# Monte Carlo Simulation in Shopping Centers´ Investment Decision

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**Abstract**

Investment decisions in shopping malls are taken by expectations built into long-term horizons with a view to his character of structural rigidity and perpetuity of his operations. In this way, investment in shopping centers is characterized by high risk and so it is necessary that, at the time of the decision, the entrepreneurs may contain information about the results that can occur when reality away from the conditions laid down in the scenarios built in condition for certainty. Among the several existing methods of valuation of investments, the discounted cash flow is the most adopted although it contains components of uncertainty that the future expectations do not they materialize. One of the alternatives for the measurement of risk consists of the combination of Monte Carlo simulation to the conventional deterministic model. The aim of this paper is to present the model of investment analysis in shopping malls with the application of Simulation technique to Monte Carlo for the treatment of present uncertainties in the discounted cash flow methodology with deterministic variables. The results of this study confirm the effectiveness of this approach, confirming that the quality of the results obtained shows a significant improvement on the results obtained with deterministic model.

**Keywords:** Investment Analysis, Monte Carlo Simulation, Shopping Center

## Introduction

According to ABRASCE - Brazilian Association of Shopping Centers, shopping centers are projects with a total area available for installation of stores above 5,000 square meters. This area is called GLA-Gross Leasable Area. They consist of several commercial operations, with single and centralized administration and practicing fixed and percentage rent on sales. There are parking spaces compatible with the region laws where they are installed. Feature anchors stores with more than 1,000 m² and they feature attraction power of consumers for the venture. The anchors are retail operations of the segments of department stores, hypermarkets, electronics etc. The remaining stores that make up the project are called non-anchors stores.

According to the Brazilian Census of shopping centers 2013/2014, prepared by ABRASCE, there are currently 495 malls in Brazil with a total GLA of 12.94 million square meters; in 2006, the figure was 7.5 million square meters, with 351 malls. Therefore, in eight years there was a growth of 41% in amount of projects and 72.5% in GLA, which shows the great dynamism of this economy sector that represents 18.3% of national retail and 2% of the Brazilian GDP.

Thus, in view of the strong competition growth in this market, there is currently a major

concern in the shopping center industry in planning new developments so that they are attractive under the investors´ point of view ensuring their competitive position and, therefore, their profitability.

Due to high volumes of investments required for construction of shopping malls, structurally they are planned with the aim of exploring their activity for long periods ensuring that remain generating revenue of perennial form. In this way, must be made predictions about the behavior of very distant realities of the moment of decision to invest.

On the other hand, malls are businesses designed to develop specific activity, which gives them a high structural rigidity and limits their capacity to adapt to compensate for possible deviations resulting from real situations other than those envisaged at the time of the decision to undertake.

Therefore, decisions to invest in shopping malls are characterized by high risk and investment success depends, in addition to the competence and probity of the managers of the business, of a precise economic feasibility study.

The entrepreneur, at the time of the decision to invest, must have at its disposal information allowing it to show the intensity of deviations that may occur in the expected results in the face of adverse environmental influences, adding that quality to the decision.

This paper deals the development of a risk analysis model of investing in shopping centers, which consists in identifying the most relevant factors and the study of the effects of your deviations on the results of the project.

Thus, the objective of this paper is to apply Monte Carlo simulation to assist in the decision to invest in the deployment of a shopping mall, through risk analysis.

## Theoretical Reasoning

### Investment analysis

The investment analysis deals to define what investment alternative should be chosen, when more than one is presented, such as acquiring a company or not, replace a machine for another new, invest or not in the project of building a factory, a shopping mall, a hotel, hospital.

HIRSCHFELD (2009) stands out among the various methods used for the choice of a particular alternative, the following: Net present value method; Net Future value method; Uniform Liquid value method; The benefit-cost method; Return rate method or internal rate of return (IRR); Method of return Period or *Payback Period*.

### Minimum Rate of Attractiveness (TMA)

For the use of methods that use the present value of a particular cash flow it is necessary the use of Minimum Rate of Attractiveness that reflects the opportunity cost associated with the investment.

To KASSAI *et al.* (2000) Minimum Rate of Attractiveness is the rate that serves as a parameter of acceptance of a particular project. The determination of TMA in a business typically is a complex task, because it depends on tangible and intangible variables, such as term, strategic importance of the projects, the growth policy, goal of distribution of dividends, earnings expectation of entrepreneurs, among others.

