision maker to visualize how money might flow into the project under that scenario.

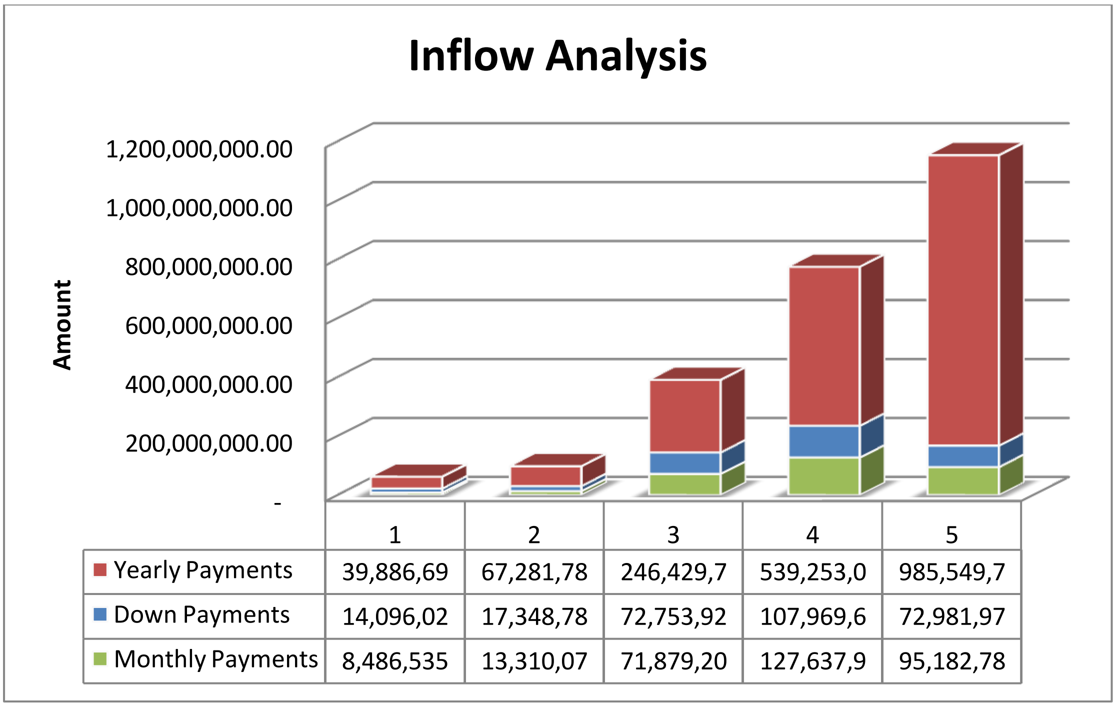
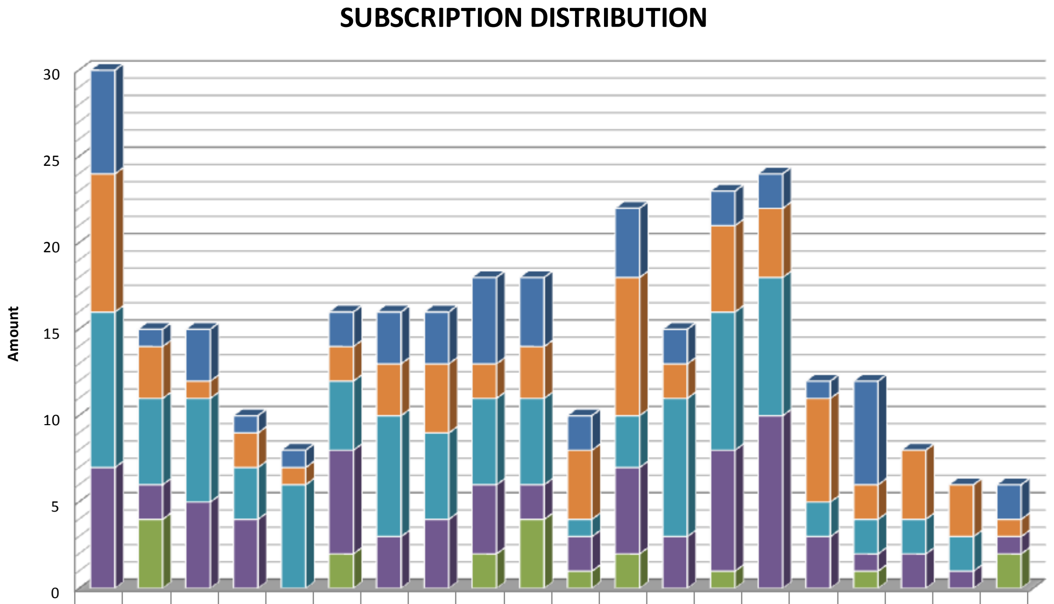


Figure 3-12: Example: Inflow Analysis

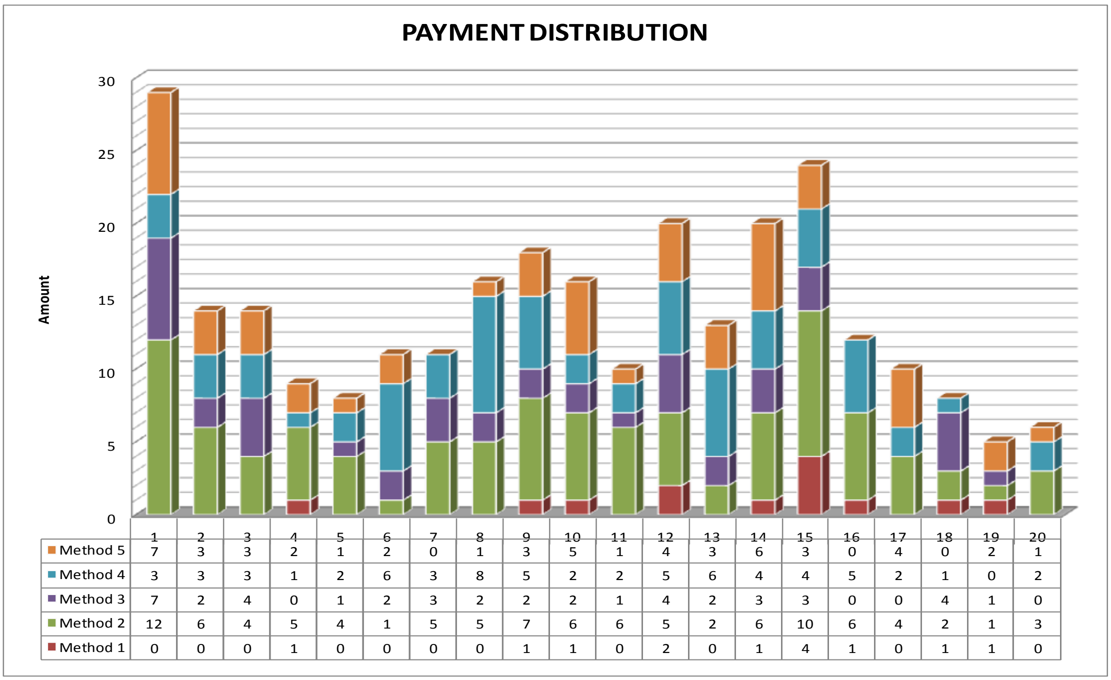
2. Subscription Analysis: A bar chart representation of the yearly volume of subscription for all the available house types (Figure 3-13); this allows the developer to visualize the probable sales distribution of house types for the development.



	A	B	C	D	E	F	G	H	I	J	K	L	M	N	O	P	Q	R	S	T
Year 5	6	1	3	1	1	2	3	3	5	4	2	4	2	2	2	1	6	0	0	2
Year 4	8	3	1	2	1	2	3	4	2	3	4	8	2	5	4	6	2	4	3	1
Year 3	9	5	6	3	6	4	7	5	5	5	1	3	8	8	8	2	2	2	2	0
Year 2	7	2	5	4	0	6	3	4	4	2	2	5	3	7	10	3	1	2	1	1
Year 1	0	4	0	0	0	2	0	0	2	4	1	2	0	1	0	0	1	0	0	2

Figure 3-13: Example: Subscription Distribution

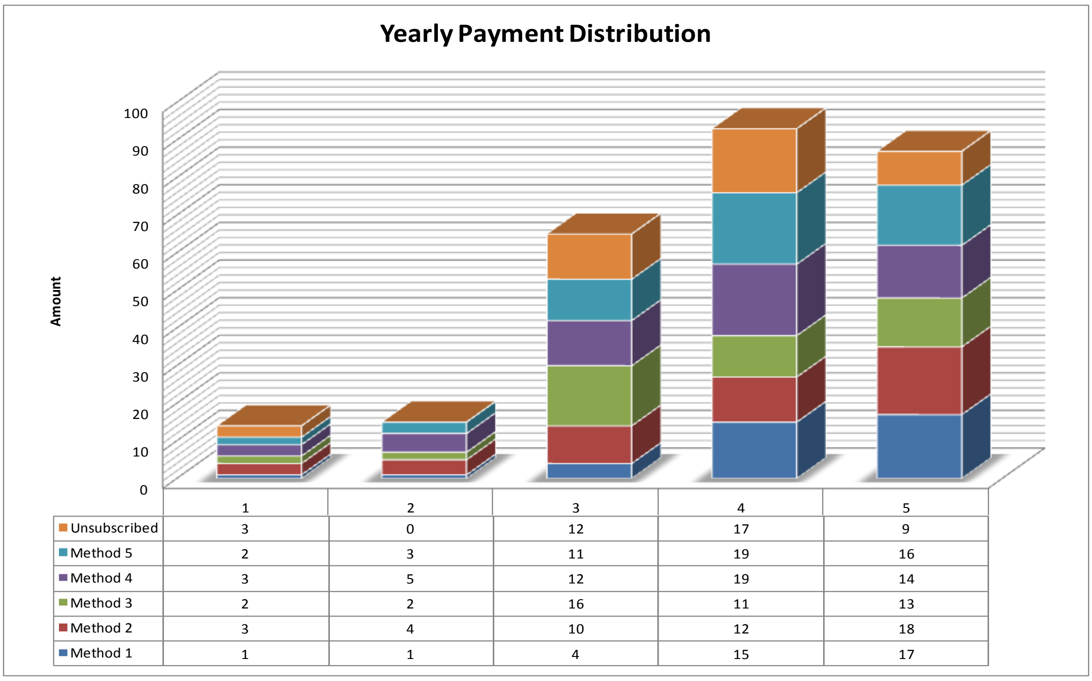
3. Payment Analysis: A bar chart representation of the distribution of payment methods over the available house types (Figure 3-14); as such not only can the developer visualize what house types were probably sold on an annual basis, but also the developer can have an idea of how much inflow each house type generates annually.



	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20
Method 5	7	3	3	2	1	2	0	1	3	5	1	4	3	6	3	0	4	0	2	1
Method 4	3	3	3	1	2	6	3	8	5	2	2	5	6	4	4	5	2	1	0	2
Method 3	7	2	4	0	1	2	3	2	2	2	1	4	2	3	3	0	0	4	1	0
Method 2	12	6	4	5	4	1	5	5	7	6	6	5	2	6	10	6	4	2	1	3
Method 1	0	0	0	1	0	0	0	0	1	1	0	2	0	1	4	1	0	1	1	0

Figure 3-14: Example: Payment Analysis

4. Yearly Payment Analysis: A bar chart representation of the distribution of the payment methods over the construction period (Figure 3-15);



	1	2	3	4	5
Unsubscribed	3	0	12	17	9
Method 5	2	3	11	19	16
Method 4	3	5	12	19	14
Method 3	2	2	16	11	13
Method 2	3	4	10	12	18
Method 1	1	1	4	15	17

Figure 3-15: Example: Yearly Inflow Distribution

5. Breakeven: A bar chart representation of the break even analysis of the development from start to end of construction (Figure 3-16); and

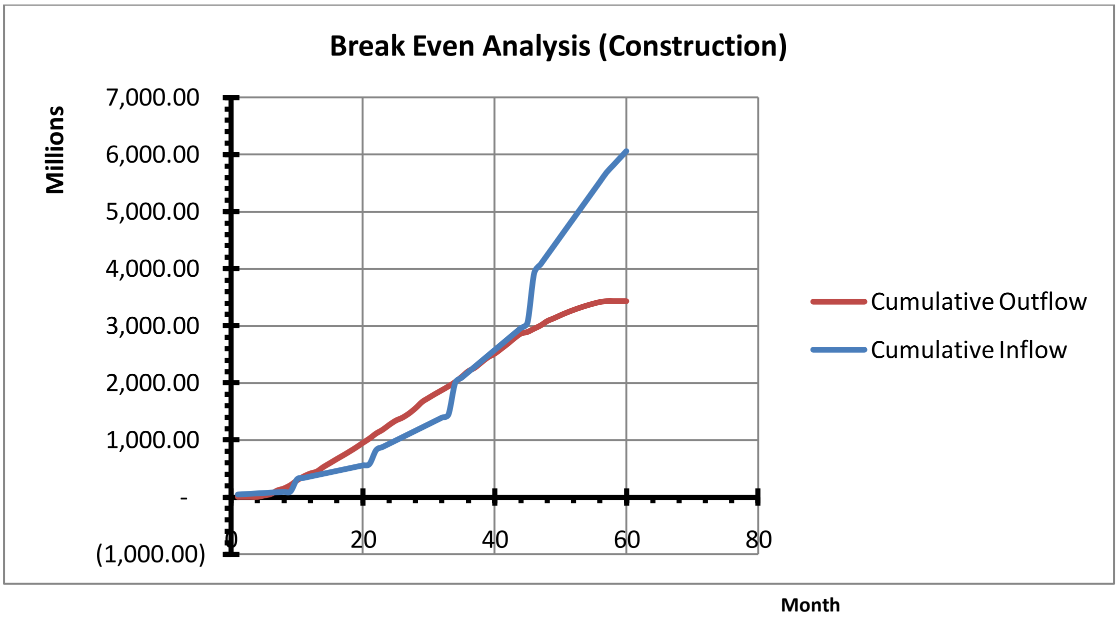


Figure 3-16: Example: Break Even Analysis

6. Breakeven (Y): A bar chart representation of the break even analysis of the development from start to the end of payment servicing years (Figure 3-17).

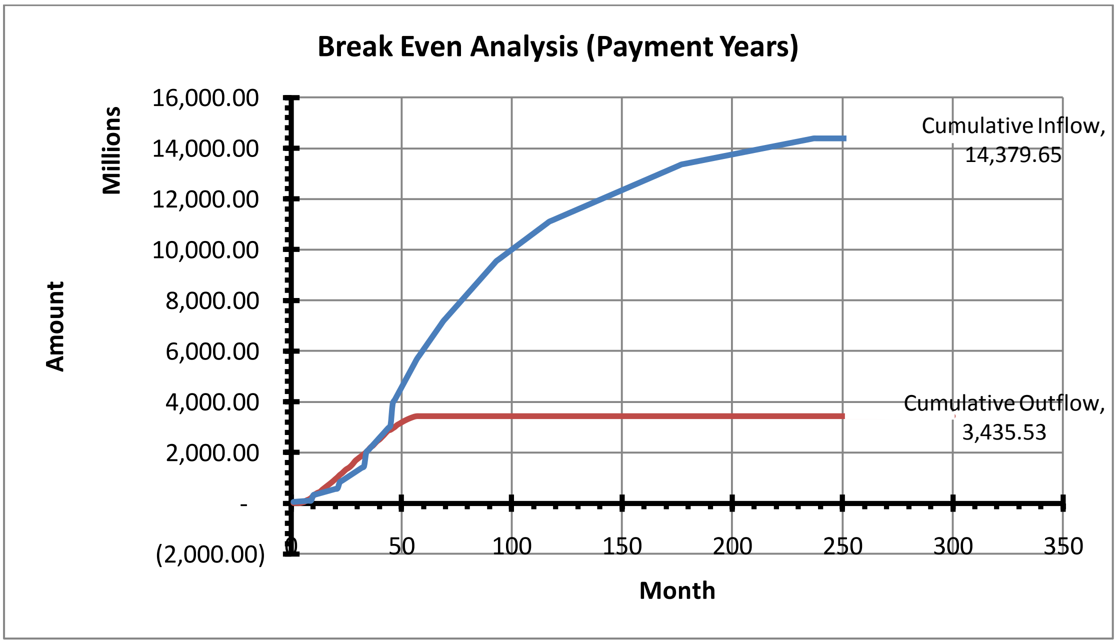


Figure 3-17: Example: Break Even Analysis for Payment Years

Based on the deductions of the Marketing report outputs, the developer can then make decisions as to which approach to employ in marketing and sales.

