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VALUE AND RISK EVALUATION OF POWER PROJECTS: A SYSTEM DYNAMICS APPROACH

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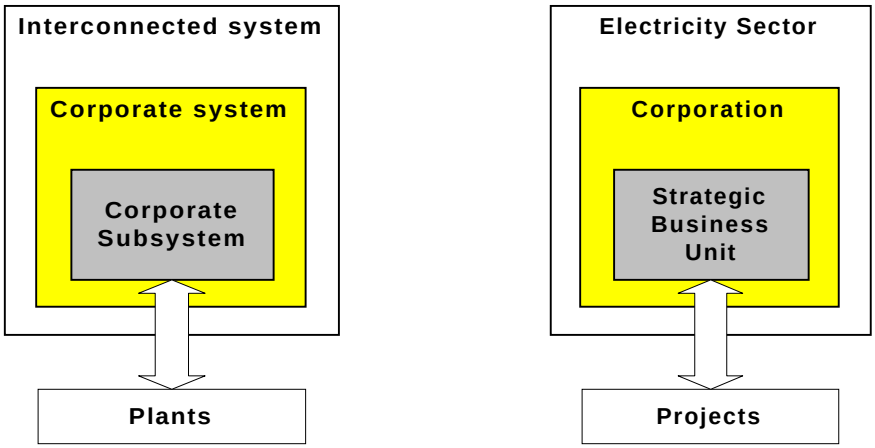
ABSTRACT

This paper describes a computational model denominated SUN (Business Unit Simulator, in Portuguese), which evaluates financial-economic performance of Strategic Businesses Units (SBU's) and/or investment projects under two approaches: deterministic and stochastic. Under the deterministic approach, each project is associated to a single cash flow, that may be evaluated with both the traditional methodology (Net Present Value and Internal Rate of Return) and the value based methods (Economic Value Added and Market Value Added). Under the stochastic approach, a set of cash flows is associated to each project, representing postulated scenarios. Based on these scenarios, the CAPM (Capital Asset Pricing Model) method is used to assign a risk index (Beta) to each project. The model evaluates the potential impact of a project, either stand alone or as part of the investment portfolio of a utility, on the SBU profitability. Therefore, it fills a gap in the available project analysis "toolkit", under two main aspects: shareholder value creation and project risk analysis. Given its flexibility, SUN may become an important component of a decision support system, from project analysis to the evaluation of value and risk embedded in SBU and firm wide restructuring.

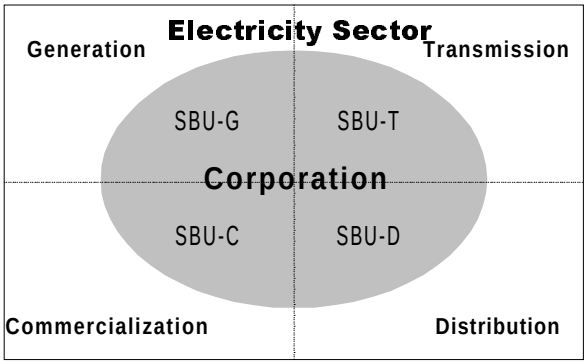
INTRODUCTION

The production and trading activities in the Brazilian electricity market is now based on competition. This structure will increase the number of agents and the range of business arrangements amongst the agents, thus increasing the complexity of evaluation and selection of investment projects in power sector. This added complexity challenges the capability of traditional models used in the financial-economic planning of electric utilities, that shall now consider a business risk component.

The hierarchic structure (left side) represents the traditional, regulated system planning point of view and was built under a technical-economic perspective. This structure is still valid under the competitive business environment, but requires a complementary hierarchic structure to better capture the economic-financial perspective of the business planning in the new environment (right side of the figure).



In the business planning structure, a SBU corresponds to a firm's business activities at an specific industry segment and may be associated to each possible intersection between a firm and an industry segment and. A SBU is an autonomous operating unit in what regards business management. The figure below represents a firm with four SBU's operating in the areas of Generation, Commercialization, Transmission and Distribution.



Investment projects are the basic components of the business plan of a SBU and are an underlying notion to planning hierarchy structure. The project concept, so defined, contrasts with SBU notion, that are continuous operations, at an indeterminate time interval (normally limited by a planning horizon for study purposes).

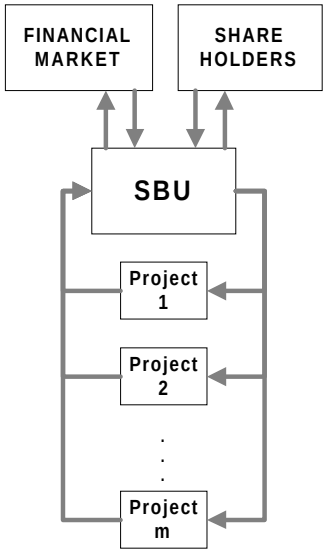
MODEL STRUCTURE

The decision problem at the SBU level may be decomposed in two subproblems: the investment decision (how much to invest in each project) and the financing decision (what funds to borrow to invest in each project). These decision subproblems may be modeled through the traditional deterministic approach (via NPV and IRR) or through shareholder value based deterministic ap-

proach (via EVA and MVA). Either approach may be employed to allocate the available resources among the projects. Under competitive pressure, the resource e allocation process has an essentially dynamic nature and includes the extreme cases of suspending temporarily the development of a project or even discarding a project altogether.

The main problem at the project level is to forecast and evaluate the cash flows of each project. This problem may be modeled by either a deterministic or a stochastic approach. Under the deterministic approach, each project is defined by a single cash flow that is evaluated by the NPV/IRR methods. Under the stochastic approach, each project is defined by several cash flows, depending on the scenarios under analysis, that are evaluated by the CAPM.

