SOA GOVERNANCE DYNAMICS FOR IT ORGANIZATIONS

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Abstract

Service Oriented Architecture and cloud computing provides the IT infrastructure, design patterns and other artifacts to an IT company get intrinsic interoperability between software programs and achieve other benefits like increase software federation, increase business and technology alignment, increase vendor diversification options, increase return over investment, increase organizational agility and reduce IT burden. As SOA governance refers to the coordination of people, processes and technologies involved in each area within an organization, a diagnosis of a governmental IT agency gave many insights over its performance and its SOA Governance problem in order to produce a SD model. Thus, by comprehending the complex interactions between the factors that could influence SOA governance systems, in conclusions it is proposed the combination of SD with other approaches to develop computer based management flight simulators.

KEY WORDS: **System Dynamics, Competitive Intelligence, Strategic Planning Product Project; Relevant information, SOA governance, cloud computing**

I. INTRODUCTION

SOA Governance (SG) problem refers to the coordination of people, processes and technologies involved in each area within an organization to estimate problems that comes from subjective variables like credibility over time, productivity, effectiveness of investments, reliability and others. A governance system is responsible for providing organization, direction, and guidance for the creation and evolution of IT assets and resources [6]. It means planning under uncertainty and considering operational and even image risks once its goal is to make processes more efficient, to prevent redundancy and to optimize them in order to improve supervision for the creation and evolution of IT assets and resources.

Planning under uncertainty and considering operational risks inherent of IT enterprises requires reliable tools to do better analysis and to manage IT assets in order to set policies that assure good performance and credibility to such organization.

Thus, a decision making simulation model based on an adaption of Forrester's' Market Growth model[15][11][12] and on the system dynamics method were considered in order to represent interactions of intended rational policies in the study of dynamics that can arise of the complex combinations of SOA Governance factors, principles and structures.

The primary gain is (a) a better planning process that benefits from simulation before making a decision and thus moving energy and resources to achieve the goals and (b) a management flight simulator to help managers learning from complex interactions between factors and enhance their mental models.

To place the issues into perspective, this paper has four sections. First, it discusses complexity and rationality. Next, discusses ways to model SOA governance by the use of system dynamics method. Follows considerations on modeling SOA governance in government IT companies. Finally, in the conclusion, there are considerations regarding the use of a multi-paradigm approach to address SOA Governance typical problems.

II COMPLEXITY

SOA governance is about complexity and the process of conceptualize, develop and apply policies, to establish practices, manage risks and consider uncertainties. Sterman (2006) remember that "most people define complexity in terms of the number of components or possible states in a system" [14]. Thus, the more complex the phenomenon, the more difficult is to conduct controlled reliable and replicable experiments and discriminate among rival hypotheses because of the large number of "physical, biological, ecological, technical, economic, social, political, and other relationships". Replication is difficult or even impossible and "decisions taken in one part of the system ripple out across geographic and disciplinary boundaries" [14].

The author concerns about policy structure and remember that "those with power and authority routinely manipulate the policy process for ideological, political, or pecuniary purposes " and about systems principles as long time delays that "mean we never experience the full consequences of our actions and follow-up studies must be carried out over decades or lifetimes, while at the same time changing conditions may render the results irrelevant and then complexity hinders the generation of evidence”[14]. So, “effective interventions require changes in the beliefs and behaviors of a large majority of actors involved, supported by complementary changes in education, incentives, and institutions” [14].

Policies come with resistance from the people and “most cases of policy resistance arise from dynamic complexity—the often counterintuitive behavior of complex systems that arises from the interactions of the agents over time”. Among the elements of dynamic complexity people find most problematic are feedback, time delays, and stocks and flows, because systems are constantly changing, are tightly coupled, governed by feedback, nonlinear once “effect is rarely proportional to cause” and “also arises as multiple factors interact in decision making” [14].