7. Sales Strategy: A bar chart representation of the yearly outputted sales of house types and the requisite payment options for procuring them based on the outputted scenario (Figure 3-18).

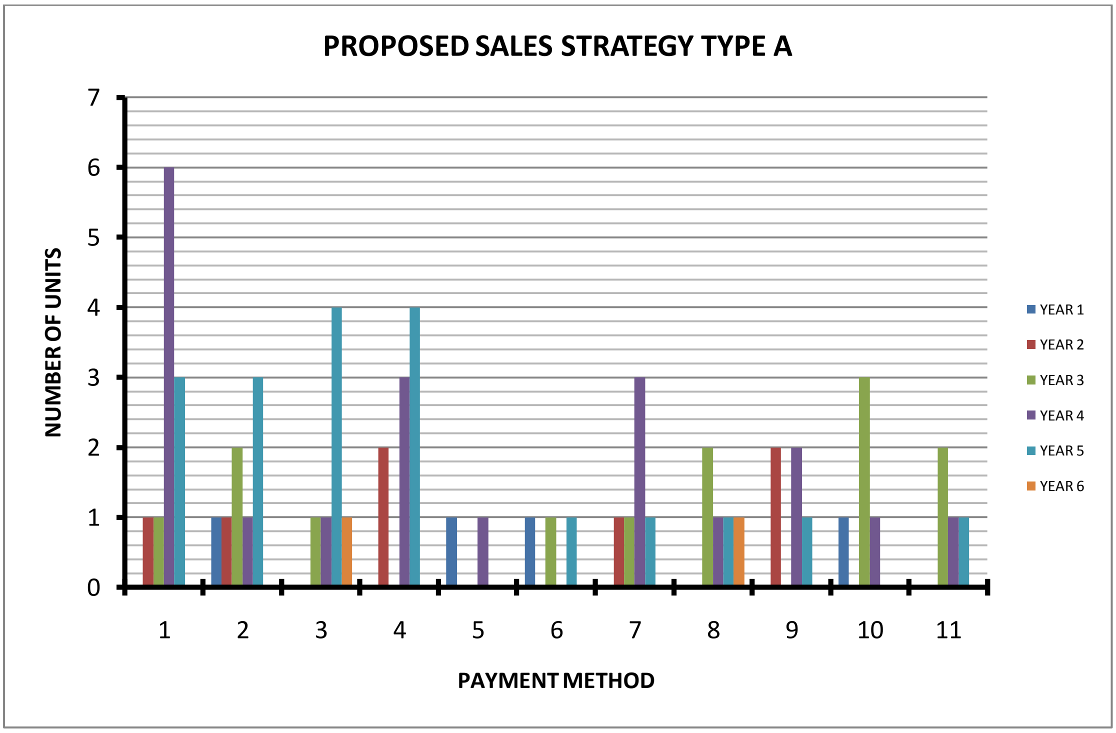


Figure 3-18: Example: Proposed Sales Strategy for House Type A

3.6 Summary

This chapter introduced the main concept of the proposed approach and all its procedures to simulating Buyer Interacted cashflow. In order to increase the confidence level and participation of private developers in the housing industry, a Monte Carlo Simulation based decision support system (ARO-META) was developed. The developed application presents the developer with a tool with which to investigate the potential effects of buyer inflow on the project cashflow. The decision support application ARO-META enables the developer to do the following:

- Input Information regarding the Housing development, Project Market Survey studies and Project Finance Options being considered.
- Choose a competitive and comfortable markup value
- See the effect of this value on the project cashflow along with the potential Interacted Profit and the confidence level of achieving it.
- Develop a sales strategy that directs buyer inflow in the required direction.

The cushioning effect of buyer participation on the Cashflow reflects in the amount of external finance that will be required and the requisite Cost of Finance. A reduction in cost of finance is the inherent addition to Expected Profit that constitutes Buyer Interacted Profit/Interacted Profit. The next chapter illustrates the implementation of the developed decision support tool (ARO-META) with step by step highlights of how the developed model functions. The developed application is also validated through the application of two case studies.

CHAPTER 4: MODEL IMPLEMENTATION AND VALIDATION

CHAPTER 4: MODEL IMPLIMENTATION AND VALIDATION

4. Introduction

This chapter presents the developed Buyer Interacted Cashflow Simulator (ARO-META). First, an illustration of the implementation of the buyer interacted cashflow approach in a macros enhanced spreadsheet environment is presented detailing the developed macros enhanced spreadsheet that manage the operations illustrated in chapter 3 and how they are connected. Then, parameters of the simulation (i.e. assumptions, decisions and forecasts) are presented as they are defined within the spreadsheet. This is then followed by a detailed illustration of the pre-configuration of the mode of operation of the three output processes. Finally, two case studies are presented for the validation of the proposed model. The first case study presents an international project located in Nigeria at its inception while the second case study is an Egyptian development that is already completed.

The developed model and details of its validation are presented in the following sections.

4.1 The Developed Model

The developed model is grouped into three major categories of sheet within the spreadsheet environment which are the 1) Input Sheet, 2) Process Sheet and 3) Output Sheet (Figure 4-1). The Input Sheets consist of the primary user interfaces of the developed application from where all input parameters as described in the previous section 3.3 are housed. The Process are a set of sheets in the spreadsheet application that handles the processes, resource abstractions and relationships that are required for the successful completion of the project as detailed in section 3.4.

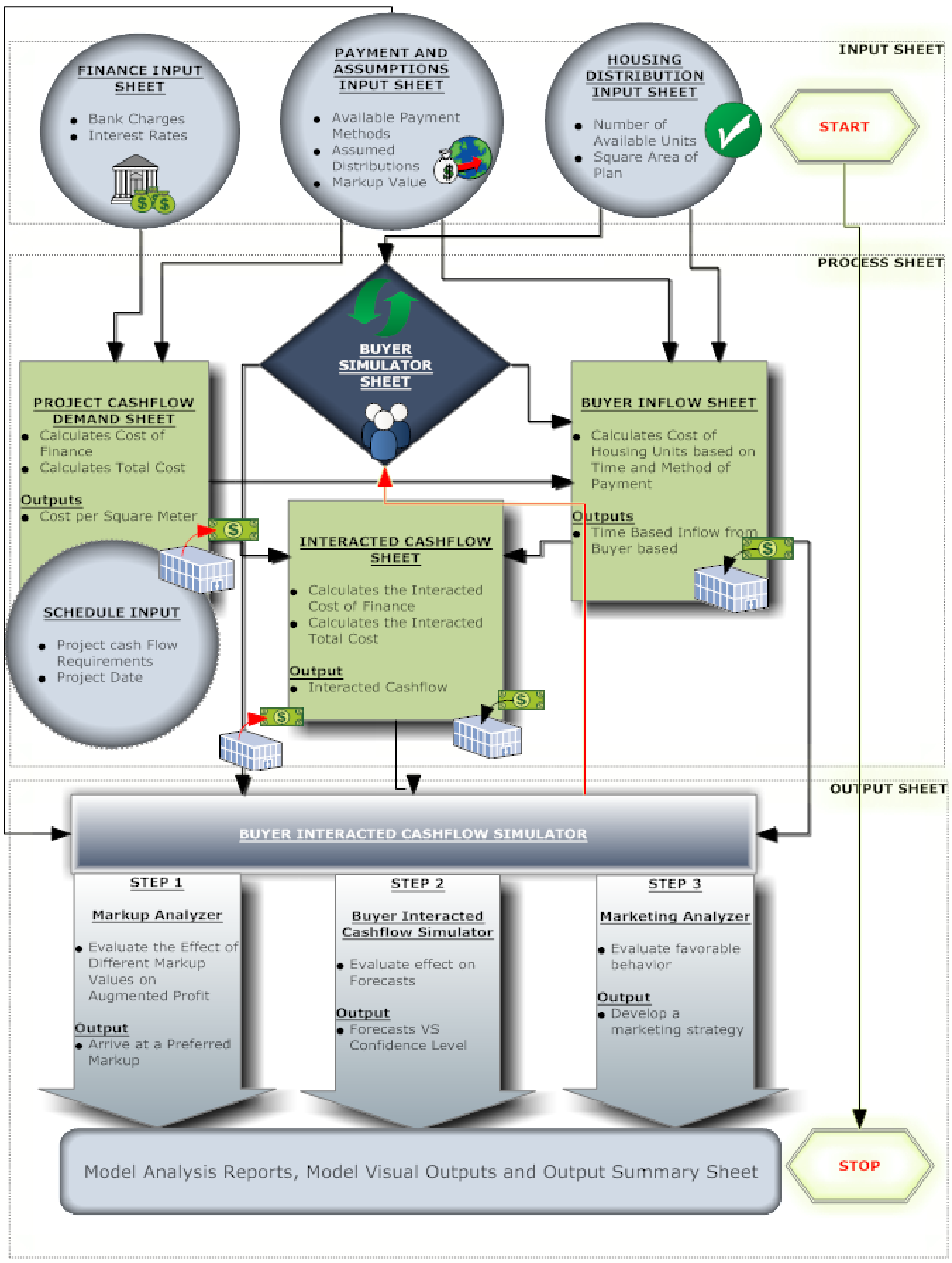


Figure 4-1: Implementation of the Proposed Buyer Interacted Cashflow Approach

Within the Process Sheets, the Total Cost of Delivery is calculated in the Project Cashflow Demand sheet; this is then transferred to the buyer within the Buyer Inflow sheet. The Nature of buyer inflow is then simulated within the Subscription Simulation sheet based on the governing assumptions from the Input sheets. The effect of this inflow is captured in the Interacted Cashflow sheet which combines the potential inflow of the buyer with the cashflow generated by the project cashflow demand sheet.

The summary of all model outputs and the expected forecasts of the developed application are captured within one sheet; the summary of model outputs sheet. This sheet conveniently captures the outputs of concern thus making it easy to view them in automated visual outputs illustrated in section 3.5.3. The three analysis processes described in section 3.5 are creatively programmed into three separate macros buttons for user ease and comfort. These buttons are housed within the welcome sheet and the model summary sheet of the developed application. The macros enabled buttons are initialized in order to obtain a report on the simulation of buyer interaction as described in section 3.2. The details of the developed model will be described in the following sections.

4.2 The Welcome Interface

The first interface the user is presented on running the application is the welcome screen illustrated in Figure 4.2.1. This screen is divided into five parts which are 1) User Instructions, 2) Inputs, 3) Outputs, 4) Processes and the 5) Visual Outputs. The conspicuous User Instructions provides the user with the instructions for running the application.

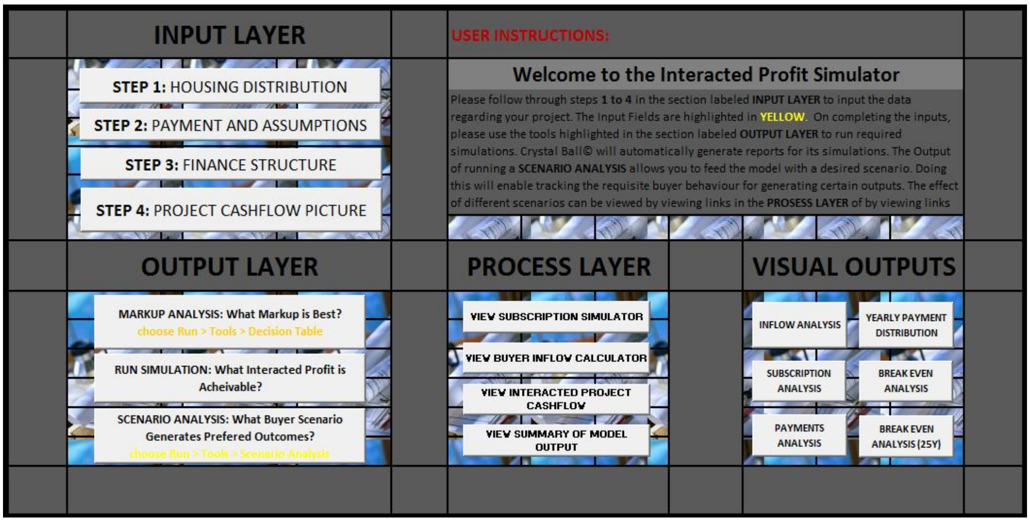


Figure 4-2: Welcome Interface (ARO-META)

4.3 The Input Sheets

There are four Input sheet in the Input module; three of them are stand alone interfaces while the fourth is imbedded in the Project cashflow demand sheet. The stand alone interfaces are the 1) Housing Distribution Spreadsheet 2) Payments and Assumptions Spreadsheet 3) Finance Spreadsheet and 4) Project Cashflow Demand Spreadsheet. Entry data is fed into the decision support tool through the four input interfaces as will be illustrated in the following sections.

4.3.1 Housing Distribution Inputs Sheet

This interface (Figure 4-3) allows the developer to input project related information (section 3.3.1) such as the number of available housing unit over twenty different house types, along with the area of each floor plan. In this prototype model, the layout only allows for a maximum of 20 typologies and a maximum of 500 housing units in all. This can however be customized to the peculiarities of its implementation.

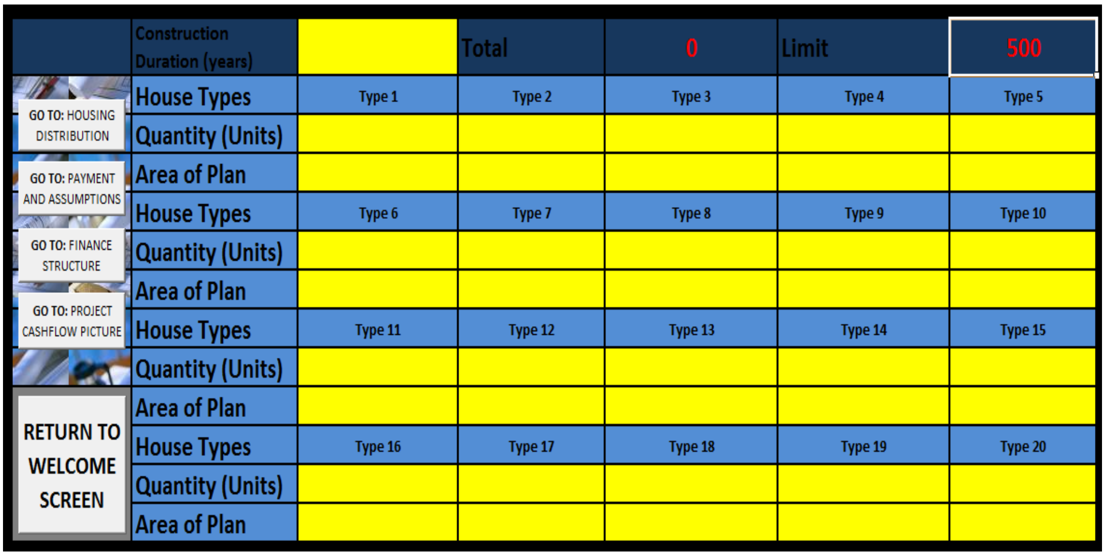


Figure 4-3: The Housing Distribution Interface

4.3.2 Payment and Assumptions Input Sheet

This interface (Figure 4-4) allows the user to input buyer related information along with market survey information (sections 2.5.5, 3.3.2and 3.3.1.3) such as payment options; their probable distribution, and the additional charges that accrue to each option.