To DAMODARAN (1997), there are two ways of estimating this rate: Cost of equity-is the rate of return that investors demand to hold an equity investment in a company, and can be set with

the use of a model of risk and return, such as the *Capital Asset Pricing Model (*CAPM); Weighted average cost of capital (WACC).

**Net present value Method (NPV)**

For HIRSCHFELD (2000), the method of net present value (NPV) is the algebraic sum of the values in *n* periods in a cash flow, reduced to instant starting and being considered *(i)* the interest rate.

The decision criterion for the method is to consider only the alternatives that present the net present value greater than or equal to zero.

**Internal Rate of Return method**

The rate of return or internal rate of return (IRR) is the discount rate that equates the flow of entries to that of outflows, i.e. the rate that produces an NPV equal to zero. For HIRSCHFELD (2009), the rate of return occurs when the sum of revenues (entries) becomes exactly equal to the sum of expenditures (outputs).

In this method, choose the alternative that present the biggest difference between the internal rate of return and the minimum rate of attractiveness.

**Return Period Method**

The Return Period method or Investment Recovery Period or *Payback Period* is used frequently, regardless of present limitations.

As HIRSCHFELD (2009), return period is the number of periods of cash flow in which the sum of the benefits is equal to the sum of the costs.

The important feature of the *payback* is that it is associated with a risk measure, since the higher the return, the greater the possibilities of cash flow is not achieved.

However, this method does not consider the "time value of money" because it is not based on discounted values. In addition, according to KASSAI *et al*. (2000) its biggest deficiency is not taking into consideration the cash flows that occur after the *payback* period.

**Projection Period**

DAMODARAN (1997), ROSS *et al*. (1999), MALIK *et al*. (2001), COPELAND *et al*. (2000) and KASSAI *et al*. (2000) suggest that the cash flow should be estimated for a period until there is stability of their result. This period must be all the time intervals at which it is possible to predict cash flow with the greatest possible predictability.

Important to note that developments such as shopping centers are planned to operate in a perpetual and thus its operation should be considered infinite term, but the period considered to reach steady-state be of 10 years.

**Perpetuity Value**

The perpetuity value is the present value of a cash flow series with infinite length, which begins after the end of the explicit period of projection and start its steady-state of results. According to MARTINS *et al*. (2001, p. 283), "generally it is estimated based on the free cash flow from the last

projection period and considering the expectation of growth", being represented by the equation (1).

$$V_p = \frac{FCL_n \times (1+g)}{CMePC - g} \quad (1)$$

Where: $V_p$ = Perpetuity Value; $FCL_n$ = Free cash flow from the last projection period; $CMePC$ = Weighted average cost of capital; $g$ = Rate of growth.

**Risk analysis - Monte Carlo method**

As MONTEIRO, C.; SANTOS, L. N.; WERNER, l. (2012), the traditional methods for evaluation of projects - net present value (NPV) and internal rate of return (IRR) - are based on deterministic data analysis. However, the reality may behave unexpectedly and, consequently, not be duly evaluated by traditional methods.

As exposed by GRANDSON *et al*. (2002), even the NPV analysis is considered the best tool for decision-making and investment even if the future cash flow of this investment is well prepared, they transmit a false security to entrepreneurs because they are associated with the degree of uncertainty and risk, and the forecast is not achieved as was established.

In this way, it is necessary to identify other possible events that may lead to non-viability of the enterprise, as well as identify measures that could be taken to neutralize them.

MONTEIRO, C.; SANTOS, L. N.; WERNER, l. (2012), claim that the Monte Carlo method can be used in the analysis of project investment through continuous and random generation of numbers that are connected to the inputs and outputs of box used in the calculation of NPV. According to the authors, such changes in cash flow act as random scenarios. Randomly generated numbers obey the predefined probability distributions based on data obtained from the analysis of past events or using projections for the future. The definition of probability distributions is made on factors that make up the NPV calculation, such as sales growth and profit per year, where the Act of randomly generate those factors makes NPV take various values.

As MOORE and WEATHERFORD (2005), the simulation can be used as an important tool to predict the risks and uncertainties of projects, assisting in the decision-making process and the method of Monte Carlo simulation can be adopted in the evaluation of projects, where the uncertainties and risks involved can be expressed in a simple way. The Monte Carlo simulation is a form of iterative evaluation of a deterministic model, using randomized numbers as inputs.

According to HERTZ (1964), the basic principle of this technique lies in the fact that the relative frequency of occurrence of certain phenomenon tends to approach the probability of occurrence of the same phenomenon, and when the experiment is repeated several times take on random values within the limits set.