Modeling is based on abstraction, simplification, quantification, and analysis [1]. The modeling process is an iterative learning process that encompass many steps like getting information about the real world or the problem articulation, structure a dynamic hypothesis, formulation or transformation of the dynamic hypothesis in many diagrams, testing and the policy formulation and evaluation [12] to assure that “the model’s structure is sound and that it is capable of reproducing the dynamic symptoms of the original problem” [11]

For system dynamicists, once a decision is based on the observed state of the system, there are a structure of interacting feedback loops and it implies a circularity of cause and effect, where the system produces the decision which produces the action which produces change in the system [7]. Within the feedback loop there are level variables that mean accumulations within the system and mathematically are integrations. Rates variables that are system condition at any point of time represent the system activity and are the policy statements in the system which defines how the existing conditions of the system produce a decision stream controlling action.

To Forrester, “speak of systems implies a structure of interacting functions. Both the separate functions and the interrelationships as defined by the structure contribute to the system behavior”[15]. Rates are not instantaneously observable once they depend only on the values of the level. Rate equation defining a rate variable is a statement of system policy that describes how and why decisions are made. “A policy statement incorporates four components - the goal of the decision point, the observed conditions as a basis for decision, the discrepancy between goal and observed conditions, and the desired action based on the discrepancy” [7].

III SOA GOVERNANCE SYSTEM MODELLING

An organization establishes governance to mitigate risk and to help advance its strategy, goals, and priorities and the investment in an SOA initiative concerns to gain benefits worth more than the cost of the investment [6].

There are seven strategic goals of service oriented computing for the long term benefit of an IT company[6]: increase intrinsic interoperability, increase federation, increase business and technology alignment, increase vendor diversification options, increase return over investment (ROI), increase organizational agility and reduce IT Burden.

The movement to cloud computing is the disruptive change that IT departments will soon face as service oriented architecture (SOA) and cloud computing begin to have an effect on the modern enterprise [10].

A SOA Governance system places constraints on decisions; determines who has responsibility and authority to make decisions; establishes constraints and parameters that control, guide, or influence decisions; and, prescribes consequences for non-compliance. In discussing the differences between management and governance states that "management is a system and resources that are responsible for day-to-day operations" while "a governance system establishes rules and constraints" or, at a final conclusion, it could mean the ability of doing applied policies[6]. To the author, "an organization establishes governance to mitigate risk and to help advance its strategy, goals, and priorities".

SOA governance is a multifactor approach and SD gives the capability to better manage risks factors to help managers to better know the productivity, the comprehension of business growth (revenues), the results of image campaigns (credibility) and the wealth of the company so they can identify and analyze trends. A stochastic programming model for a SOA Governance is dynamic since the information on the actual value of uncertain parameters is revealed in stages.

IV Modeling SOA Governance on Governmental IT Companies

The preceding concepts will be exemplified in order to show their utility and how it can be used by a SOA governance research once it may be considered an extension of IT governance or, in a broad sense, of corporate governance as a whole and some key activities that were revealed by the diagnosis did on an important Brazilian governmental IT organization as being part of it are:

- Managing the portfolio of services;
- Managing the service lifecycle;
- Using policies to restrict behavior;
- Monitoring performance of services;
- Managing how and by whom services are used;

The utilization of SD can add another way to see interactions within the company, within the market, and between the two. In this paper, a model with no influences of the outside can be made in order to represent their behavior, the social-economic and political environment to provide deeper insights by simulation experiments and the flows of goods, services, money and information. Fig.1 shows the main relations of a SOA governance problem:

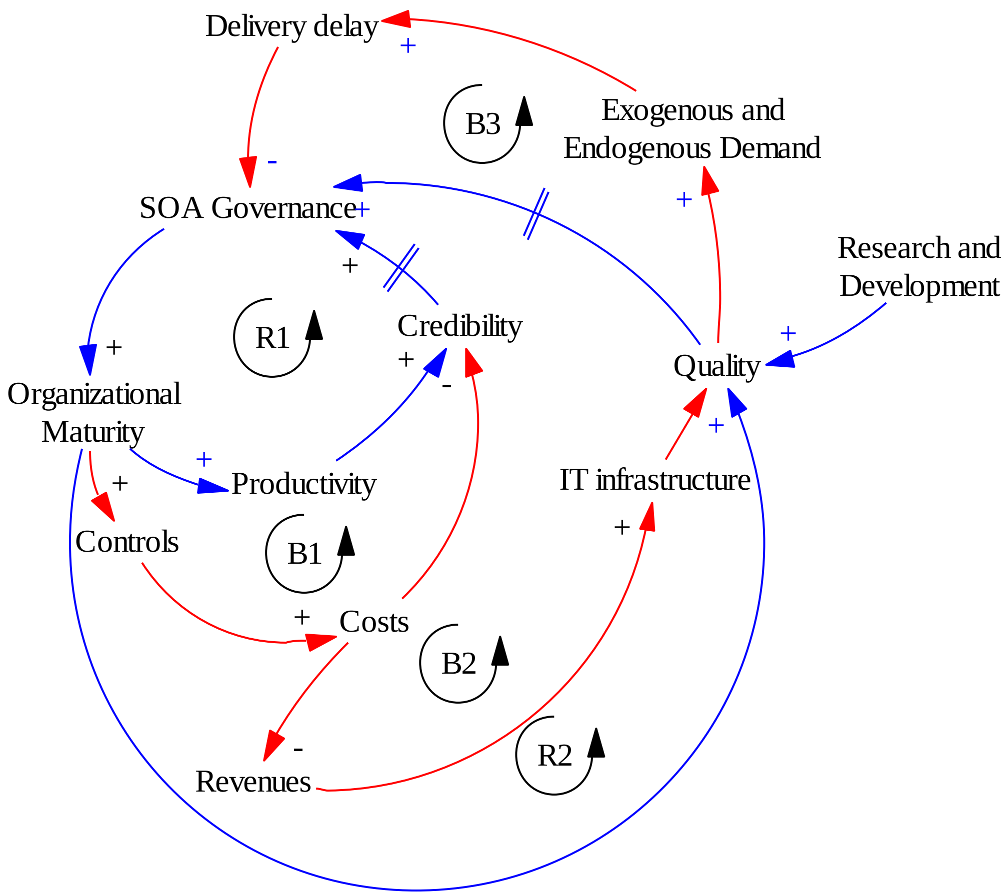

Figure 1: Cause and effects on factors for a SOA Governance Model

The diagnosis revealed that the management of the demand, the quality, the credibility, the organizational maturity framework and investments in the IT infrastructure are central on a good SOA governance program and that there is following reinforcing and balancing loops governing its dynamics:

R1: **SOA governance, organizational maturity, productivity, credibility**. This loop focuses on productivity as a consequence of the adoption of an organizational maturity framework and the consequent enhance on productivity.

R2**: SOA governance, organizational maturity, quality**. This loop is about the quality obtained as a consequence of the adoption of an organizational maturity framework;

B1**: SOA governance, organizational maturity, controls, costs, credibility**. This loops considers the enhance on costs because the growth of controls because the adoption of the organizational maturity framework;

B2: **SOA governance, organizational maturity, controls, costs, revenues, IT infrastructure, quality**. This loop considers that IT infrastructure investments cause the growth on quality;

B3: **SOA governance, organizational maturity, controls, costs, revenues, IT infrastructure, quality, Exogenous and endogenous demand, delivery delay**.

This loop considers that IT infrastructure investments causes enhance on demand that may cause delivery delays if it exceeds the capacity available.

In Fig. 1, the model represents a governmental IT agency with functions and structures that share controls and together have an organizational maturity that can produce an acceptable level of productivity and credibility that gives better governance if the costs are maintained on appropriate levels. Though revenues were previously budgeted, in the model they are used to express how many investments on IT infrastructure are permanently required in order to assure good levels of quality and thus, assure better governance. The focus is on those resources to be leveraged for SOA to deliver value to the business.

As in Forrester's "market growth model, this model encompass bounded and intended rationality in its decision making. **The SOA governance decision making process is intended rational if "**it would produce reasonable and sensible results if the actual environment were as simple as the decision maker presumes it to be, that is, if the premises accepted by the subject were true" [12] creating feedbacks or other complexities.