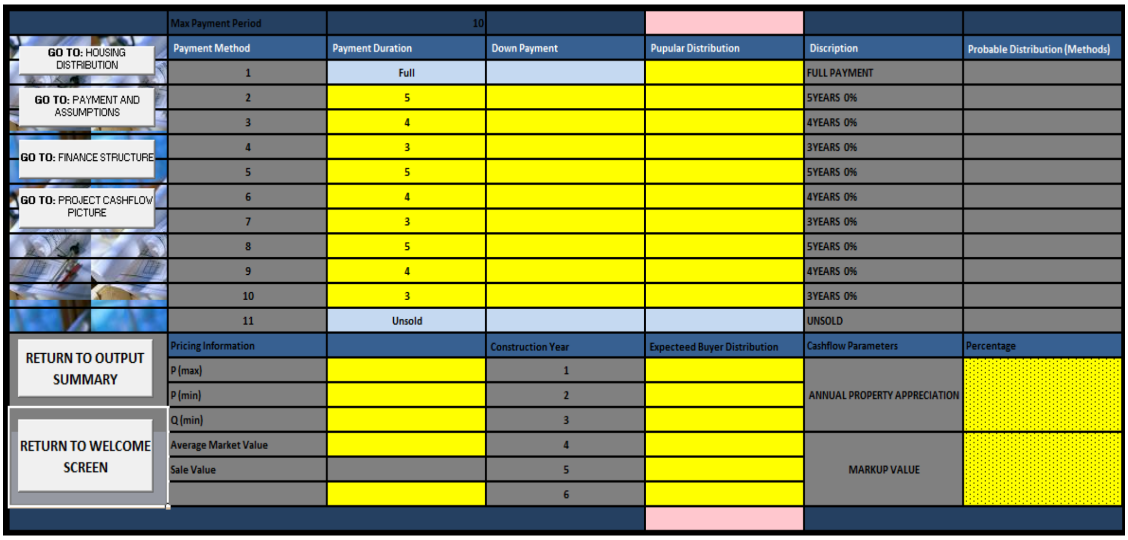


Figure 4-4: The Payment and Assumptions Interface

It also allows the input of all preliminary cost incurred in setting up the project along with the annual percentage of buyer participation, assumption for the annual property appreciation and finally the expected Markup Value.

4.3.3 Project Cashflow Inputs

This interface (Figure 4-5) allows input regarding project projected cashout. The project cashout is captured directly from industry standard project management software (i.e. Primavera and Microsoft Projects). This allows for capturing of the direct cost of project delivery on a monthly time basis.

Figure 4-5: Project Cashflow Input Interface

4.3.4 Finance Inputs

This interface (Figure 4-6) allows the user to input finance related information. These include the cost of finance charges as described in section 3.3.3. The general nature of finance charges have been explained in section 2.8.

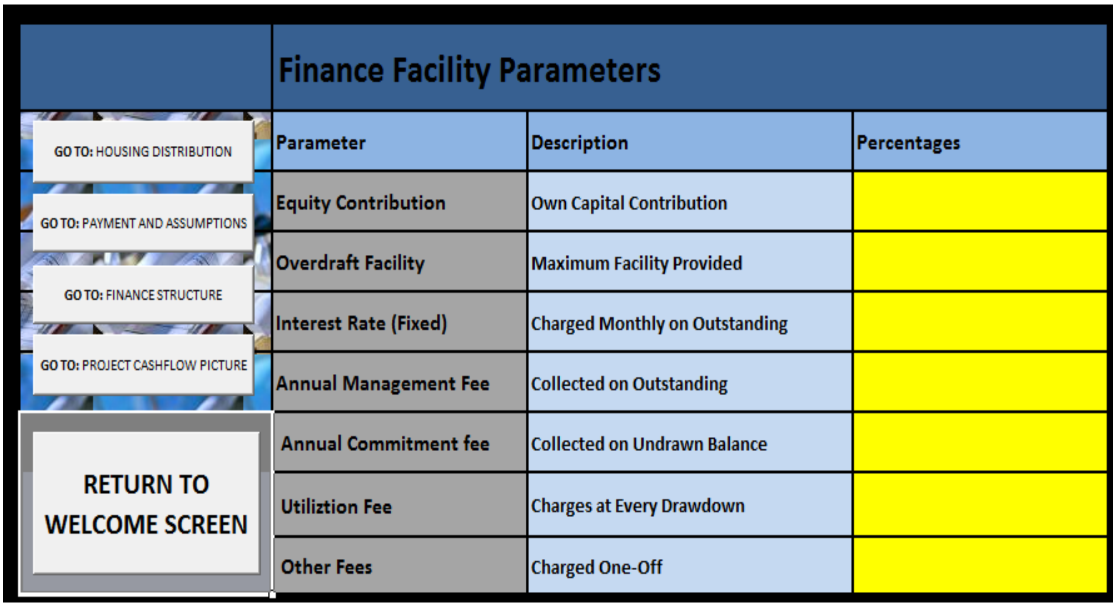


Figure 4-6: The Finance Inputs Interface

4.4 The Process sheet

The process layer represents the hidden sheet from where all computations are made in the model. The structure of this sheet ranges from a dynamic buyer database to more elaborate spreadsheets for simulating the resource interacted abstraction of the system. This is not an input layer and access is granted to the user to this layer in order to view the spreadsheet details of the cash flow computations. The sheets that handle the computational tasks of the model are illustrated in the following sections.

4.4.1 The Project Cashflow Demand Sheet

The process sheet illustrated in Figure 4-7 was developed for the computations involved in Project Cash flow Demand Module described in section 3.4.1. This spreadsheet generates the Total Cost of Delivery $T_{(Z)}$.

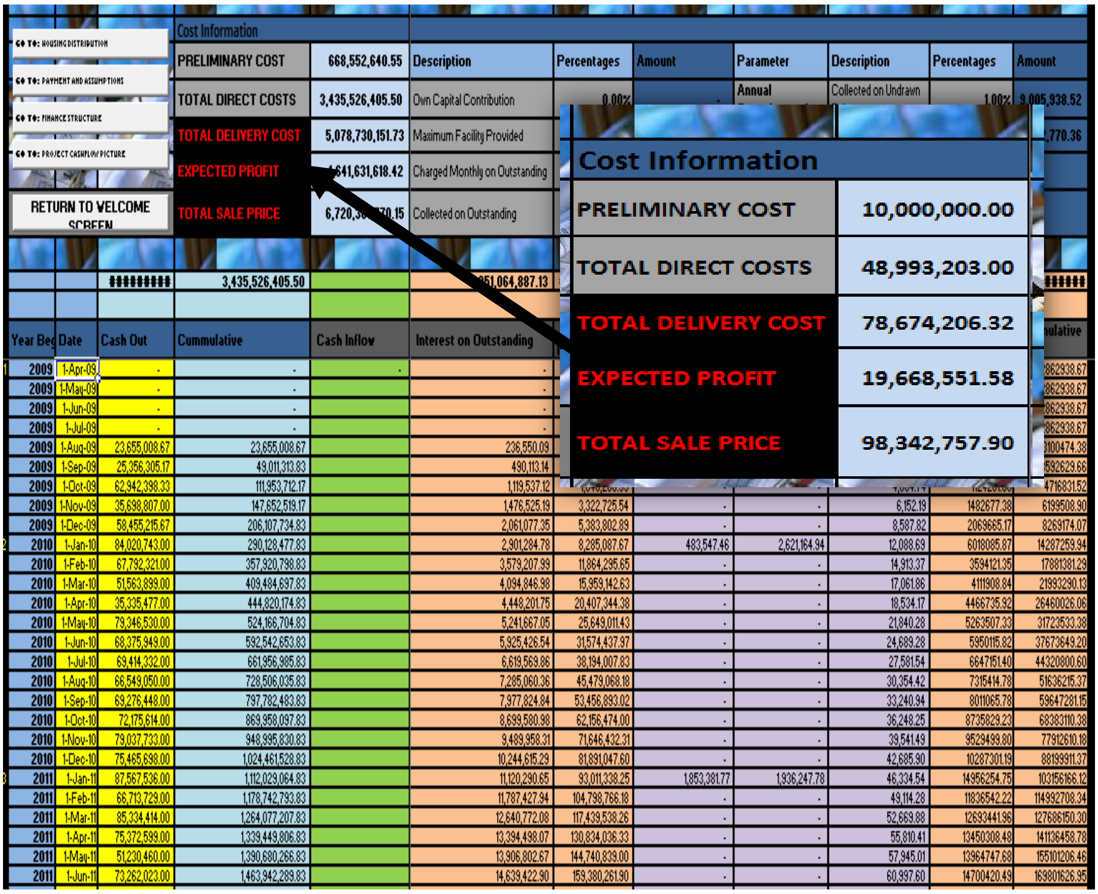


Figure 4-7: Example: Overview of the Project Cashflow Demand Module

4.4.2 The Subscription Simulation Sheet

The illustration in Figure 4-8 presents an overview of the Subscription Simulation Sheet. The parts highlighted in green are the color presets that are used to represent the assumptions that were selected in the Crystal Ball© application. As illustrated, once the total available number of housing units is reached, the module overrides the other the other buyer details by ascribing the default term 'Over Subscribed'. This nullifies the inflow computations from these buyer nodes in future cashflow computations in the Buyer Inflow Module.

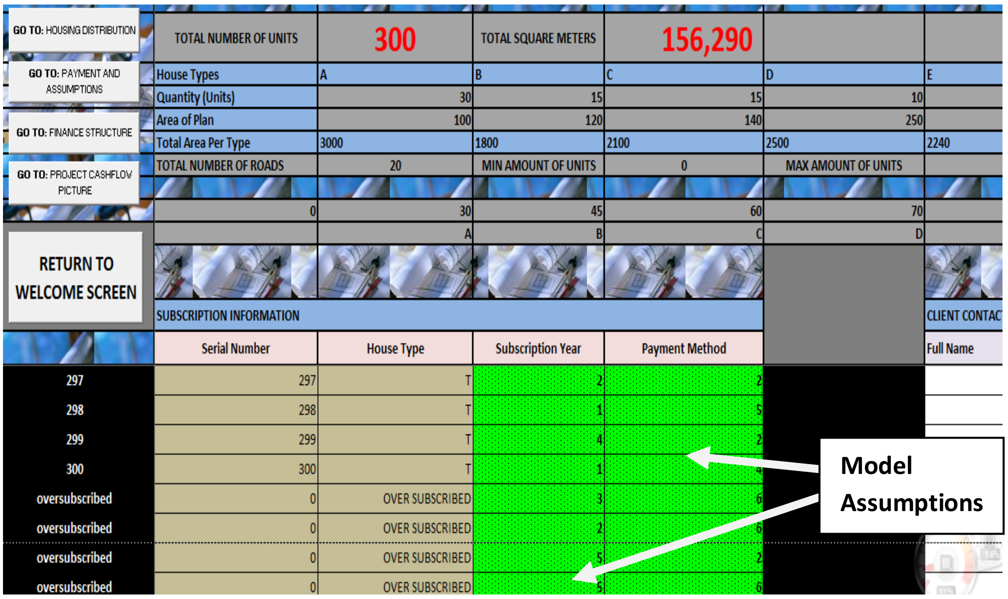


Figure 4-8: Example: The Subscription Simulation Module

The Subscription simulator sheet is linked to the Buyer inflow sheet and the simulation of buyer behavior is used to create the requisite buyer inflow as will be illustrated in the following section.

4.4.3 The Buyer Inflow Sheet

The illustration in Figure 4-9 module presents an overview of the buyer inflow spreadsheet; the processes executed within this module are described in section 3.4.3. The section of the image that is colored in black is retrieved from the subscription simulator module. Based on the simulation of the payment methods and year of the individual buyer, the model retrieves the requisite payment due from the cost per square meter matrix (Figure 4-10) and multiplies that by the square area of the subscribed house type (Section 3.4.3). These payments are then summed in term of yearly inflow, sum of monthly inflow per year and sum of post construction monthly inflows per year as illustrated in the preceding section.

