2012 14th International Conference on Modelling and Simulation

Cloud Management Simulation and Design

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***Abstract*— The new paradigm of cloud computing infrastructure can be described as an integrated approach for restructuring processes in all functions considering customer values. Now a massive restructuring process based paradigm shift is required to address excellence with respect to criteria like cost, quality, delivery and service. This paper provides a good solution for enterprises to improve the utilization benefit of information resources in Cloud computing arena using simulation and modeling approach for the private cloud provisioning, cloud business process workflow design, ticketing system, change management etc. By the application of system dynamics, this paper conducts a qualitative and quantitative research on mechanism of information resources allocation in cloud computing, managed & shared services, Infrastructure management business process modeling (BPM) and simulation. The paper aims to create a dynamic cloud business process modeling mechanisms which helps managers understand better the dynamic interrelationships in organization design and, in particular, the interrelationships between an organization's profitability (both short-term and long-term) and investment in cloud computing and overall infrastructure. The intention of this paper is to put forward a conceptual framework of simulation and modeling framework, for assisting management in handling cloud workflow design, service management and business process modeling.**

Keywords- BPM, ITSM, Cloud Computing, Causal Loop Diagram, Flow Diagram, Service Management, Ticketing, SLA, Orchestration, Provisioning, Service Catalogue.

I. INTRODUCTION

The new cloud computing paradigm gives an over whelming need for business change to adapt to survive. Change is the only guaranty and rate of external changes are high – rate of change internal must be higher to stay in the game. This gives importance to focus on change from internal IT perspective and focus on IT only cost to view of business service costs and value with IT as aspect of that equation. Because of the cloud computing Infrastructure there is an impact on the service provider that they still need to cut costs – systems management to drive cost out but at the same time the businesses must adapt and that usually means new or changed IT services to support, enable or automate the newly critical business activities or they will die. There are also Shifts in sourcing – like off shore, multi source, low cost delivery centers – now another shift to near shore, on shore, closer shore, nearer to customer. Quality of service, especially IT services that enable business productivity is critical now. It's not just about low cost IT, but about the IT enabled business service. In source what was outsourced. Low cost delivery centers for point solutions did not reduce overall cost of service and overall quality of service suffered. Need for integration, collaboration and governance especially in complex multi soured, multi vendor, and heterogeneous environments. A shift in focus from IT services to the overall cost and quality of the IT enabled business service or business process.

The area of cloud computing service management and business process modeling has critical new value is IT services supporting, enabling or automating critical business activities as determined by the new business strategy. It can also help address any of your clients who appear to have inadequate service management capabilities, such as overly complex technology environment, lack of defined, repeatable, quality processes. Or they just seem to be spending money and not getting the value out of it. So cost reduction pressures can definitely lead to a need for additional discipline in IT processes and services in cloud computing infrastructure [6].

Strategy and planning for cloud workflow design, service management and business process modeling processes may be the most critical thing to get right. Changed business requirements and flat budgets drive the need for business driven IT prioritization. System Dynamics simulation and modeling helps in prioritizing improvements to IT services that enable business workforce productivity, especially for critical business functions like private cloud, ticketing system, change management and information access. Motivation for modeling cloud computing ITSM and BPM processes creates learning environment that enables efficient and effective management of cloud computing requirements in different planning time frames. The models can be simulated and analyzed for long term computing investments decisions for IT service integrators and service providers to deduce significant implication once the seed values are available for the performance drivers of the model. This research attempts to examine the impact of potential strategies surrounding cloud computing ITSM and BPM processes under changing conditions, and provide guidance for managerial decisions, using a systems dynamics approach [5].

978-0-7695-4682-7/12 $26.00 © 2012 IEEE
DOI 10.1109/UKSim.2012.79

II. SYSTEM DYNAMICS SIMULATION AND MODELING

System Dynamics (SD) is a methodology whereby complex, dynamics and nonlinear interactions in social systems can be understood and analyzed, and new structures and policies can be designed to improve the system behavior[1]. Similarly we can say, System Dynamics (SD) is a complex scientific and technological activity, for which methodological analysis could suggest some new and interesting perspectives both to practitioners and theorists of system dynamics (SD). There is a great difference between purely Correlation or Statistical models and System Dynamics (SD). The System Dynamics (SD) models also try to offer explanation and understanding, not only for forecasting and control but also give scenario planning data points for policy planning. Now we will discuss the building blocks of System dynamics in the below section.