In order to reduce the complexity of decision making and to cope with bounded rationality because the incapability of processing much information and complexity, Sterman argues that "since optimal decision making with perfect models is impossible, people and organizations have developed a number of ways to simplify the task of decision making" [12] like:

(a) stablishing routines that "may be informal or highly codified protocols",

(b) using rules of thumb`(decision making heuristics) that "are based on simplified, incomplete models of the problem situation" and "tend to rely on relatively certain information readily available to the decision maker";

(c) managing attention by "directing the attention of its members toward some cues and away from others" and can include "formal reporting relationships, agenda setting, the geographical structure of the organization and physical layout of its facilities, and accounting and information systems";

(d) goal setting by setting "goals and adjust their behavior in an attempt to meet them" instead of "making decisions by explicitly solving optimization problems". Sterman also refers to the "behavior effort is reduced once a satisfactory solution to a problem is found or a satisfactory level of performance is attained"; and,

(e) problem decomposition when "limited information processing capability forces people to divide the total task of making a decision into smaller units.

Sterman considered that "cognitive limitations and the other bounds on rationality mean decisions are often made as if there were no time delays, side effects, feedbacks, or nonlinearities" to conclude that "since real systems often involve considerable dynamic complexity, decisions made in this fashion often cause policy resistance, instability, and dysfunction"[14].

Setting specific goals provides decision makers with a concrete target against which they can compare the actual performance of the system and initiate corrective action when there is a discrepancy. The more concrete and specific the goal, the easier it is for people to determine which information cues are important and which can be ignored and to decide which actions to take to reach the goal.[12].

SOA governance encompasses service policies as metadata that consist of a set of constraints and capabilities that govern how services and their consumers interact. Simple policies typically include rules describing who can access a service and what credentials they need, how messages should be routed to the service and what service-level agreements (SLAs) apply to the service requiring a considerable number of IT support processes as well as organizational processes that will also involve organizational managers. SOA needs a solid foundation that is based on standards and includes policies, contracts, and SLA. Consequently SOA increases the need for good governance as it will help assign decision-making authorities, roles, and responsibilities and bring focus to the organizational capabilities needed to be successful.

Fig.2 shows a simplified SOA governance model that puts together the backlog formation based on a growing demand, the pricing process as influencing decisions of infrastructure investment, the delivery delay and capacity adjustment.

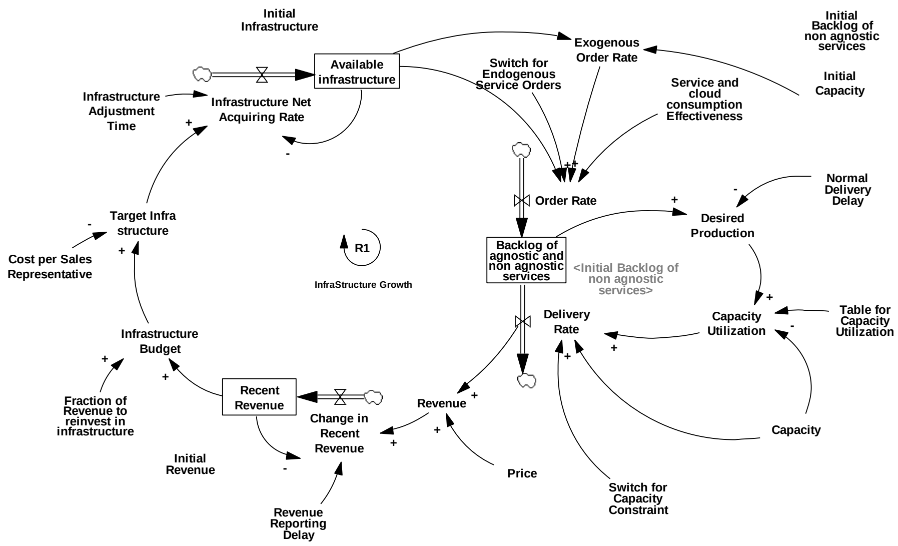

Fig.2: A SOA governance model

Fig.2 diagram explain in more details how policies can be quantitatively observed even though some variables are qualitative by nature. Based on the dynamics of a particular IT company under research, some examples of policies were implemented in the model as:

- A one quarter-year delay is assumed in the budgeting process;
- Twenty percent of the organization's budget is allocated to the infrastructure;
- The fully loaded cost per infrastructure representative is $200000/month;
- An average delay of 18 months is required to adjust the infrastructure to target levels;
- Capacity utilization saturates 25% above normal, implying normal utilization yields 80% of maximum output;
- The model is considering a delivery delay of 2 days.