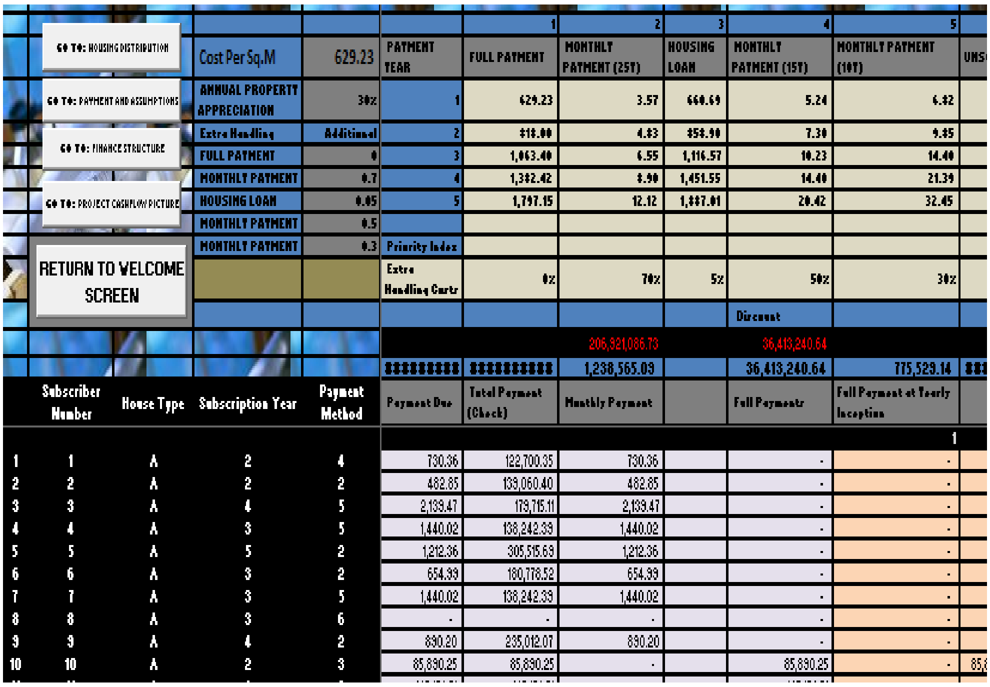


Figure 4-9: Example: Overview of the Buyer Inflow Module

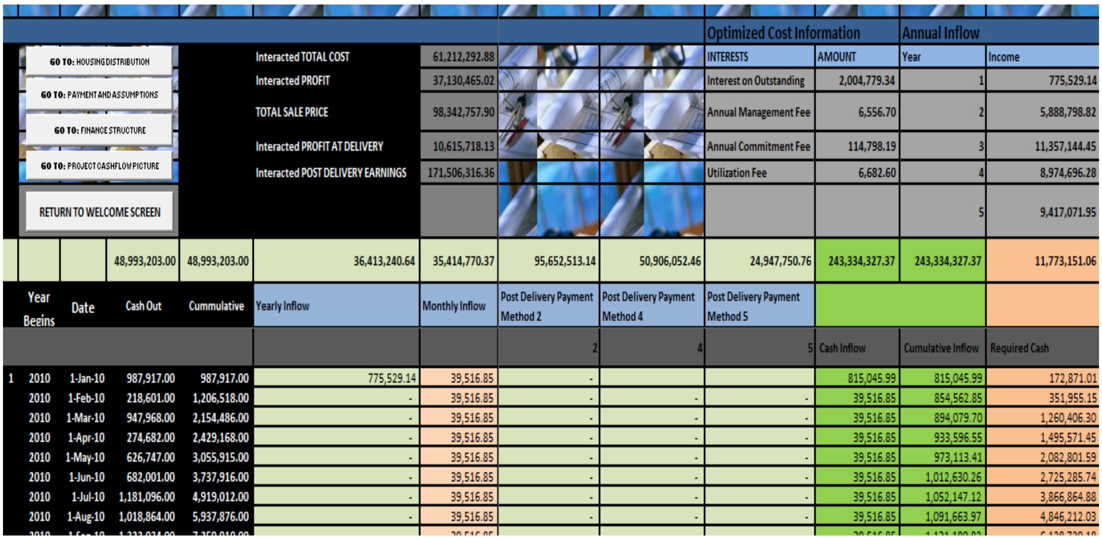
	1	2	3	4	5	6	7	8	9	10	11
PAYMENT YEAR	FULL PAYMENT	DISCOUNTED FULL	MONTHLY PAYMENT 10YEARS	MONTHLY PAYMENT 8YEARS	MONTHLY PAYMENT	MONTHLY PAYMENT	MONTHLY PAYMENT	MONTHLY PAYMENT	MONTHLY PAYMENT	MONTHLY	MONTHLY
1	74,477.46	72,987.91	3,896.79	4,307.28	4,293.53	3,005.47	3,756.84	4,293.53	2,003.65	2,003.65	-
2	89,372.95	87,585.49	5,195.73	5,907.12	6,010.94	3,442.76	3,744.36	3,644.45	1,448.46	1,341.89	-
3	107,247.54	105,102.59	7,014.23	8,269.97	8,655.76	4,647.72	5,242.11	5,248.01	1,871.85	1,734.14	-
4	128,697.05	126,123.11	9,619.52	11,908.76	12,983.63	6,374.02	7,548.63	7,872.02	2,433.41	2,254.38	-
5	154,436.46	151,347.73	13,467.32	17,863.15	20,773.81	8,923.63	11,322.95	12,595.23	3,185.55	2,951.19	-
6	185,323.75	181,617.28	19,392.94	28,581.03	37,392.86	12,850.02	18,116.72	22,671.42	4,204.93	3,895.57	154,436.46
Number of Years	Full	Full	10	8	7	10	8	7	15	15	-

Figure 4-10: Example: The Cost per Square Meter Matrix

The dynamic buyer inflow accumulation is then fed as input (inflow) to the project cashflow demand within the Buyer Interacted Cashflow Sheet as will be illustrated in the following section.

4.4.4 The Buyer Interacted Cashflow Sheet

Figure 4-11 illustrates the layout of the Buyer Interacted Project Cashflow Module. The general layout and processes involved are similar to the Project Cashflow Demand Module. The major difference in this module is the inclusion of the outputs of the Buyer Inflow Module into the project cashflow of the Interacted Cashflow Module. The Buyer inflow computations include the general finance risks of the cashflow. The general processes and computations involved in this module are described in section 3.4.4 and further illustrated below.



			48,993,203.00	48,993,203.00	36,413,240.64	35,414,770.37	95,652,513.14	50,906,052.46	24,947,750.76	243,334,327.37	243,334,327.37	11,773,151.06
	Year Begins	Date	Cash Out	Cummulative	Yearly Inflow	Monthly Inflow	Post Delivery Payment Method 2	Post Delivery Payment Method 4	Post Delivery Payment Method 5			
							2	4	5	Cash Inflow	Cumulative Inflow	Required Cash
1	2010	1-Jan-10	987,917.00	987,917.00	775,529.14	39,516.85	-			815,045.99	815,045.99	172,871.01
	2010	1-Feb-10	218,601.00	1,206,518.00	-	39,516.85	-	-	-	39,516.85	854,562.85	351,955.15
	2010	1-Mar-10	947,968.00	2,154,486.00	-	39,516.85	-	-	-	39,516.85	894,079.70	1,260,406.30
	2010	1-Apr-10	274,682.00	2,429,168.00	-	39,516.85	-	-	-	39,516.85	933,596.55	1,495,571.45
	2010	1-May-10	626,747.00	3,055,915.00	-	39,516.85	-	-	-	39,516.85	973,113.41	2,082,801.59
	2010	1-Jun-10	682,001.00	3,737,916.00	-	39,516.85	-	-	-	39,516.85	1,012,630.26	2,725,285.74
	2010	1-Jul-10	1,181,096.00	4,919,012.00	-	39,516.85	-	-	-	39,516.85	1,052,147.12	3,866,864.88
	2010	1-Aug-10	1,018,864.00	5,937,876.00	-	39,516.85	-	-	-	39,516.85	1,091,663.97	4,846,212.03

Figure 4-11: The Buyer Interacted Project Cashflow Module

4.5 Buyer Interacted Cashflow Simulator Parameters: Assumptions, Decision Variable and Expected Forecast

There are three major parameters defined in the developed prototype model. They are;

1. Assumptions; values that are to be varied in the simulation,
2. Decision variables; values that determine the outcome of the simulation process on which the developer has control, and
3. Forecasts; values that vary throughout the simulation process, which are the outputs of interest.

These parameters will be presented in the following sections.

4.5.1 Assumptions

These values capture the uncertainties of the system being investigated over which the developer has no control. The Behavior of the buyer is one of the assumptions of this model, the uncertainties lie in the payment method that the buyer will employ and the time at which he will get engaged in the project. The number of scenarios to be explored in such can be heavy on processing time and the results can tend towards being widely assumptive. This is averted mainly due to the type of distributions assigned to the assumptions (Figure 4-12). A custom distribution is assigned to the uncertainties giving the developer the opportunity to assign the range of distribution of different payment methods over a requisite range of payment distributions.

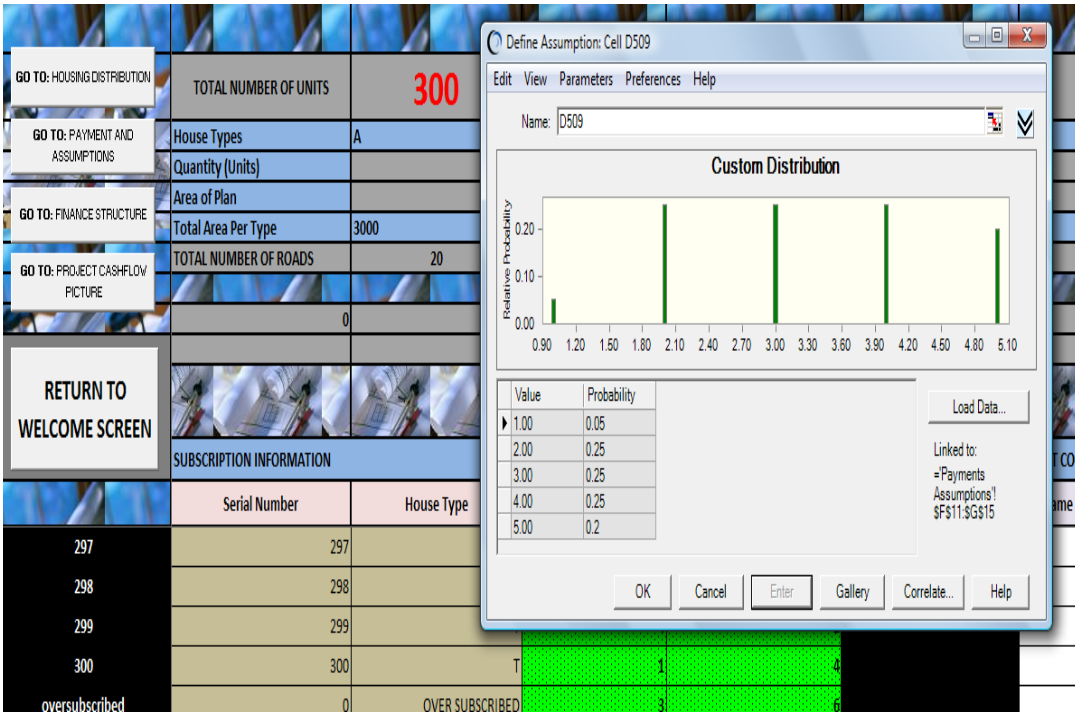


Figure 4-12: Assigning a custom distribution to Buyer Assumptions

4.5.2 Decision Variable

For the purpose of this study, the choice of Markup ($Z_{(M)}$), is a decision that is being examined (Figure 4-13). It can be enhanced by simulating the effects of different Markup ($Z_{(M)}$) values on the average range of Interacted Profit (section 3.5). Since Markup affects delivery price, a carefully chosen Markup value ($Z_{(M)}$) can keep the prices of the housing units competitive while also ensuring that the confidence level of the Internal Rate of Return and Expected Profits are substantial.

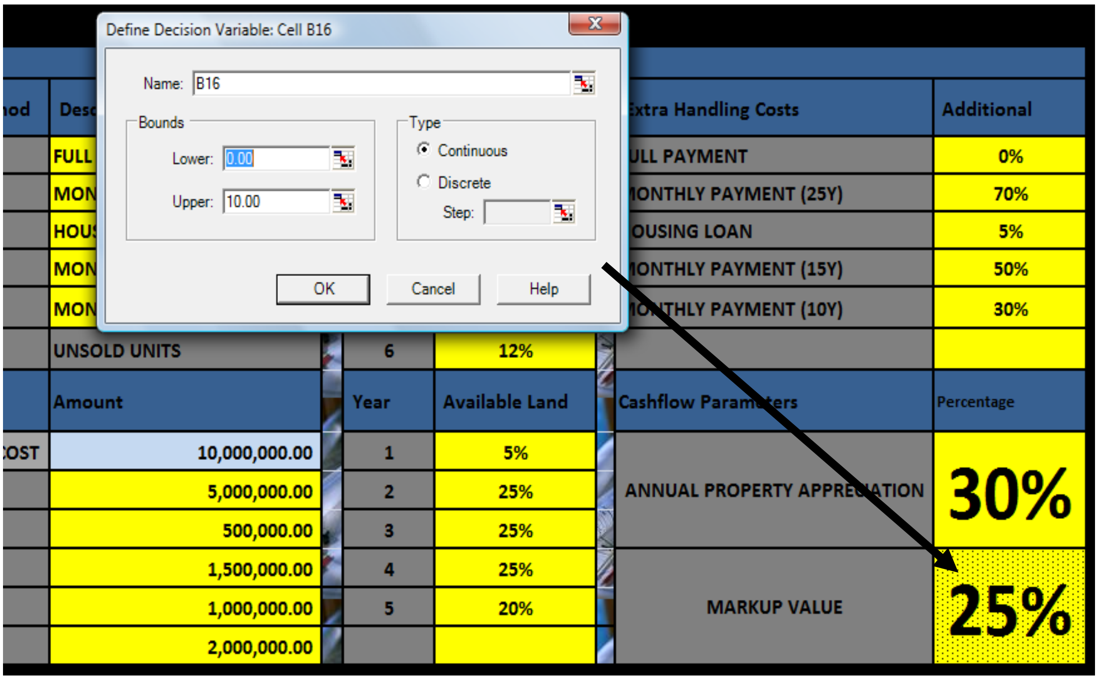


Figure 4-13: Selection of the Decision Variable

4.5.3 Expected Forecasts

There are eleven major outputs that are assigned as forecasts in this research. They are;

1. **Internal Rate of Return**; The rate of return on investment
2. **Cost of Finance**; finance costs based on the traditional approach
3. **Total Delivery Cost**; Total Cost of Delivery based on the traditional approach
4. **Expected Profit**; profit expected based on the traditional approach.
5. **Interacted Cost of Finance**; possible range of the cost of finance based on the buyer interacted cashflow.
6. **Interacted Total Delivery Cost**; possible range of the total cost of delivery based on the buyer interacted cashflow.
7. **Interacted Cost per Square Meter**; Cost per Square meter sales value of the property after Markup Selection.
8. **Interacted Profit**; possible range of expected profit based on the buyer interacted cashflow.
9. **Interacted Profit at Delivery**; expected profit at delivery based on the buyer interacted cashflow.
10. **Post Delivery Earnings**; earnings after delivery based on the buyer interacted cashflow, and
11. **Value of Unsold Units**; sales value of the unsold housing units.

These eleven outputs are selected from the Model Output Summary Sheet (Figure 4-14). Other outputs are presented in form of reports on a basis of buyer scenarios as detailed in section 3.5.3. The functionality and application of these forecasts will be illustrated in the case study.

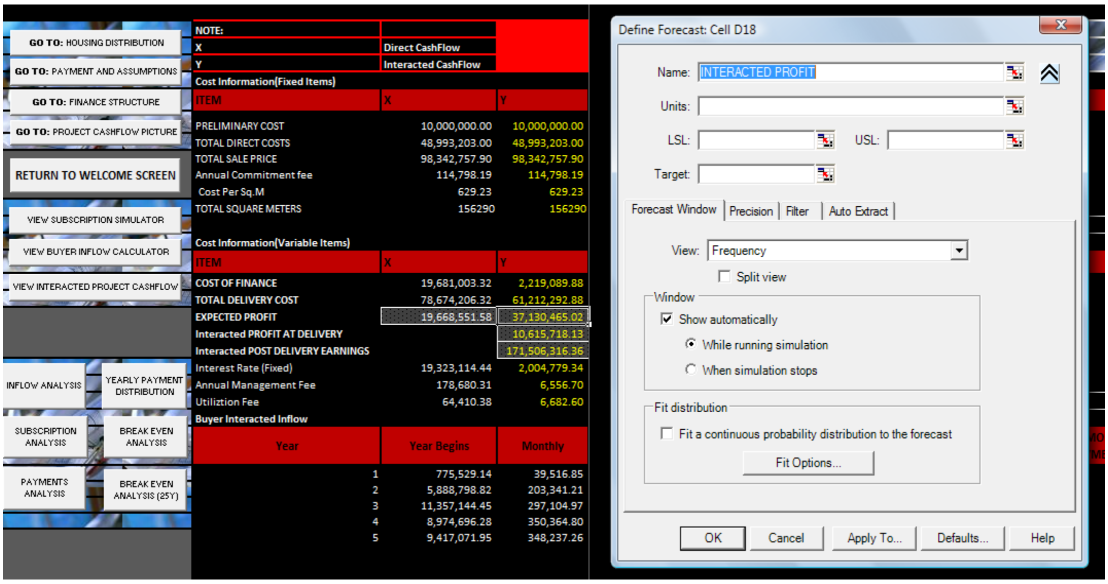


Figure 4-14: Forecast Selection Process from the Model Summary Output Sheet

In order to validate the model, two real-life case studies from the building industry were applied. This was done to evaluate the level of confidence that industry practitioner would have in the model output and performance. This chapter illustrates how the proposed model functioned to derive the forecasts for the case studies.

4.6 Overview of the International Case Study

The presented case study is a housing development in Nigeria comprising of 464 housing units and 20 commercial units. The housing units comprise of 4bd-Type A1, 4bd-Type A3, 4bd-Detached, 4bd-Terrace, 4bd-SemiDetached, 5bd-Detached (executive), 5bd-Detached, Type A1, 5bd-Detached Type B, Sample 4bd-Type A1, Sample 5bd-Detached Sample 4bd-Terrace and Sample 4bd-Type A3. The sample homes are meant to be constructed in the preliminary phase of delivery and the developer secured a purchase on delivery agreement with a co-operative for these sample homes.