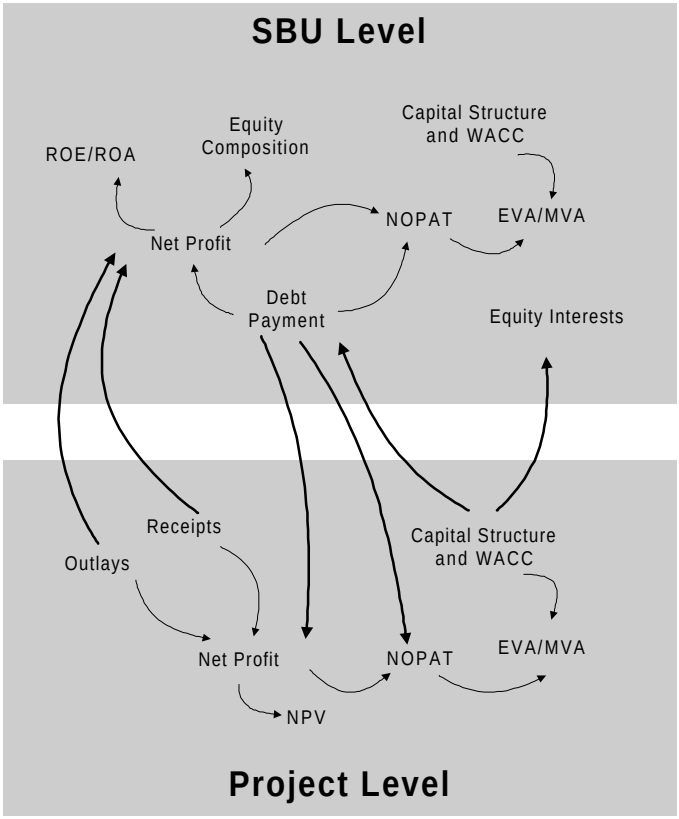
The structure of the SUN model is presented below. This structure emphasizes that, under the SBU point of view, a project is an investment which will produce economic results (energy sales, for instance). Under the project point of view, the SBU is a lending entity. In this model, the capital required to start (and maintain) a project is obtained from the SBU, which procures capital from shareholders and/ or capital markets.



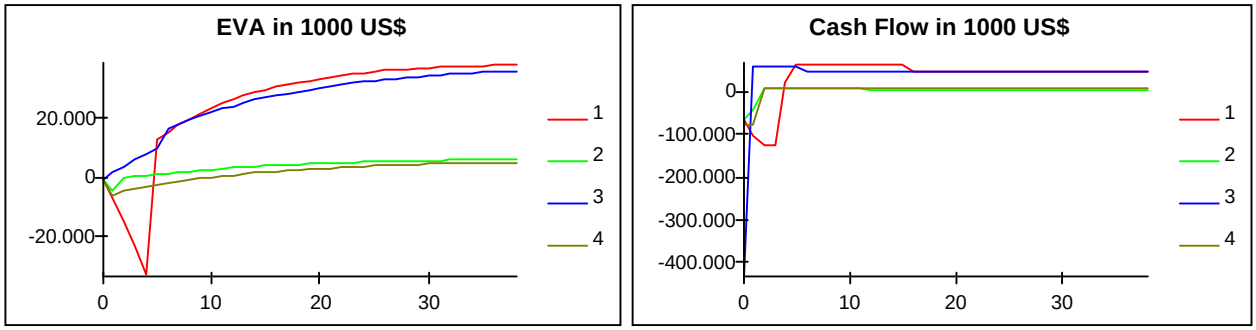
The purpose of the SUN model is to measure the financial-economic performance of SBU and projects under two aspects: value and risk. Given basic inputs (like capital outlays, receivables and capital structure) the model calculates deterministic indices (NPV, EVA, MVA) and a stochastic index (Beta) for each project and for the SBU as a whole. The combined use of risk and return indicators provides a complete framework to evaluate assets at the SBU and project levels.

The SUN model has a modular structure, where each module calculates a group of model variables. The computational implementation of the model is supported by the shell *Powersim*. Model inputs are stored in a text file and a subset of parameters (policy levers) may be changed by slide bars at simulation time, thus facilitating sensitivity analysis.

The model was developed under the system dynamics framework. The figure below presents a high level causal loop diagram of the SUN model, indicating the cause-effect relationships among the main variables; the arrows indicate the influence direction.



A graphical interface, a kind of flight simulator, has been developed to ease data handling and the visualization of the results. Graphical interfaces allow comparison of values and offers subsidies to decision making. The figure below presents the simulation results for a SBU compound by four projects.



CONCLUSIONS

The modeling technique used the SUN model, system dynamics, allows the consideration of "non-orthodox" structures and costs of capital at the project and SBU levels along the study horizon. This is possible because it represents the financial-economic problem through feedback loops.

Shareholder value based methods (EVA/MVA) complement the more traditional NPV/IRR approaches, whereas CAPM permits the inclusion of a explicit risk measure at project level, in addition to the (deterministic) return measures. This is in contrast to the deterministic equivalent of the discounted cash flow method, where the risk measure is implicit in the discount rate.

The CAPM methodology, complemented by the deterministic ones (EVA/MVA and/or NPV/IRR), makes the SUN model a flexible decision support tool under different decision circumstances, from a single project analysis to the evaluation of complex restructuring decisions like the acquisition, merger and integration of firms and SBU's.

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