A. Stock and level Variables

The stocks represent the accumulation of basic variables or quantities that change. In a population model one stock may represent the population of a country.

B. Flow Variables

These variables represent the instantaneous flow rates. Unlike in physical systems where the rate variables mostly follow the laws of nature, in industrial and in many social and socio-economic systems, which are man – managed, rate variables often reflect overall policies governing individual decisions.

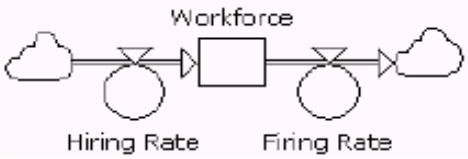

Figure 1. A simple model created in the graphical modeling language

C. Connectors

A flow represents a physical link between stocks. However there is also information or dependency links.

Figure 2. Information links connects various variables

D. Delays

Physical flows quite undergo delays. Examples are, delays in clerical processing of order mailing of orders, filling of orders, shipment, training of unskilled workers, payment of debt and in capacity installation, etc. These delays have the following characteristics:

1) A rate variable appearing in a physical flow undergoes a delay.2) an accumulation takes place during the delay. 3) Outflow rate from a delay depends on the amount accumulated in the delay and Average time a unit spends in the delay. 4) During the steady state condition (when the int flow rate is constant for a long time resulting in a constant outflow rate), the accumulation in the delay is also constant and is equal to the product of the inflow rate and the average delay time constant. Exponential delays have all the above-mentioned characteristics [4] .

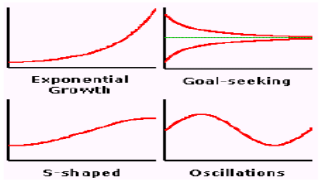

Figure 3. Four common behaviors created by various feedback loops

E. Causal Loop Diagrams

Casual loop diagrams are visual representations of cause-effect relationships among elements of a system forming structures of feedback loops. These diagram is simple to develop and understand and since it presents on overall view of the causal structure of a system, it is often used in conceptualizing a real life problem, in developing the model equations, in explaining the results of a simulation run, in designing new policies, and ultimately, in communicating with a person who is not familiar with the system dynamics approach[2]. It is therefore no wonder that causal loop diagrams have distinct place in system dynamics modeling.

F. Diagramming Approach

In causal loop diagram, which one is the rate and which one is the level is not clear. We think them as factors that influence each other dynamically. Notice that the influence can be positive or negative and can be shown in the sign near the arrow head. Positive sign indicate that higher the cause will produce higher effect, lower the cause will also lower the effect[3]. When several arrows in the causal diagram return to one factor, it created a closing path or a loop. Since the relationship is done dynamically, it gives some feedback to the original factor, thus we call it a feedback loop. There are two kinds of feedback loops: positive feedback loop and negative feedback loop. Positive feedback loops have an even number of '–' signs and negative feedback loops have an odd number of "–" signs.

III. CLOUD READINESS DYNAMICS

When a business wants to investigate if it should use cloud computing- a new paradigm, it needs to assess the organization processes concerning the intensification as well as the supporting course of actions concerning the existing IT infrastructure. Regrettably there subsists no acquaintance like well-accepted guiding principle or business blueprints which can support this investigation and provide a positive

way to change the development in order to implement cloud computing. In the current situation - and for the next couple of years before the strengthen acquaintance would become established - a corporation could only trust on some finest practice and try to acclimatize to them.