Consideration is given by the developer to possibilities of retaining some units of the development for post completion sale or lease. The annual rate of property appreciation was set at 20% annual increase based on pessimistic market data. Also a performance bond of 70% of the total project value was also mandated by the financier along with other preliminary costs such as land cost, marketing, legal and insurance, and governmental costs. An initial markup value of 60% was presented by the developer. The output of the three stage analysis of the case study is presented in the following sections.

4.6.1 Markup Analysis Report (Stage 1 Analysis)

An analysis of a markup percentage ranging from 10% to 100% for the development was conducted (Figure 4-15, Figure 4-16). Based on the output, the decision maker is able to visualize that a desire to attain an internal rate of return that is above 100% will require a Markup percentage of 28% to 56% considering a 100% confidence level. However a 40% Markup percentage was selected because it presented the internal rate of return of 118% along the 100% confidence line.

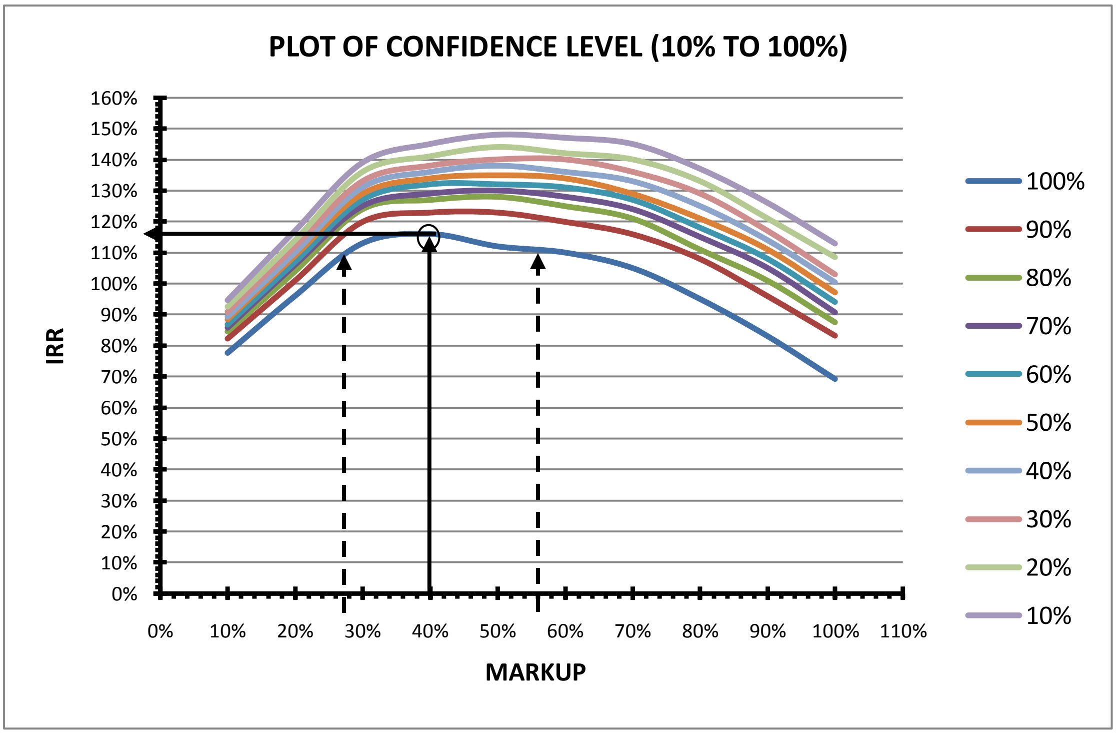


Figure 4-15: Case Study 1: Markup Analysis Report Graph

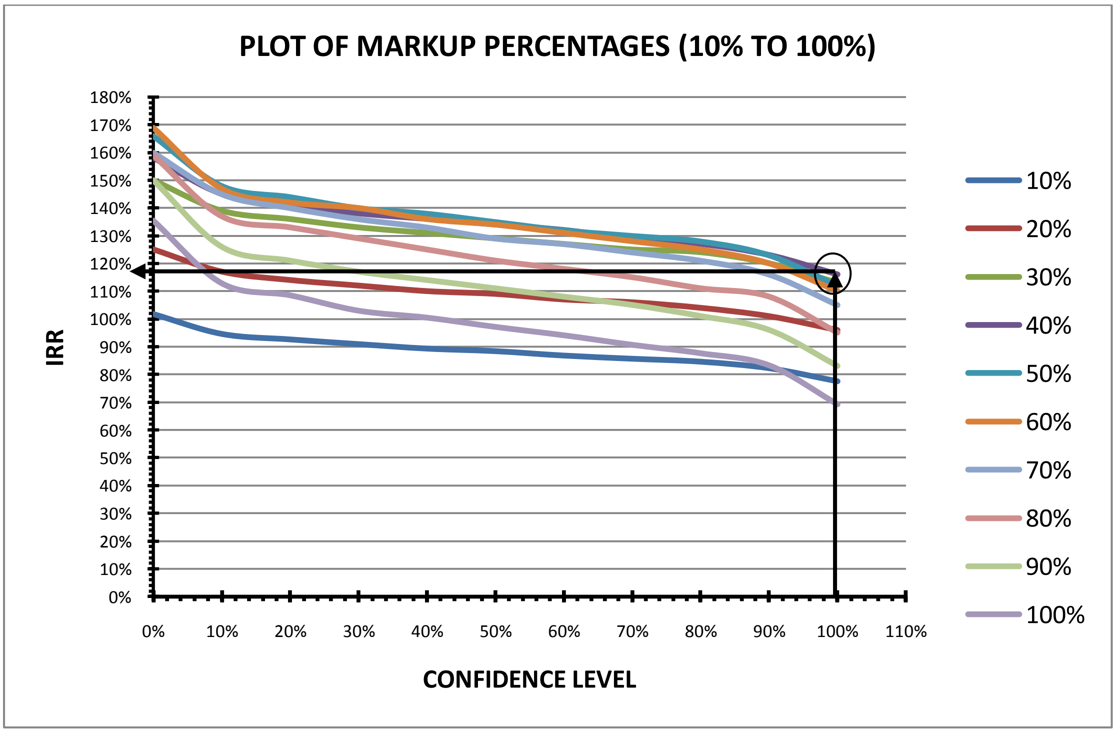


Figure 4-16: Case Study 1: Markup Analysis Report Graph

At this value; the developer was comfortable with the rate of return. Further analysis of the effect of the selected Markup percentage on the model forecasts was conducted in buyer interacted cashflow analysis (stage 2). This analysis is presented in the next section.

4.6.2 Buyer Interacted Cashflow Simulation (Stage 2 Analysis)

An analysis of 10000 possible buyer scenarios was conducted in order to track output of Interacted Profit amongst other forecasts and the confidence level of achieving the result (Figure 4-17). The output of the analysis processes suggest that at a Markup Percentage of 40%, will provide a 100% confidence level Interacted Profit being above 151,929,345.89. At an 80% confidence level, as illustrated in Figure 4-17, other forecast values can also be visualized by tracing off the graphed output. This output allows the decision maker to make decisions based on a more holistic overview of the nature of effect that buyer behavior will have on the project cashflow. At a more detailed level, the results of the Buyer interacted Cashflow Simulation Process can also be tabulated.

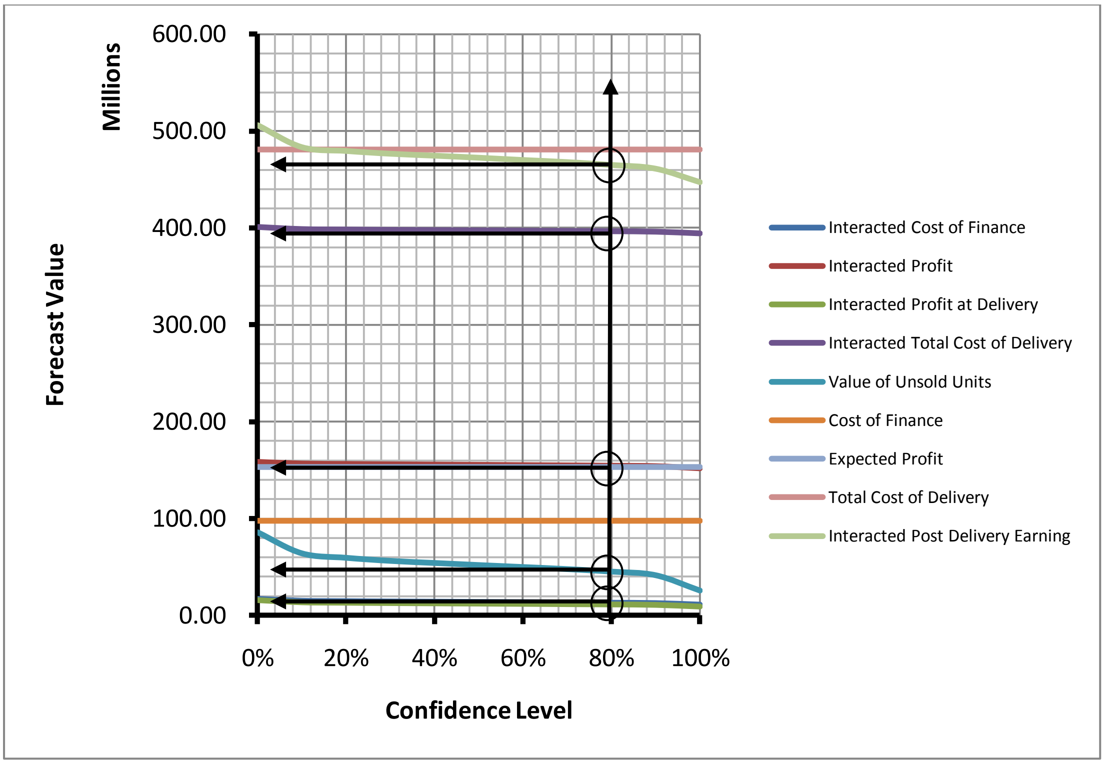
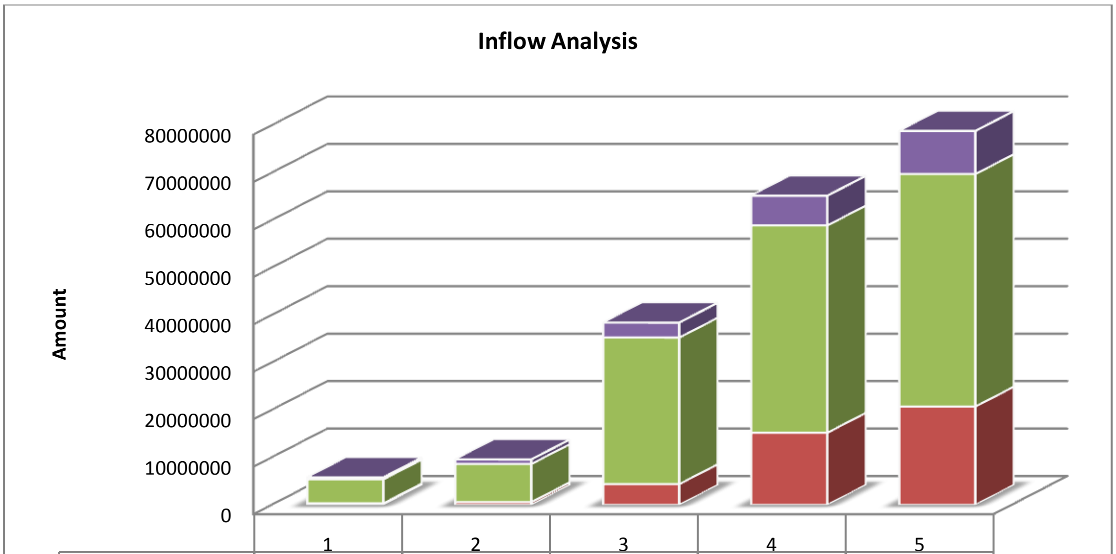


Figure 4-17: Case Study 1 Buyer Interacted Cashflow Analysis Report Graph

4.6.3 Marketing Analysis (Stage 3 Analysis)

An analysis of the possible buyer scenarios that would generate an output that lie on the 80% of confidence as outputted from the previous analysis (Stage 2) was conducted. Based on the requisite buyer behavior that generates this outcome, the developer can generate a report that gives him an understanding of what buyer behavior would yield the preferred 80% confidence of outcomes. Additionally, during the cause of the project, the developer can also track the progress and implication of sales outcomes, as such sales strategies can be modified during the cause of the project to ensure that outcomes are advantageous. A sample of the initial Marketing Analysis run in the case study is presented. The inflow analysis (Figure 4-18) presents an overview of how payment flow into the developers coffers. Although inflow analysis is a normal practice in project finance, this approach considers the buyer inflow before it occurs, consequently mitigating the impact of uncertainties of buyer behavior on decision making.



	1	2	3	4	5
Monthly Payments	383,500.91	949,671.51	3,135,682.58	6,249,470.69	9,063,927.02
Down Payments	5,050,137.71	8,042,274.43	30,882,785.70	43,695,449.74	49,013,258.38
Yearly Payments	345,344.80	595,055.65	4,408,092.91	15,229,819.39	20,740,023.29
Year	1	2	3	4	5

Figure 4-18: Case Study 1: Inflow Analysis Report Graph

The breakeven analysis result (Figure 4-19) shows that there would be a possibility of having cash constraints between the 15th to the 34th months of the project as such the developer was considering increasing the marketing drive and providing incentives during this time in order to improve cashflow. Alternatively, a stronger marketing drive can be used to mitigate this scenario by increasing the sales and subsequently inflow in this period. Analysis can be run in real time during the cause of the development. As buyers buy, the developer can assess the sensitivity of the buying pattern on the overall profitability of the development and make policy changes to apply corrective measures.