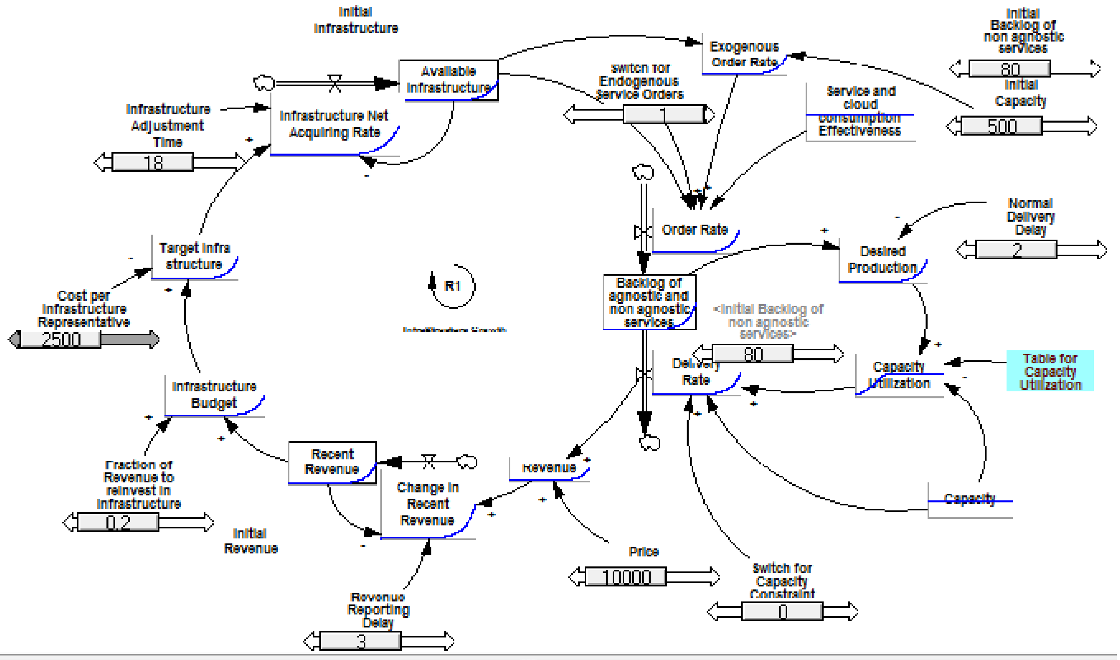

Figure 3: A simulation model

The key decision rules follow the assumption that for a governmental agency, the market is unlimited. Many organizational functions and structures were omitted and the representation of the agency comprehends IT infrastructure hiring, management of the capacity and receiving and delivering services and their interactions create important feedback loops so an increment in orders move the others functions each with their own goals and decision rules. The diagnosis revealed that the bounded rationality exists because managers of different subunits did not understand the overall feedback structure governing the system as a whole[12].

BACKLOG OF AGNOSTIC AND NON AGNOSTIC SERVICES

The agency deliver an inventory of services by demand that can be delivered immediately if it is an agnostic service or after a software development process if it is a non-agnostic service or even a maintenance on the code. Orders accumulate on a backlog.

Backlog of agnostic and non-agnostic services= INTEG (Order Rate-Delivery Rate)
Delivery Delay = Backlog of agnostic and non-agnostic services / Delivery Rate
Backlog Ratio = Order Rate/Delivery Rate (if it is > 1, then the backlog is accumulating)

As software development process provides services means that the same product can be delivered many times as a code reuse or components, in this case, services. But, because there are adaptions of agnostic services or even entirely different software development as the case of non-agnostic services, the backlog reflect the demand, influences the capacity and accumulate revenues and it altogether can be viewed as the performance of the ordering and delivering processes. After using the service for a while, demands of adjustment or even to recode may be considered knew demands. The process may consider these knew demands as replacement purchases that require adaption or even refactoring.The model considers that inadequate capacity limits the growth in company revenues. In short, services produce revenue to pay for the further expansion of the IT infrastructure. Delivery delays and service and cloud computing effectiveness can make the product sufficiently unattractive that the sales loop is no longer able to generate revenue greater than its current expenditures.