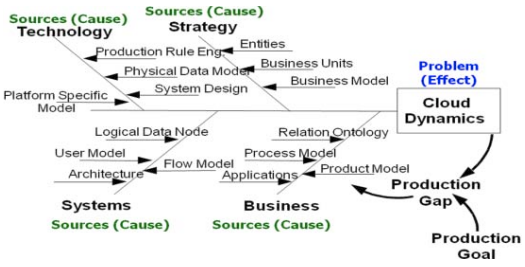

Figure 4. Cloud Readiness Dynamics

The expanding influence of internet and budding infrastructure management services is stressing businesses' abilities to successfully and powerfully manage their IT infrastructures. Commerce has become reliant on each other as never before because of their dependence on implicit, shared infrastructure resources and increasingly rely on highly available systems. The enablement focuses on the risk/readiness of our businesses, applications, environments and recognizes concerns and exposures, which if not properly tackle, might otherwise be limiting with regard to performance, adaptability, availability, or security. A effective element of achievement is a focal point on instituting a universal considerate of the IT environment including the efficacy and efficiencies of systems and maneuver processes and procedures in place or planned. Key cloud ecosystem processes impacting availability can be analyzed including Service Level Management, Configuration Management Problem Management, Change Management, Service Delivery Monitoring, Performance and Capacity Management, Back-up/Recovery, Disaster Recovery, Security, and Test Management. Figure 4 gives the cloud readiness dynamics fish bone diagram for technology, strategy, systems and business as a sources and causes for cloud dynamics for any organization. It also gives the factors that effects technology, strategy, systems and business. The factors help to strengthen each cause to understand the cloud dynamics of any organization.

IV. CLOUD DYNAMICS

A scenario for implementing the private cloud computing service management is discussed in this section. This requires a predictive analysis using system dynamics modeling to evaluate the ITSM and BPM processes to implement the environment. On a physical environment for a test and development team to complete their life Software Test and development Life Cycle, requires lot of trial and error machines. These machines are expected to go down for OS and application failures. So to make these machines up and running administrators and developers has to spend a lot of time, as they have to build up the environment from scratch. Templates and snapshots would play a major role here in reducing the rework and saving significant amount of time. For getting a machine with various hardware configurations users need to get approval from Project manager, Procurement team and then finally the system is allocated. Many admins are required as there would be a lot of rework required to revert the machines from non functional to functional state.

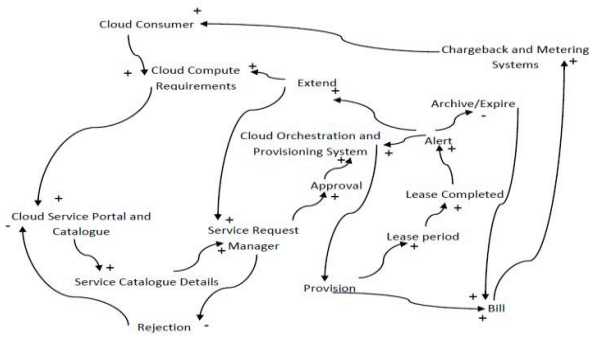

Figure 5. Causal loop diagram for Cloud Dynamics

Usually the project managers take care of the infrastructure that is required for the team. To get the physical machines required with various hardware configurations in the test and development infrastructure, he may have to coordinate with procurement and various vendors. If the Datacenter is virtualized and moved into a private cloud all the above mentioned activities and process could be automated using various applications. With this a significant amount time is saved. This would also give the Self-service capability: Testing teams can easily commission and decommission computing resources as appropriate, which shortens the procurement process, speeding up development and testing efforts. Under the covers, the system automatically provisions the storage, operating system and middleware needed to make the test environment run.

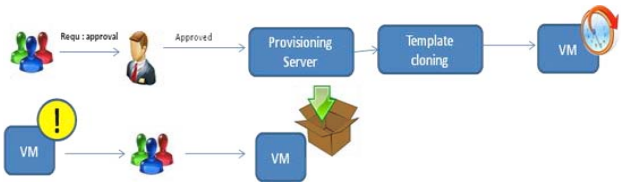

Figure 6. Cloud Provisioning Process

The Virtual Machines are created with a lease period and the process for getting machines with different flavors of Operating Systems and with different hardware configurations are possible. When the allocated Virtual machine is about to get expired, an email would be triggered to user asking for action from the user. If the Virtual

Machine is not required, the machine is archived and kept for future reference. This process would also free up the computing resources used by the Virtual Machine.