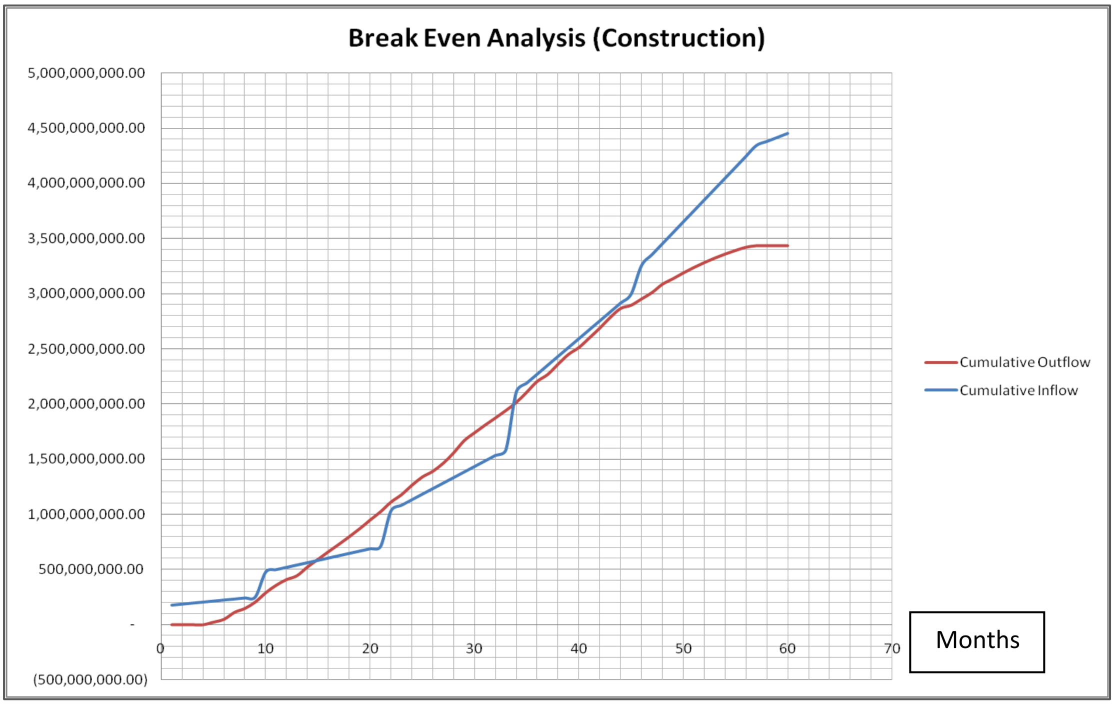
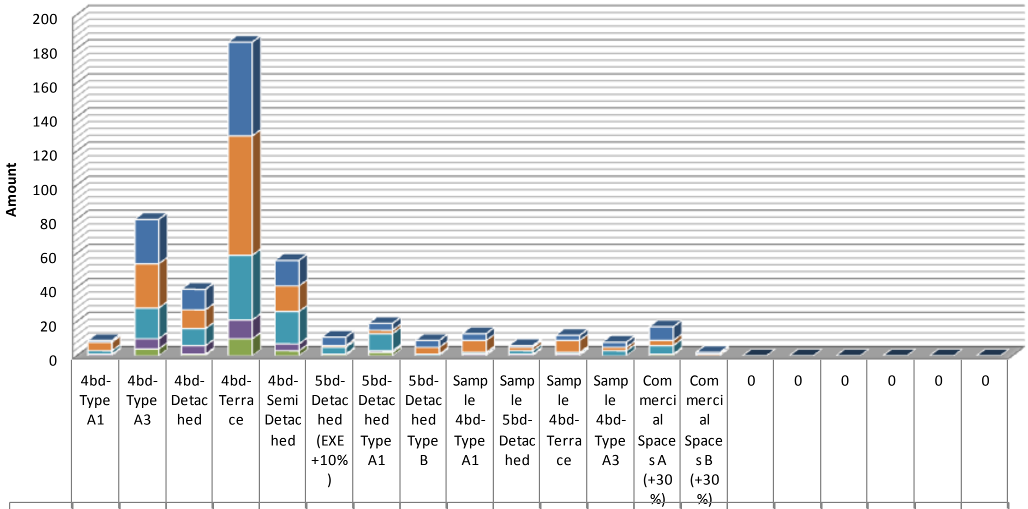


Figure 4-19: Case Study 1: Marketing Analysis Report Graph

On establishing the need for corrective measures to be applied, the decision maker can check the disparity in the real distribution of sold units and the generated subscription distribution thus applying him to visually and graphically track the required corrections to sales. However the Subscription distribution report (Figure 4-20) outputted gives a visual and tabulated distribution of units that are to be sold annually at the least in order to achieve the expected confidence level for outcomes.



	4bd-Type A1	4bd-Type A3	4bd-Detached	4bd-Terrace	4bd-Semi Detached	5bd-Detached (EXE +10%)	5bd-Detached Type A1	5bd-Detached Type B	Sample 4bd-Type A1	Sample 5bd-Detached	Sample 4bd-Terrace	Sample 4bd-Type A3	Commercial Space sA (+30%)	Commercial Space sB (+30%)	0	0	0	0	0	0
Year 5	1	26	12	55	15	5	4	4	4	1	3	3	8	1	0	0	0	0	0	0
Year 4	5	26	11	70	15	1	2	4	7	2	7	2	3	1	0	0	0	0	0	0
Year 3	2	18	10	38	19	4	10	1	1	2	1	3	5	0	0	0	0	0	0	0
Year 2	1	6	5	11	4	0	1	0	1	1	1	0	0	0	0	0	0	0	0	0
Year 1	0	4	1	10	3	1	2	0	0	0	0	0	1	0	0	0	0	0	0	0

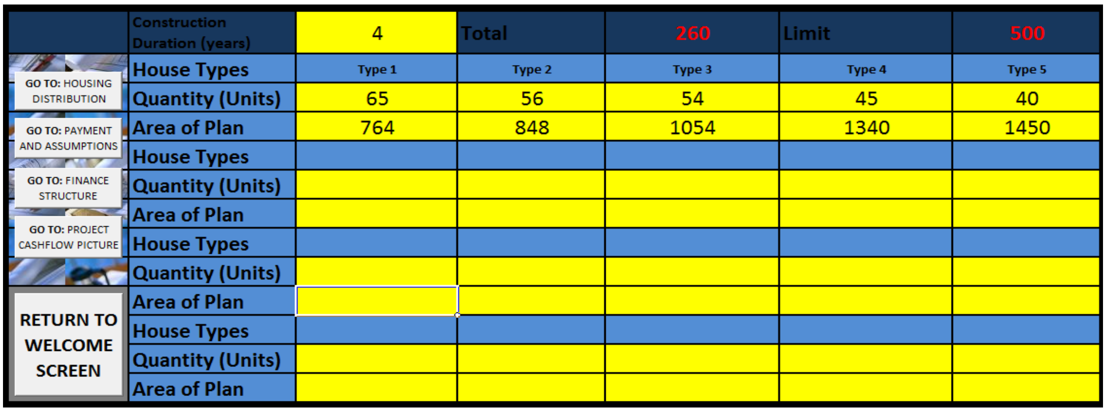
Figure 4-20: Case Study 1: Subscription Analysis Report Graph

All the Marketing Analysis reports demonstrated so far are based on the assumption that the simulated outcomes will be expressed in reality. However every approach to simulate such uncertainty only allows for the formulation of strategies to attaining the required outcome. This demonstrates the usefulness of the Marketing Analyzer in providing a platform for the developer to understand the consequences of sales outcomes on the overall profitability of the project. Additionally it demonstrates that, rather than going blind, the decision maker can measure and generate alternatives methods in order to make adequate corrections to the sales strategy during the cause of the development. Another example of the ability of the developed decision support tool in serving as an investigative platform is presented in the second case study.

4.7 Overview of the Egyptian Case Study

In order to demonstrate the adaptive capability of the approach an application to an existing project in Egypt is presented. Due to the sensitivity of project cashflow data, the project team requested that the project details and company name be kept anonymous. Other project information such as Markup percentage and the distribution of buyers over their available payment options was also withheld. However, the project cashflow and the project physical description were provided.

Though the project has reached its completion, it is hoped that the results will serve as a basis for comparison between the real life financial performance of the development and the projected financial performance generated from the developed approach. The development was composed of five house types with built up areas as follows; 65 units of Type 1 of 764 Sq.M each, 56 Units of Type 2 of 848 Sq.M each, 54 units of Type 3 of 1054 Sq.M each, 45 units of Type 4 of 1340 Sq.M each and 40 units of Type 5 of 1450 Sq.M each as show in the input module illustrated in Figure 4-21.

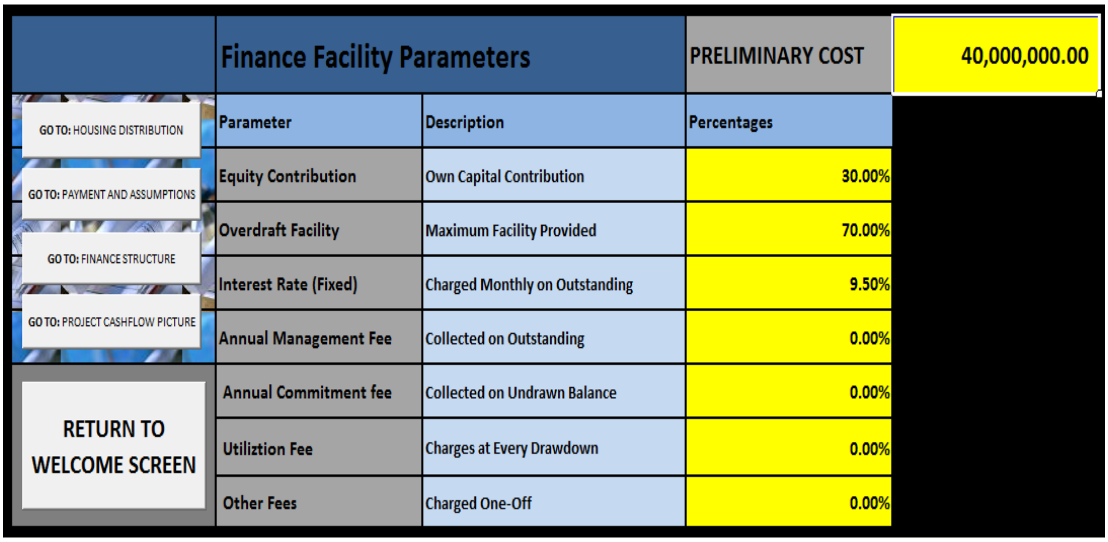


Construction Duration (years)	4	Total	260	Limit	500
House Types	Type 1	Type 2	Type 3	Type 4	Type 5
Quantity (Units)	65	56	54	45	40
Area of Plan	764	848	1054	1340	1450
House Types					
Quantity (Units)					
Area of Plan					
House Types					
Quantity (Units)					
Area of Plan					
House Types					
Quantity (Units)					
Area of Plan					

Figure 4-21: Case Study 2: Housing Distribution Input Interface

The nature of finance that was used to facilitate the development was not known, the present finance circumstance was applied. Field investigation in CIB bank revealed the possible cost of finance charges for construction project finance might have implied a 30%

percent equity contribution from the project proponent while the bank would be willing to finance the remaining 70% at a prevailing interest rate of 9.5% (Figure 4-22). Additional processing charges would also be charged on a one-off basis by the bank. These additional charges would be reflected as part of the project preliminary costs which was supplied as 40,000,000 L.E by the project engineer.



Finance Facility Parameters		PRELIMINARY COST	40,000,000.00
Parameter	Description	Percentages	
Equity Contribution	Own Capital Contribution	30.00%	
Overdraft Facility	Maximum Facility Provided	70.00%	
Interest Rate (Fixed)	Charged Monthly on Outstanding	9.50%	
Annual Management Fee	Collected on Outstanding	0.00%	
Annual Commitment fee	Collected on Undrawn Balance	0.00%	
Utiliztion Fee	Charges at Every Drawdown	0.00%	
Other Fees	Charged One-Off	0.00%	

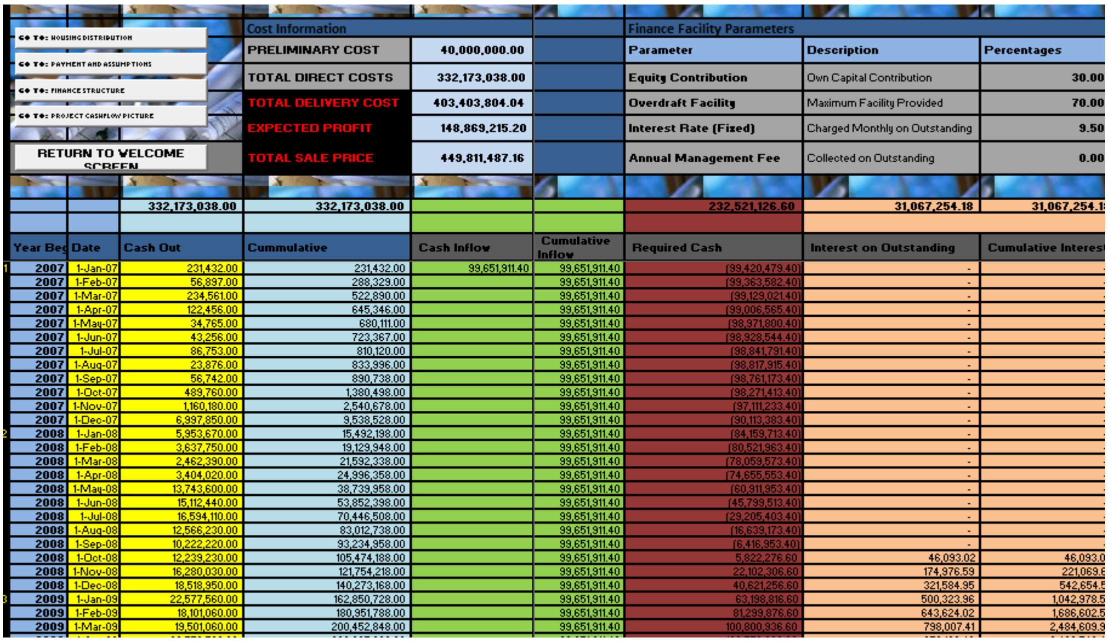
Figure 4-22: Case Study 2: Finance Structure Input Interface

Field investigation revealed that the developments of the same class were offered for an average of 1600LE per Sq.M (shell finishing) at the time. Finally, a questionnaire survey (Appendix 2b) of the preferential response of a sample of 40 potential buyers to the available payment packages was conducted in order to keep the simulation runs within realistic limits. It was assumed that the target market would be affluent upper class members of society due to the reduced risk of affordability while administering the questionnaire. The questionnaire was also used to gather information regarding the price sensitivity of buyers and finally the relative time when they would be confident to engage the developer. The results of the survey are attached in Appendix 2c. These results were fed as input into the payments and assumptions module of the developed system as illustrated in Figure 4-23.

	Max Payment Period	10		100%		
GO TO: HOUSING DISTRIBUTION	Payment Method	Payment Duration	Down Payment	Pupular Distribution	Discription	Probable Distribution (Methods)
	1	Full		2%	FULL PAYMENT	2%
GO TO: PAYMENT AND ASSUMPTIONS	2	5	20%	18%	5YEARS 20%	18%
	3	4	20%	11%	4YEARS 20%	11%
GO TO: FINANCE STRUCTURE	4	3	20%	5%	3YEARS 10%	5%
	5	5	10%	10%	5YEARS 10%	10%
GO TO: PROJECT CASHFLOW PICTURE	6	4	10%	4%	4YEARS 10%	4%
	7	3	10%	5%	3YEARS 30%	5%
	8	5	30%	24%	5YEARS 30%	24%
	9	4	30%	12%	4YEARS 30%	12%
	10	3	30%	9%	3YEARS 0%	9%
	11	Unsold		0%	UNSOLD	0%
RETURN TO OUTPUT SUMMARY	Pricing Information		Construction Year	Expecteed Buyer Distribution	Cashflow Parameters	Percentage
	P (max)	3200.00	1	7%	ANNUAL PROPERTY APPRECIATION	10%
	P (min)	1610.51	2	16%		
RETURN TO WELCOME SCREEN			3	45%		
	Average Market Value	1,600.00	4	32%	MARKUP VALUE	37%
	Sale Value	1,610.51	5	0%		
			6	0%		
				100%		

Figure 4-23: Case Study 2: Payments and Assumptions Input Interface

The project cashflow data (Appendix 2a) was captured from the cashflow outputs from the project schedule in Primavera© and fed into the developed system as illustrated in Figure 4-24.