As the client is a governmental agency, there is a previously allocated budget by government budgeting process. In the model it is used as a way to foresee, quantify and justify the amount of infrastructure investment that must be made in order to maintain the infrastructure evolving adequately to the growing demand.

Once someone decides to purchase something and the demand grows exponentially, there could be delivery delays that gives more complexity to the model and can cause as side effect the less soa governance level.

The desired production rate depends on the backlog and the normal delivery delay, the normal time required to process, develop or adapt the software and deliver a service:

Desired Production = Backlog of agnostic and non-agnostic services /Normal Delivery Delay

Production capacity and capacity utilization determine the delivery rate:

Delivery Rate = Capacity * Capacity Utilization
Capacity Utilization = f(Desired Production/Capacity)

This process permanently aligns production dynamics to the market expressed by the backlog of agnostic and non-agnostic services. Though this adaption of marketing growth model is simplified by nature, it reveals that system dynamics is useful to represent a SOA governance problem and suggests a dynamic scorecard based on many indicators to optimize and even integrate many business processes and also can provide management flight simulators and to managers on a way to comprehend the systemic implications of the interventions in an IT agency.

Though not implemented on this version of the model, system dynamics is useful to represent problems of risk management in an IT organization and, as in economics, external factors like interest rates can give insights over the decisions and to comprehend the behavior of the system over a fixed value or by a probability distribution that could explain it. Also, additional methods are more efficient and can be used on a combined way in order to enhance SD model capabilities.

V OTHER ADDITIONAL AND USEFUL APPROACHES

A SOA governance problema requires the combination of SD with other approaches such as agent based modelling and event based modelling . Distinguishing people from products allows us to represent several other important characteristics of the real system, like emergencies order backlogs, replacement purchases, decision based on probabilities (e.g. Bayesian nets), a chain of cause and effects events and fuzzy logic.

As for agent based modelling, Fig.4 presents a conceptual model to study IT organizations governance.