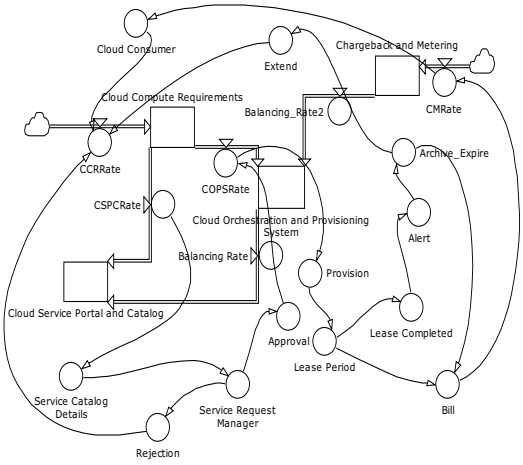

Figure 7. Cloud Dynamics Flow Diagram

With the help of an orchestration application the requests for new machine could be automated. It is also possible to provide machines with variable hardware configurations. Test and operation teams may be have different conventions and configurations than development teams. This can lead to unintended application behavior and delays in service delivery. Templatized solution stacks can include the application and entire environment down to the operating system. They enable all teams to see the exact environment in which the application was designed and unit tested. Instead of test and development teams submitting a request for new physical hardware, Datacenter private cloud strategy lets them call up a service portal, and find a catalog of preconfigured, virtualized test systems. All the above process is monitored using system dynamics ITSM and BPM modeling techniques. This application is capable of triggering various alert as and when failure occurs. These alerts are converted to incident tickets by the application and it would be routed to various IT support teams.

The same is depicted in figure 5(causal loop), 6(workflow) and 7(Flow Diagram). Figures depict the cloud consumer and its infrastructure requirements. He looks into self service portal and its details. He puts his request to self service portal and request for approval. It goes for the workflow. It gets approved and the machine is provisioned for the stipulated period of time and it is decommissioned once the lease period is over. It also send the notification for expiration or archival and finally the decision is also taken and based on the resource usage metering, billing and chargeback can be done.

V. CLOUD BPM AND ITSM DYNAMICS

Generally in evolution of new cloud BPM and ITSM process when there is a need of improvement in timing of a program or if there is need to introduce a new policy that may bring in new productivity and quality improvements, it becomes necessary for BPM and ITSM tools to adhere to that implement process changes request in existing BPM and ITSM tools. Any new process change inside a BPM and ITSM tools requires an IT change request to take place i.e. change request for existing BPM and ITSM tools. Once the BPM and ITSM tool changes are completed the new process functionality will be available that is BPM and ITSM tool functionality required by cloud. However introducing the new process functionality does not mean that the impact of the process change is felt immediately. So, there is a certain delay before any cloud efficiency is realized.