**Real Options Method**

The real options, according to MINARDI (2004), can be assessed by analogy with financial options. Financial options contracts give the holder the right to buy or sell, depending on the type of option, a predetermined amount of an asset on a specified date, for a predetermined price.

In a project, considered every possible alternative, such as expansions, reductions, deactivations, how an option that has a cost, or gain, with a certain probability of occurrence. This flexibility is a possibility to change a project at different stages of their operational life (MINARDI,

2004). Therefore, the theory of options makes it possible to overcome the limitations of traditional methods of analysis, as it considers the managerial flexibilities in the evaluation of investment.

## Methodology

The choice of research method is fundamental to the evaluation and understanding of the information obtained. BRYMAN (1989) lists some of the main research methods: experimental research, evaluation research (*survey*), action research and case study.

For the preparation of this paper was adopted as case study methodology due to the complexity that involves the analysis of investments in shopping centers and to the fact that the case study helps answer the questions "how" (how to evaluate the investment analysis in companies?) and why (why certain factors are more relevant for the valuation which others?) (YIN, 2010).

According to YIN (2010), the evidence can come from six different sources: documents, records on file, interviews, direct observation, participant observation, and physical artifacts. He points out three principles for data collection: using multiple sources of evidence (triangulation), creating a database for the study of case or keep the thread of evidence.

For this paper, the principle for the data collection was the creation of a database using direct observation as a source. It is a shopping center to be built in the southern Brazil having 56,280 .00 m² of total GLA (Gross Leasable Area), 19,700 .00 m² occupied by anchor stores and 36,580 .00 m² by non-anchor stores in 101,304 .00 m² of built area.

Adopting the classification proposed by LEAK and TURNER (1982), the project is classified as a Regional Mall, characterized for presenting an area of influence of 8 to 24 km, with wide variety of branches with predominance of clothing and possessing two to four traditional anchors of the branches department store, electronics and hypermarkets. Containing 250 stores and 2,814 parking spaces, it will be designed to suit the target audience of class B and C.

### Deterministic economic evaluation

As exposed in the literature review, to the economic assessment will be applied the methods of net present value of projected cash flow and the internal rate of return. To do so, will be projected the values of income and expenses.

### Projection time

It was considered 10 years horizon, which is the period, required a shopping center to show its steady state. However, after this period will be considered an infinite horizon generating stabilized results, but growing at a rate of 3%.

### Rental Revenue

In this paper were only considered fixed rents. The rents calculated variables in function of sales stores were disregarded for purposes of this study with a view to their low representation and little influence on the result. Rental revenues were subdivided into rents of anchor stores and non-anchor stores. Were adopted the following calculation parameters: Rent anchor stores: R$ 30.00/m² for 19,700 m² of GLA; Average rent non-anchor stores: R$ 120.00/m² for 36,580 m² of GLA.

**Vacancy of non-anchor stores**

Is the amount of vacant stores, which results in non-receipt of rent, as well as represents an expense related to the operational expenses to be borne by the Entrepreneur.

For the first few years after its inauguration, the vacancy is considered greater, because the mall is in the initial phase of operation and historically is observed a greater vacancy than in subsequent years. Is only considered vacancy for non-anchor stores, because the anchor stores are considered structural stores at the mall and it is only opened after the lease of all anchor stores. Thus, the evolution of vacancy is presented in table 1.

*Table 1 – Non-anchor stores vacancy evolution*

| Year | 1 | 2 | 3 | 4 | 5 | 6 | 7 | 8 | 9 | 10 |
|---|---|---|---|---|---|---|---|---|---|---|
| % GLA | 10,00% | 10,00% | 8,00% | 6,00% | 5,00% | 5,00% | 3,00% | 3,00% | 3,00% | 3,00% |

**Revenue of Res Sperata (CDU)**

This is the payment made by retailers for acquisition of commercial point in leasing contracts of longer than 5 years. The practice of shopping centers sector is to give ample facilities to retailers for payment of CDU, especially taking into account that in the first two years, after the inauguration of its stores, they are undercapitalized due to application of major investments in facilities and constitution of stocks. In this way, we will adopt term to 48 months payment and amount of R$ 1,500/ m².

**Taxes**

The Federal Brazilian tax law No. 9,718/22/27 of 1998 and its latest amendment by law No. 12,995 of 6/18/2014, article 13, requires that all enterprise whose total annual gross revenue exceeds R$ 78 million should adopt the taxation scheme based on Real Profit. As the company that owns the project, object of this study, already has other operations whose revenue combined exceed the limit established by law, this article adopts the Real Profit scheme for calculation of taxes.