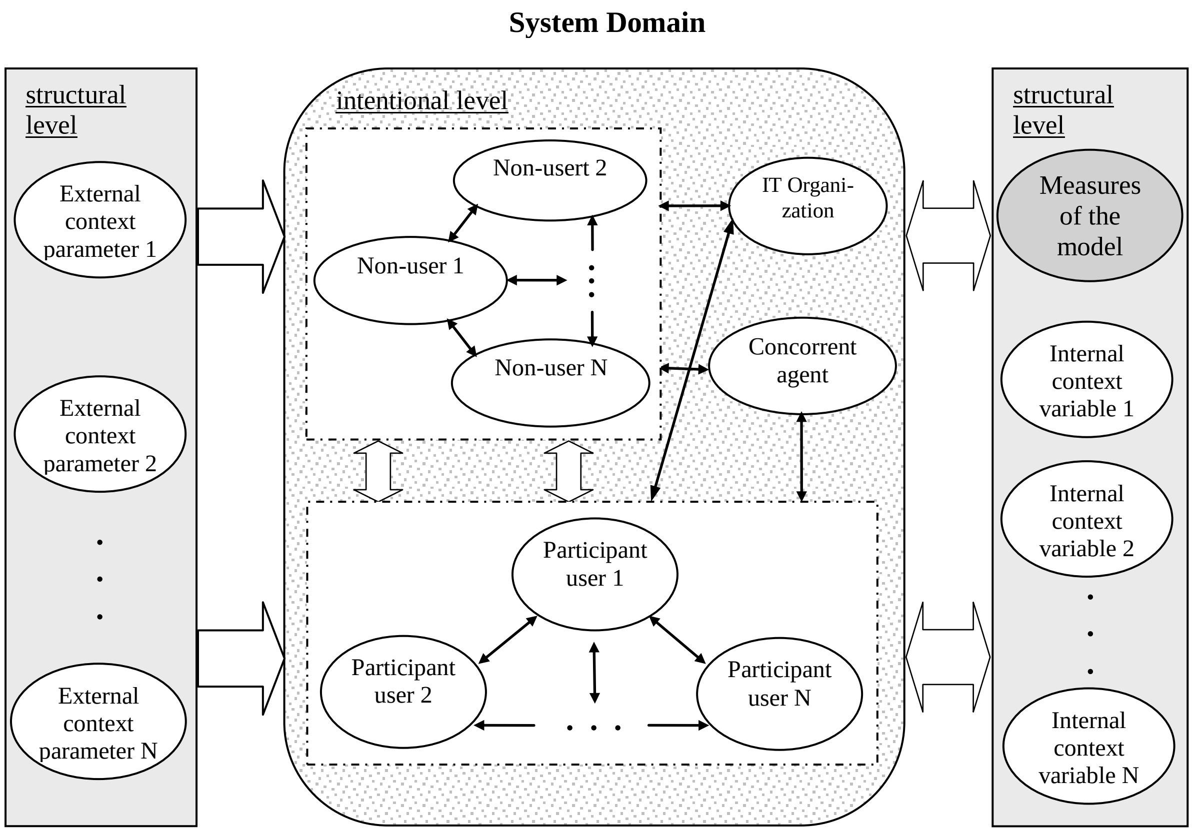

Fig.4 – **Generic conceptual model to study IT organizations governance by an Agent based modeling method [13]**

This model was originally developed for regulatory governance analysis of sectors under regulation [13]. The conceptual model is generic and, consequently, it is useful to structure different IT organizational scenarios. The intentional level (action level), where the interactions among the agents occur, is differentiated from the structural or contextual level. The structural level indicates the contexts where the interactions happen, e.g., the circumstances that limit, amplify and determine the interactions among the agents and with the environment. Moreover, structural level is the level where the emergent phenomenon takes place. It is a higher level comparing to the intentional level where the agents interact. The basic principle that guides the model is that all interactions have an intention or a set of intentions [13].

Another useful approach is the event based modeling (EBM).The term Discrete Event is however mainly used in the narrower sense to denote "Process-Centric" modeling that suggests representing the system being analyzed as a sequence of operations being performed on entities (transactions) of certain types such as customers, documents, parts, data packets, vehicles, or phone calls. The entities are passive, but can have attributes that affect the way they are handled or may change as the entity flows through the process. Process-centric modeling is a medium-low abstraction level modeling approach. Although each object is modeled individually as an entity, typically the modeler ignores many “physical level” details, such as exact geometry, accelerations, and decelerations. Process-centric modeling is used widely in the manufacturing, logistics, and healthcare fields [1].Many organizational process are internal and there are few that involves managing the relationship with clients of an organization.

VI Conclusions

A core objective of service-oriented computing is to achieve a state of intrinsic interoperability among software programs delivered as services[6]. On a SOA governance management problem, SD combined to an agent based modeling (ABM) method can help to relate the heterogeneous behavior of the agents (different information, different decision rules, and different situations) with the macro behavior of the system [9], [4].

The agents have several interaction rules and, by simulation, it is possible to explore the emergent behavior along the time and the space [2], [3]. This modeling technique does not assume a unique component that takes decisions for the system as a whole. Agents are independent entities that establish their own goals and have rules for the decision making process and for the interactions with other agents.

The agents' rules can be sufficiently simple, but the behavior of the system can become extremely complex .To use agent based modeling the first stage is the definition of the rules to model agents' behavior. The criteria that can be used to the rules delimitation is based on the variables used in the dynamic model and the agent-based model.

The modeling process of an agent-based model defines its individual components, as a bottom-up approach. The definition of the agents' behaviors is extremely important for a good representation of a SOA-Governance model. Besides, there must be a very good equivalence between the system under analysis and the conceptual model to guarantee great consistency to the agent-based model and reliability from the simulation results[8].

Once credibility is being modeled, population dynamics and client satisfaction studies focus on the population dynamics of an IT organizations that has, among others, rates of complaint, satisfaction and efficiency that must be considered in assessing credibility and estimating opportunities to optimize business process in order to forecast productivity enhancement opportunities quantitatively. This way, event based modeling, a kind of discrete event modeling that considers that "processes we observe in the world consist of continuous changes" and that the technique" approximate continuous real-world processes with non-continuous events that you define" [1].

In order to cope with the complexities and peculiarities of IT organizations and to get a better SOA governance, these three methods combined can be very useful to address SOA governance problem. Agent based modeling is better when there are individual data available, SD when you have information about global dependencies, and EBM if the system can be easily described as a process[1]. The authors believe that these techniques are most useful particularly for organizations that are certified at level four or five of the Capability Maturity Model Integration (CMMi) Model.