GO TO: HOUSING DISTRIBUTION	Cost Information		Finance Facility Parameters
GO TO: PAYMENT AND ASSUMPTIONS	PRELIMINARY COST	40,000,000.00	
GO TO: FINANCE STRUCTURE	TOTAL DIRECT COSTS	332,173,038.00	
GO TO: PROJECT CASHFLOW PICTURE	TOTAL DELIVERY COST	403,403,804.04	
RETURN TO WELCOME SCREEN	EXPECTED PROFIT	148,869,215.20	
	TOTAL SALE PRICE	449,811,487.16	

Parameter	Description	Percentages
Equity Contribution	Own Capital Contribution	30.00
Overdraft Facility	Maximum Facility Provided	70.00
Interest Rate (Fixed)	Charged Monthly on Outstanding	9.50
Annual Management Fee	Collected on Outstanding	0.00

	Year Beg	Date	Cash Out	Cummulative	Cash Inflow	Cumulative Inflow	Required Cash	Interest on Outstanding	Cumulative Interest
			332,173,038.00	332,173,038.00			232,521,126.60	31,067,254.18	31,067,254.1
1	2007	1-Jan-07	231,432.00	231,432.00	99,651,911.40	99,651,911.40	(99,420,479.40)	-	-
	2007	1-Feb-07	56,897.00	288,329.00		99,651,911.40	(99,363,582.40)	-	-
	2007	1-Mar-07	234,561.00	522,890.00		99,651,911.40	(99,129,021.40)	-	-
	2007	1-Apr-07	122,456.00	645,346.00		99,651,911.40	(99,006,565.40)	-	-
	2007	1-May-07	34,765.00	680,111.00		99,651,911.40	(98,971,800.40)	-	-
	2007	1-Jun-07	43,256.00	723,367.00		99,651,911.40	(98,928,544.40)	-	-
	2007	1-Jul-07	86,753.00	810,120.00		99,651,911.40	(98,841,791.40)	-	-
	2007	1-Aug-07	23,876.00	833,996.00		99,651,911.40	(98,817,915.40)	-	-
	2007	1-Sep-07	56,742.00	890,738.00		99,651,911.40	(98,761,173.40)	-	-
	2007	1-Oct-07	489,760.00	1,380,498.00		99,651,911.40	(98,271,413.40)	-	-
	2007	1-Nov-07	1,160,180.00	2,540,678.00		99,651,911.40	(97,111,233.40)	-	-
	2007	1-Dec-07	6,997,850.00	9,538,528.00		99,651,911.40	(90,113,383.40)	-	-
2	2008	1-Jan-08	5,953,670.00	15,492,198.00		99,651,911.40	(84,159,713.40)	-	-
	2008	1-Feb-08	3,637,750.00	19,129,948.00		99,651,911.40	(80,521,963.40)	-	-
	2008	1-Mar-08	2,462,390.00	21,592,338.00		99,651,911.40	(78,059,573.40)	-	-
	2008	1-Apr-08	3,404,020.00	24,996,358.00		99,651,911.40	(74,655,553.40)	-	-
	2008	1-May-08	13,743,600.00	38,739,958.00		99,651,911.40	(60,911,953.40)	-	-
	2008	1-Jun-08	15,112,440.00	53,852,398.00		99,651,911.40	(45,799,513.40)	-	-
	2008	1-Jul-08	16,594,110.00	70,446,508.00		99,651,911.40	(29,205,403.40)	-	-
	2008	1-Aug-08	12,566,230.00	83,012,738.00		99,651,911.40	(16,639,173.40)	-	-
	2008	1-Sep-08	10,222,220.00	93,234,958.00		99,651,911.40	(6,416,953.40)	-	-
	2008	1-Oct-08	12,239,230.00	105,474,188.00		99,651,911.40	5,822,276.60	46,093.02	46,093.0
	2008	1-Nov-08	16,280,030.00	121,754,218.00		99,651,911.40	22,102,306.60	174,976.59	221,069.6
	2008	1-Dec-08	18,518,950.00	140,273,168.00		99,651,911.40	40,621,256.60	321,584.95	542,654.5
3	2009	1-Jan-09	22,577,560.00	162,850,728.00		99,651,911.40	63,198,816.60	500,323.96	1,042,978.5
	2009	1-Feb-09	18,101,060.00	180,951,788.00		99,651,911.40	81,299,876.60	643,624.02	1,686,602.5
	2009	1-Mar-09	19,501,060.00	200,452,848.00		99,651,911.40	100,800,936.60	798,007.41	2,484,609.9

Figure 4-24: Case Study 2: Project Cashflow Picture Input Interface

This information will be used for running the three stage analysis as will be demonstrated in the following sections.

4.7.1 Markup Analysis Report (Stage 1 Analysis)

On supplying the developed model with the Project Physical Description, Project Cashflow, Payments and Assumptions and Finance Charges, the Total Cost to the buyer that matched the market average was outputted as 1610.51 per Sq.M at a Markup of 37%. This would imply that at 37% the developer would be at par with the market and as such there would be little of no elasticity of demand (section 2.5.5). A Markup Analysis (Stage 1 Analysis) was conducted to visualize the effect of varying the Markup percentage on the probable Internal Rate of Return of the development. The target Minimum Attractive Rate of Return (MARR) is set at 100% with a required confidence level (certainty) of 100%. The output of the Stage 1 analysis is illustrated in Figure 4-25

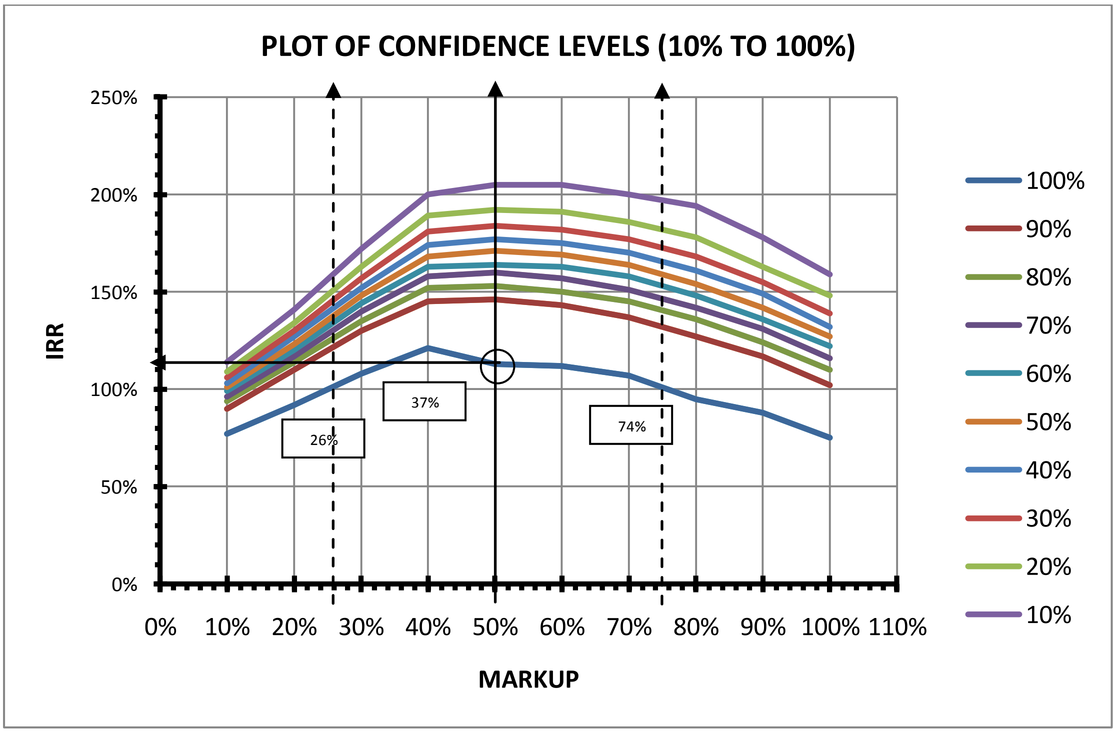


Figure 4-25: Case Study 2 Markup Analysis Report Graph 1B

The above illustration shows that a markup percentage of 26% to 74% would perform adequately to generate a 100% IRR with a 100% level of confidence. Though the highest level of confidence is at the 37% markup percentage, this would imply that 100% of the development would have to be sold. Consideration is given to selecting a markup percentage of 50% which would imply that 9% of the development would probably be unsold. However since this percentage is outputted as being able to provide an IRR that is above the minimum, the trade-off would be adequate.

This stage of analysis (Stage 1) can also be outputted in a graph that allows the decision maker to have an overview of the performance of a range of markup percentages (Figure 4-26). The choice of 50% markup value can be tracked as illustrated below

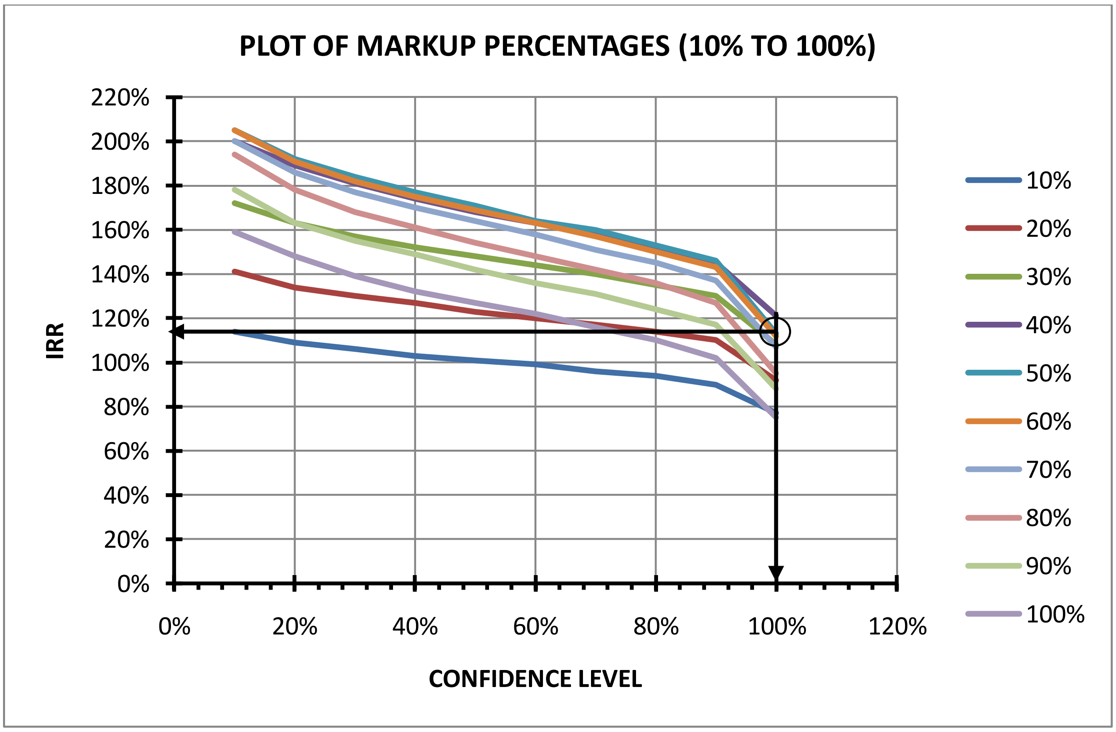


Figure 4-26: Case Study 2 Markup Analysis Report Graph 2

Further investigation was conducted to assess the behavior of the analysis outcomes. The output of stage 2 and stage 3 analysis of the case study is presented in the following sections.

4.7.2 Buyer Interacted Cashflow Simulation (Stage 2 Analysis)

An analysis of 10000 possible buyer scenarios was conducted in order to track the confidence of achieving other forecast values as itemized in section 4.5.3 (Figure 4-27). The output of the analysis processes suggest that at a Markup Percentage of 50%, as selected in the Stage 1 analysis process, considering a 100% confidence level, other forecast values would be as illustrated in Figure 4-27.

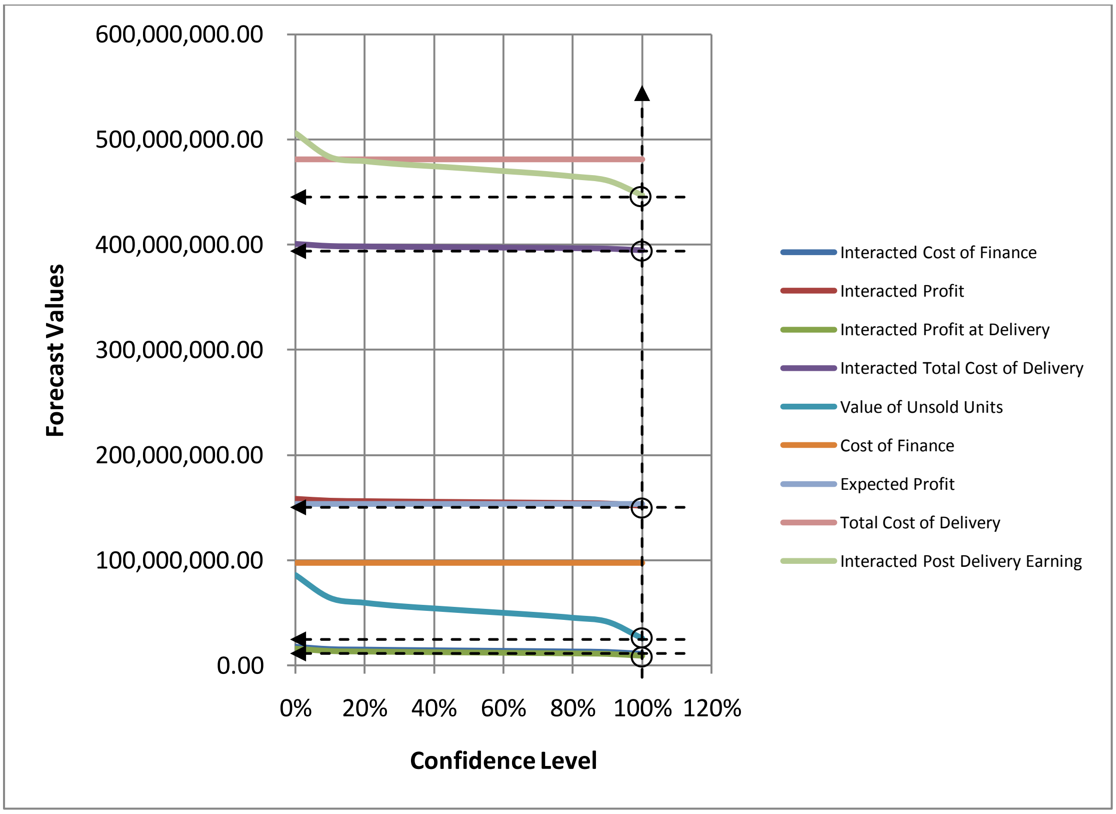


Figure 4-27: Case Study 2 Buyer Interacted Cashflow Analysis Report Graph

4.7.3 Marketing Analysis (Stage 3 Analysis)

An analysis of the possible buyer scenarios that would generate an output that lies on the 100% confidence as outputted from the previous analysis (Stage 2) was conducted. Based on the requisite buyer behavior that generates this outcome, the developer conducted a red flag analysis of the breakeven point (Figure 4-28) between cash outflows and payment inflows.