**Charges vacancy expenses**

It is the Owners´ expense by concerning operating expenses appropriate to the vacant stores. The proportion of vacant stores is established by forecasting the vacancy evolution in the set of 36,580.00 m² of GLA of **non-anchor stores**. The operating expense considered in this paper is R$ 100.00/m² considering the constructive characteristics and dimensions of the Mall in analysis.

**Legal fees**

These are the expenses of legal advice for charges of judicial rents and operating expenses, which the composition is not possible through friendly agreements. The monthly amount to be adopted is of 1% on the value of the net revenue from rent.

**Extra Advertising & Promotion Fund**

The owners generally contribute to Promotions fund, aiming at the realization of more elaborate

events during the first 4 years in major retail dates, which are the months of May and December.

**Building Fund**

These are the expenses incurred to increase the asset value of the project, such as renovations and acquisitions of fixed assets that by their nature aggregate further value to the Mall. Will be adopted the value corresponding to the application of the percentage of 1% on the value of the net revenue from rent.

**Other expenses**

In this item are included the following expenses: monthly ABRASCE (Brazilian Association of Shopping Centers), audit expenses of stores, accounting and audit expenses and architectural services. The average adopted for this expenditure is 1% of the value of the net revenue from rent.

**Investments**

Investments involve expenditures with the following items: land acquisition, parking construction, landscaping, stores leasing, administration, deployment works in stores, building cost, projects, management of the work, documentation expenses and miscellaneous. The total value is R$ 238,576 thousand.

**Depreciation**

Adopted the straight-line depreciation method for the period of 25 years for R $ 160,580,432.

**Minimum rate of attractiveness**

The minimum rate of attractiveness will be estimated by the equity cost method that can be defined with the use of risk and return model. To this end, the entrepreneurs of the project of this paper consider the minimum rate of attractiveness as being: TMA = financial application rate + risk premium.

For the financial application rate is assumed the rate of remuneration of Bank Deposit Certificates CDB of 7% per annum and for the risk premium rate of 8%. Like this, TMA = 7% + 8% = 15%

**Perpetuity Value**

It was considered the growth rate, from the 11th year of 3% per annum, the minimum rate of attractiveness of 15% per annum and the free cash flow of the 10th year the amount of R$ 39,740.14 thousand. For calculating the perpetuity value was adopted the equation 2. Like this,

$$V_p = \frac{FCL_n \times (1+g)}{CMePC - g} = \frac{39.740{,}14 \times (1+3\%)}{15\% - 3\%} = 341.102{,}86 \qquad (2)$$

**Projected cash flow and calculation of NPV, IRR and Payback**

NPV is positive indicating the feasibility of the project, i.e. the project generates, at present value, R $ 43,831.17 thousand more than was invested. The IRR of 18.78% per year is higher than the minimum rate of attractiveness required by entrepreneurs from 15% per annum, which also demonstrates its viability. The Payback from the 6-year project is considered appropriate for this type of investment.

**Risk analysis**

The previous calculation of the internal rate of return calculation and net present value was based on a scenario more likely, not considering the uncertainties associated with their variables. However, it is important to analyze the feasibility of the project possibilities considering that its operation does not take place under a perfect control of your variables.

To this end, each item of revenue and expense was considered as a random variable and each was associated with a probability distribution, based on statistical data collected, enabling the analysis of the evaluation in terms of risk.

For the measurement of the influences of the random variables in the internal rate of return and net present value was applied the Monte Carlo method simulation with the implementation of Oracle Crystal Ball software, in conjunction with the Microsoft Excel spreadsheet.

## Results analysis

Five thousand iterations were performed, i.e. 5,000 random values were used for each of the 15 random variables and, consequently was obtained the same number of values for the NPV and IRR. The level of trust established was 95% and the total run time of the simulations was 0.53 seconds.

**NPV Values**

The first output of the Crystal Ball is the NPV distribution function that showed the probability of 97.12% of project NPV is positive, as can be seen in figure 1.

The average value of the NPV distribution reached R$ 40,727.46 thousand and is very close to the calculated value based on deterministic scenario of R$ 43,831.17 thousand (see figure 1).