This way, the research is being conducted by the authors and it combines methods and techniques to study IT organizations models and the influence of subjective factors over it. It is projected to combine structural model and internal model to better mimic the real system.

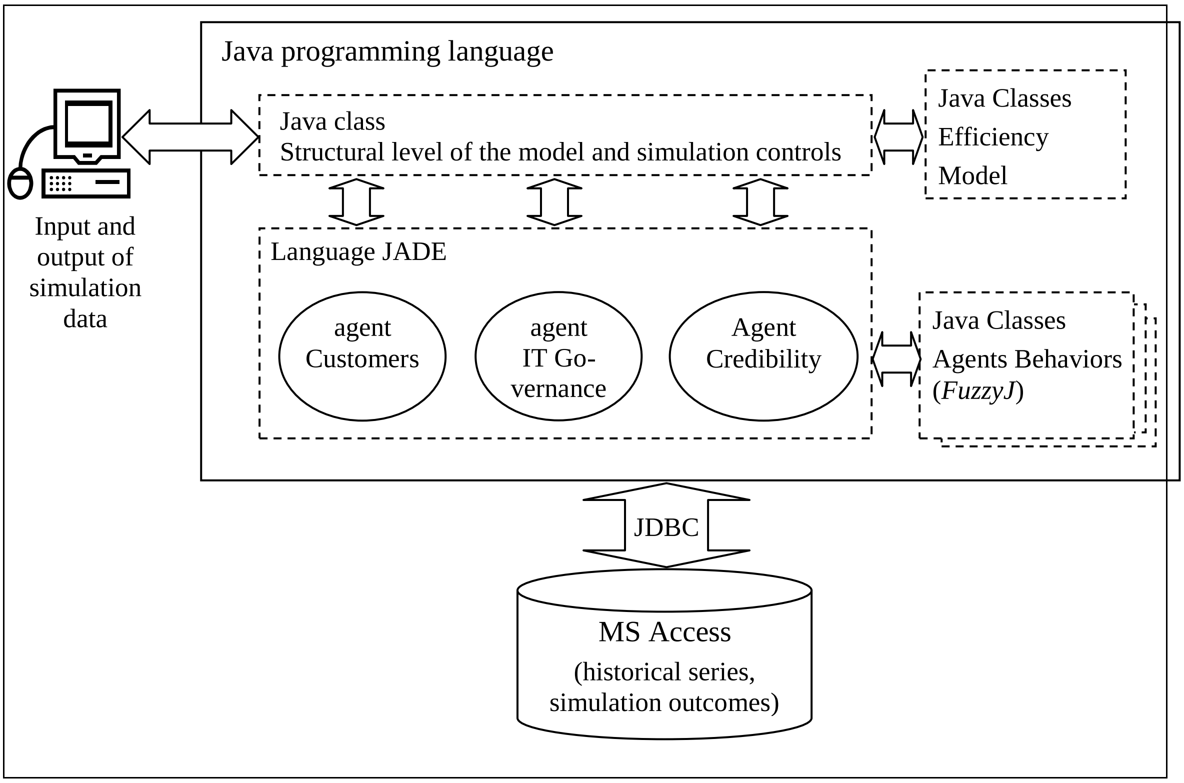

Fig.5: The combination os many approaches in order to develop a SOA-Governance Information System

The research is in progress and Fig.5 shows the software planned to be developed in order to combine these methods and to get a multi-paradigm approach on modeling credibility, including a fuzzy logic engine in order to better manage risks and uncertainties over the mapping of probabilities and creating different combinations of logic that can be applied to the model.

The authors identified the main actors and the methodology to proceed the modeling recommendations identified on the literature review. The software to be produced will consider efficiency, effectiveness, credibility and productivity based on operational and image risks and compliance to help Brazilian IT companies on anticipating problems, better produce policies and determine the growth and stability of the enterprise by comprehending how a policy change will affect the total system.

It's also possible to say that, before starting a software engineering development project by defining functional requirements and structuring use cases, these techniques are useful to model the behavior or processes and comprehend how distinct functions can interact with each other. Thus, the non-functional requirements could be better elicited once it engineers the system as a whole using systems principles.

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