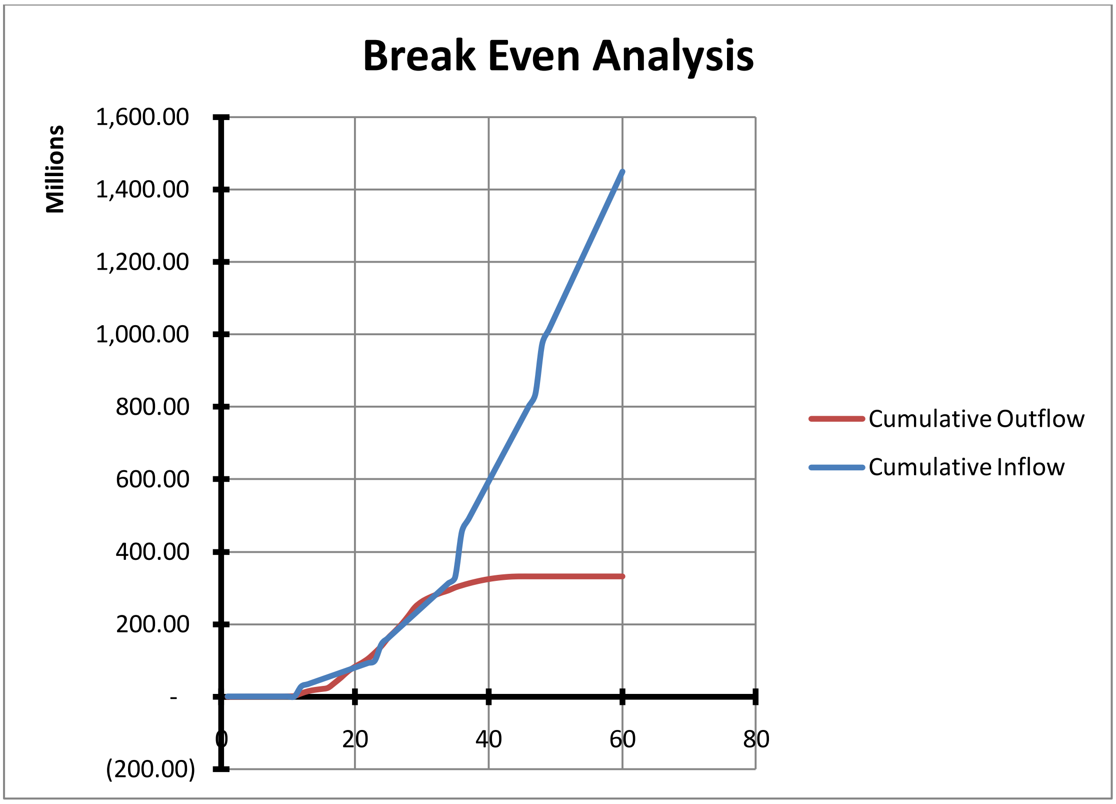


Figure 4-28: Case Study 2 Marketing Analysis Report Graph

4.8 Validation Feedback for Case Studies

The proposed model was received with much enthusiasm by the development team of both the Nigerian and the Egyptian housing development companies. According to those engineers, project finance and marketing teams, when the model was applied to their projects it provided a platform for the understanding of the effect of the three project proponents; the buyer, the financier and the developer. The summary of responses to the administered evaluation questionnaire is presented in Table 1.

Table 1: Analysis of Validation Response

Cases	Nigerian Case Study		Egyptian Case Study	
Question	Response		Response	
	Yes	Others	Yes	Others
Enthusiasm	92%	8%	89%	11%
Is the platform Easy to Use?	95%	5%	92%	8%
Does the platform provide an Understanding of the interactions between the developer, financier and the buyer?	93%	7%	93%	7%
Can the platform help improve the profitability of your housing development?	92%	8%	91%	9%
The platform has the potential to give Foresight regarding project cashflow?	86%	14%	92%	8%
Can the platform provide an Advantage over your market competitors?	95%	5%	94%	6%
Can the platform alert you to the possible project cashflow risks?	98%	2%	89%	11%
Average Score	**93%**	**7%**	**91%**	**9%**

4.9 Summary

This chapter introduced the steps of developing the model based on the proposed approach. These steps started by building the bidding analysis part, then the part specialized with the risk analysis, and finally the part that integrate the results of the previous two parts through a simulation process. The results chart generated from the simulation analysis can assist decision takers in deciding on the optimum markup according to the proposed selection concept of this study which makes a balance between the probabilities of winning the bid and avoiding all risks that might affect the project, or according to the criteria that fit their objectives through conducting what-if-scenarios.

The next chapter introduces an overview of this research effort, recommendations for further research, and finally the conclusion.

CHAPTER 5: CONCLUSIONS AND RECOMMENDATIONS

CHAPTER 5: CONCLUSION AND RECOMMENDATIONS

5. Introduction

With the global increase in demand for housing, government and private developers are under ever increasing pressure to meet up with the ever growing housing deficit. Although there is increased private sector participation in the global housing market, this participation is often hindered in developing countries by the abject lack of infrastructure, finance and the buying capacity of the potential home owner. The Cost burden of accessing funds to execute potential housing developments is relatively high in developing countries and this forms a large share of the Total Cost of Delivery to which the developer then adds a percentage of expected profit.

The main objective of this thesis was to develop a novel Buyer Interacted Cashflow System that takes into account the role of the buyer in improving the cashflow of housing projects from the developer's perspective. This, as concluded, can overcome the drawbacks of traditional project finance practices in project cashflow and finance by taking advantage of the potential for cost of finance savings.

5.1 Research Overview

The developed framework is expected to help improve the confidence of potential developers in engaging in housing developments. Developing a project cashflow that includes cash inflows from the buyer, is however complex due to the variability of human behavior. This challenge has been innovatively handled in this research through three successive processes which are 1) Analyzing Markup; 2) Simulating the Buyer Interacted Cashflow; and finally 3) Developing a Market Engagement Approach.

This approach is practical and can be used as a decision support tool by non-technical decision makers. The first analysis is responsible for simulating the effect of the Developers chosen Markup Percentage on the internal rate of return of the development. This Markup analysis is graphically presented in a Markup Analysis Report that allows the developer to visually track the confidence level of achieving a preferred rate of return. On choosing a preferred Markup percentage, the second stage of analysis is used to simulate the effect of potential buyer behavior on predefined forecasts (i.e. Interacted Profit) This Buyer Interacted Cashflow Simulation Analysis is presented in a Buyer Interacted Cashflow Analysis Report that allows the developer to visually track the possible confidence level (in percentage value) of achieving all forecasts discussed in section 4.5.3. The third scheme is used to track the requisite buyer behavior that produces a certain forecast. This assists the developer in developing a Marketing strategy to drive patronage in the direction that could generate required profitability of the development.

This proposed framework was implemented in a prototype program called ARO-META which was validated using two real-life case studies, one Nigerian and one Egyptian. In the first case study, Markup Analysis (Stage 1), an analysis of a markup percentage, ranging from 10% to 100% for the development was conducted. The output of the analysis processes suggest that at a Markup Percentage of 40% will provide a 100% confidence level of achieving a above 100% Internal Rate of Return. The second stage of analysis, Buyer Interacted Cashflow Analysis (Stage 2), considered the effect of this 40% Markup percentage on some of the eleven forecast values earlier highlighted and results of provided that at an 80% level of confidence, there would be relatively satisfactory outcomes. However, the Marketing Analysis

Stage (Stage 3) indicated that, there would be a possibility of having cash constraints at some point during the development thus giving the developer foresight enough to allow for mitigating strategies to sales.

In the second case study, supplying the developed model with the Project Physical Description, Project Cashflow, Payments and Assumptions and Finance Charges, the Total Cost to the buyer that matched the market average was outputted as 1610.51 per Sq.M at a Markup of 37%. This would imply that at 37% the developer would be at par with the market and as such there would be little of no elasticity of demand. A Markup Analysis was conducted to visualize the effect of varying the Markup percentage on the probable Internal Rate of Return of the development. The target Minimum Attractive Rate of Return (MARR) is set at 100% with a required confidence level (certainty) of 100%. Consideration is given to selecting a markup percentage of 50% which would imply that 9% of the development would probably be unsold.

However since this percentage is outputted as being able to provide an IRR that is above the minimum, the trade-off would be adequate. An analysis (Stage 2) of 10000 possible buyer scenarios was conducted in order to track the confidence of achieving other forecast values. The output of the analysis processes suggest that at a Markup Percentage of 50%, considering a 100% confidence level, other forecast values would remain within impressive values. The Marketing Analysis (Stage 3), also provided insightful information regarding the effect of buyers on the inflow and the breakeven point of the development.

5.2 Conclusion

This research has made a number of contributions within its individual modules and also in the integrated Buyer Interacted cashflow framework itself. The details are as follows:

- **Novel Approach**: The research introduces a new cashflow modeling scheme that considers the buyers inflow from the inception of the project.
- **Markup Analysis**: A new system (ARO-META) is presented to support the developer in choosing a Markup percentage in order to derive a delivery cost to the buyer that is competitive while also ensuring that Interacted Rate of Return is within a comfortable range.
- **Buyer Interacted Cashflow Simulation**: The proposed model for Buyer Interacted Cashflow is novel in its formulation and its integration of buyer inflow. One of the outputs of simulating buyer interacted cashflow for a project is the range of Interacted Profit for the project and the requisite confidence level of achieving them. The concept of Interacted Profit is novel and simply varies from the traditional expected profit by the addition of the Cost of Finance saving from potential reduction of external finance. This Cost of Finance saving is added to Expected Profit to arrive at Interacted Profit.
- **Marketing Analysis**: The proposed methodology of examining all possible scenarios of buyer behavior provide a more accurate and practical approach to marketing than the traditional way of presenting the buyer with all options of available housing units. This is because the Marketing Analyzer enables the developer to be more focused on directing sales towards a more measurable

predicted outcome. The decision maker is provided with visual outputs in the form of bar charts with which to interpret the outcome of buyer scenarios on other factors such as subscriptions, cash inflow, break even points. The developed application, as such, is novel in its use of simulation to determine the best sales strategy to employ in reaching an acceptable level of Interacted Profit.

5.3 Limitations of the Research Approach

There are some limitations to the developed approach. These include:

- Reliance on User inputs for Property Appreciation
- Calendar flexibility is limited to monthly time steps with the considerations being at the first day of the month without considerations of holidays and weekends
- All installment payment methods are assumed to be from monthly payments

5.4 Suggestions for future research

There are several potential improvements to the developed Buyer Interacted Cashflow approach presented in this study along with other areas of potential future research directions related to the developed system. These include:

- Adding a module to the developed application as an Inflation and property appreciation rate computation tool. Such module will help in computing the possibilities of inflation in the future based on historical records for inflation. This will reduce the impact of human judgment on the allotted rate of inflation

- Developing a behaviorally constrained optimization approach to Buyer Interacted Cashflow Application.
- Developing a Hybrid Genetic Algorithm Enhanced Simulation approach to develop an optimized Buyer Interacted Cashflow simulation application.
- Interfacing the developed application with industry applications such as Primavera©, Ms-Projects©, etc. to directly implement the Buyer Interacted Cashflow approach.
- Inclusion of other project performance indicators (i.e. ROE, NPV, etc.)

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APPENDIXES

Appendix 2A

Table 2: Project Cashflow Data (Case Study 2)

Week Number	Date	Monthly Planned	Planned Cumulative
Prep 1	01-Dec-06	160,543	160,543
Prep 2	01-Jan-07	231,432	391,975
Prep 3	01-Feb-07	56,897	448,872
Prep 4	01-Mar-07	234,561	683,433
Prep 5	01-Apr-07	122,456	805,889
Prep 6	01-May-07	34,765	840,654
Month 1	01-Jun-07	43,256	883,910
Month 2	01-Jul-07	86,753	970,663
Month 3	01-Aug-07	23,876	994,539
Month 4	01-Sep-07	56,742	1,051,281
Month 5	01-Oct-07	489,760	1,541,041
Month 6	01-Nov-07	1,160,180	2,701,221
Month 7	01-Dec-07	6,997,850	9,699,071
Month 8	01-Jan-08	5,953,670	15,652,741
Month 9	01-Feb-08	3,637,750	19,290,491
Month 10	01-Mar-08	2,462,390	21,752,881
Month 11	01-Apr-08	3,404,020	25,156,901
Month 12	01-May-08	13,743,600	38,900,501
Month 13	01-Jun-08	15,112,440	54,012,941
Month 14	01-Jul-08	16,594,110	70,607,051
Month 15	01-Aug-08	12,566,230	83,173,281
Month 16	01-Sep-08	10,222,220	93,395,501
Month 17	01-Oct-08	12,239,230	105,634,731
Month 18	01-Nov-08	16,280,030	121,914,761
Month 19	01-Dec-08	18,518,950	140,433,711
Month 20	01-Jan-09	22,577,560	163,011,271
Month 21	01-Feb-09	18,101,060	181,112,331
Month 22	01-Mar-09	19,501,060	200,613,391
Month 23	01-Apr-09	22,752,760	223,366,151
Month 24	01-May-09	24,162,250	247,528,401
Month 25	01-Jun-09	15,096,460	262,624,861
Month 26	01-Jul-09	10,111,670	272,736,531
Month 27	01-Aug-09	7,966,050	280,702,581
Month 28	01-Sep-09	6,997,850	287,700,431
Month 29	01-Oct-09	5,953,670	293,654,101
Month 30	01-Nov-09	7,966,050	301,620,151

Appendix 2B

Table 3: Sample of Questionnaire

Questionnaire to Survey theResponse of Buyers to Housing Developments in Cairo

	Questionnaire	Ranking	Key
	Section 1	10	Most Preferred
		1	Least Preferred

Please rate the payment methods on a scale of 1 to 10

Nos	Payment Method	Down Payment	Ranking
1	Full	100%	
2	3	10%	
3	3	20%	
4	3	30%	
5	4	10%	
6	4	20%	
7	4	30%	
8	5	10%	
9	5	20%	
10	5	30%	

Note: Down Payments is payed first then the remaining payments are payed on a monthly basis

	Questionnaire	Ranking	Key
	Section 2		

Please check one option each under each column

Nos	Project Period	Trusted Developer	New Developer
1	Before Construction		
2	After 30% Completion		
3	At 50% Completion		
4	At 70% Completion		
5	After Completion		

Note: Prices at the inception are the lowest and the prices of the development will increase as the project progresses.

	Ranking	Key
Section 3	10	Most Preferred
	1	Least Preferred

Please indicate your Ranking of the factors below for Situations where there are Close Alternatives to the housing development in question

Nos	Parameter	Preference
1	Size	
2	Diversity of Units	
3	Construction Period	
4	Price	
5	Unitilities and Facilities	
6	Contractor Reputation	
7	Proximity	
8	Quality	
9	Security	
10	Transportation	

Please indicate your Ranking (as above) of the factors below for Situations where there are **No** Close Alternatives to the housing development in question

Nos	Parameter	Preference
1	Size	
2	Diversity of Units	
3	Construction Period	
4	Price	
5	Unitilities and Facilities	
6	Contractor Reputation	
7	Proximity	
8	Quality	
9	Security	
10	Transportation	

Appendix 2C

Table 4: Questionnaire Results (Payment Options)

Nos	Payment Method	Down Payment	Ranking
	Questionnaire	Ranking	Key
	Section 1	10	Most Preferred
		1	Least Preferred
Please rate the payment methods on a scale of 1 to 10			
Nos	Payment Method	Down Payment	Ranking
1	Full	100%	2%
2	3	10%	5%
3	3	20%	5%
4	3	30%	9%
5	4	10%	11%
6	4	20%	4%
7	4	30%	12%
8	5	10%	8%
9	5	20%	14%
10	5	30%	19%
Note: Down Payments is payed first then the remaining payments are payed on a monthly basis			

Table 5: Questionnaire Results (Payment Time)

Nos	Project Period	Trusted Developer	New Developer
	Questionnaire	Ranking	Key
	Section 2		
Please check one option each under each column			
Nos	Project Period	Trusted Developer	New Developer
1	Before Construction	7%	2%
2	After 30% Completion	38%	15%
3	At 50% Completion	23%	28%
4	At 70% Completion	21%	41%
5	After Completion	11%	14%
Note: Prices at the inception are the lowest and the prices of the development will increase as the project progresses.			

Table 6: Questionnaire Analysis (Price Sensitivity)

	Ranking	Key
Section 3	10	Most Preferred
	1	Least Preferred
Please indicate your Ranking of the factors below for Situations where there are Close Alternatives to the housing development in question		
Nos	Parameter	Preference
1	Size	
2	Diversity of Units	
3	Construction Period	
4	Price	78%
5	Unitilities and Facilities	
6	Contractor Reputation	
7	Proximity	
8	Quality	
9	Security	
10	Transportation	
Please indicate your Ranking (as above) of the factors below for Situations where there are **No** Close Alternatives to the housing development in question		
Nos	Parameter	Preference
1	Size	
2	Diversity of Units	
3	Construction Period	
4	Price	83%
5	Unitilities and Facilities	
6	Contractor Reputation	
7	Proximity	
8	Quality	
9	Security	
10	Transportation	