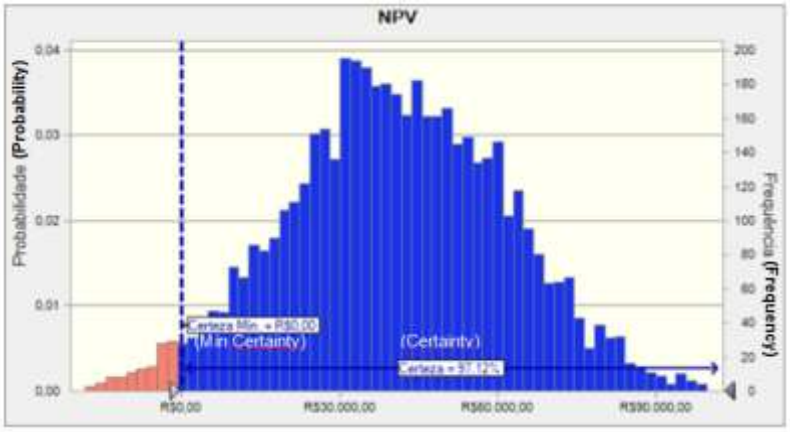

*Figure 1 – NPV Distribution Function*

The Crystal Ball also shows the contribution of each random variable in NPV variation. It has been shown that the variable Non-anchor stores Rent contributes with 52.2% of the variance of the NPV, followed by the building cost with 43.2%. Therefore, 95.4% of the variation of the NPV is explained by these two variables. The other variables showed negligible influence on the variation of the NPV.

**IRR values**

The IRR distribution function presented the probability of 97.12% of the IRR of the project exceed the minimum rate of 15% attractiveness, as can be seen in figure 2.

The average value of the IRR distribution reached 18.59% with a standard deviation of 1.93% which confirms their statistical significance and is very close to the calculated value based on deterministic scenario of 18.78% (see figure 2).

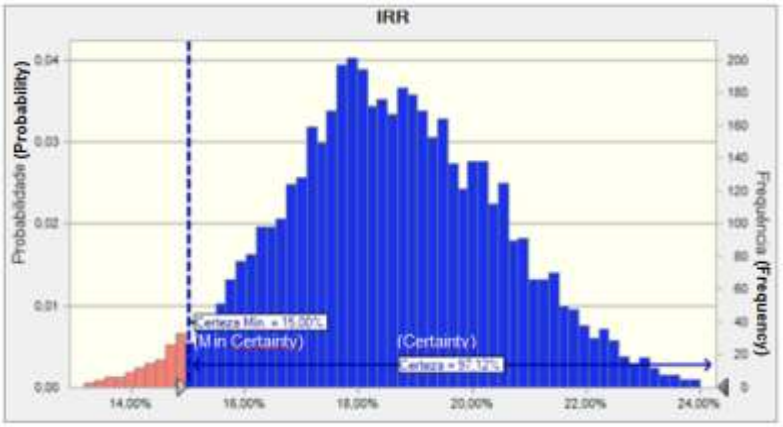


*Figure 2 – IRR distribution Function*

Similarly to the sensitivity analysis presented by the Crystal Ball for the NPV is shown the influence of random variables in the variation of the IRR. It has been shown that the variable building cost contributes with 53.4% for the variance of the IRR, followed by the non-anchor store rental with 42.9%. Therefore, 96.3% of the variation of the IRR is explained by these two variables. The other variables showed negligible influence on the variation of the NPV.

## Conclusions

The main objective of this paper was to use the Monte Carlo simulation as a technique to aid the analysis of investment in projects of shopping malls.

This work presented a methodology that integrates traditional methods of evaluation of projects such as NPV and IRR, with the Monte Carlo method as a simulation tool for risk analysis. The method implemented consists of two steps, and the first step is described the analysis of the investment in certain situations, while the second is performed the analysis of the situation of risk.

Applying the methodology proposed in the analysis of investment for the deployment of a shopping center, it was possible to obtain simple information for decision-making with greater

accuracy and reliability, seeking to make inferences to analyze the level of risk of the project.

The Monte Carlo simulation helps in making better decisions because it examines the effects of all possible combinations of variables and allows the analyst a better understanding and visualization of risk and uncertainty, and so they can estimate the probability of project success.

The analysis model, using Oracle Crystal Ball software, in conjunction with the Microsoft Excel spreadsheet, proved to be a very useful tool to visualize and quantify the effects of uncertainties and risks on the investment analysis. In addition, the sensitivity analysis feature this software helps to focus the attention of the analyst on the variables that are important for the decision, including adopting actions that minimize the effects of a particular uncertainty.

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