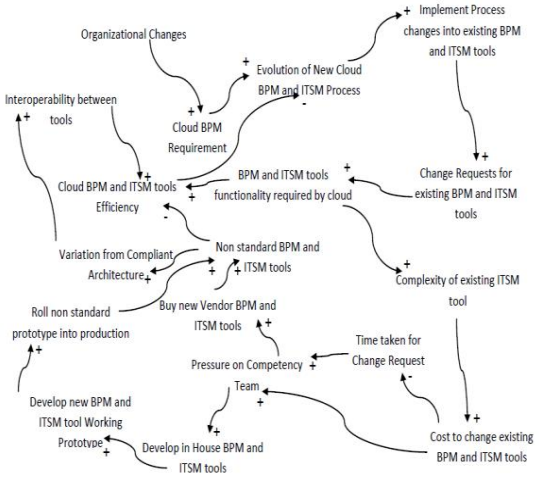

Figure 8. Cloud BPM and ITSM Causal Loop Diagram

Adding new functionality to an existing BPM and ITSM tool will only add to its complexity. Complexity of the BPM and ITSM tools is measured in many ways. Function point count is the standard used to measure complexity of the BPM and ITSM tools in the firm. As the complexity of the BPM and ITSM tool increases, the time taken to implement a change also increases and the costs associated with making such complex change also increases. Both timing and cost increases lead to increased pressure on competency team. Managers may either choose to develop solutions quickly by allocating funds and resources if they see the delay in implementation of new BPM and ITSM tool change and indulge in control/ extreme measures such as buying a vendor BPM and ITSM solutions. This leads to perceived process improvement in short term, but in the long run with the delay as these new non standard tools do not adhere standards, results in decreased Cloud BPM and ITSM tools efficiency. The other reinforcing loop is

caused due to an increase in the number of non-standard IT tools. An increase in the number of non-standard BPM and ITSM tools will result in an increased variation from complaint architecture and then a reduction in the interoperability between tools.

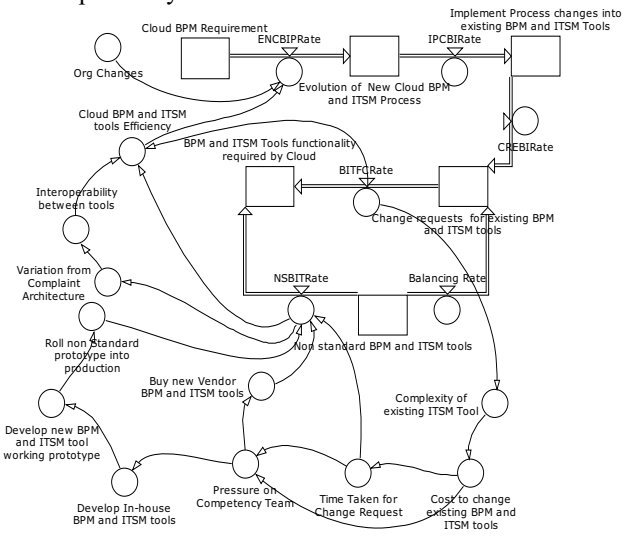

Figure 9. Cloud BPM and ITSM Flow Diagram

Figure 8(Causal Loop) and Figure 9 (Flow Diagram) depicts the cloud BPM and ITSM process. It explains how the organizational changes happen when new cloud BPM and ITSM processes are adopted. This gives rise to various change requests for existing systems. It simulates various factors like time taken to change, pressure on competency team, deploying new tools etc. It also extrapolates the differences between the standard and non-standard BPM and ITSM tools and its efficiencies.

VI. CLOUD SERVICE MANAGEMENT DYNAMICS

Cloud milieu, it's overriding that services are able to strongly connect and consistently commune with internal IT services and infrastructure services. Ticketing systems Change management, and SLAs based service management in the cloud situation requires that resource usage and utilization be observed and administered in order to support strategic decision making. By indulgent exactly who is using a service, along with how and when, service contributor can determine the inherent value that the service is providing to the company, and IT can also use this information to calculate the ROI for their Cloud computing initiatives and related offerings.

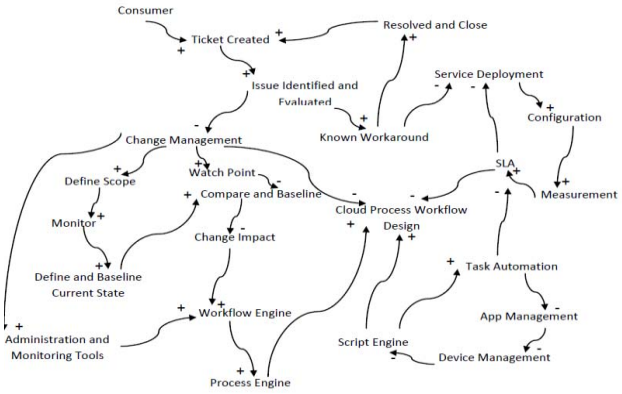

Figure 10. Cloud Service Management Causal Loop Diagram

Austere change management offerings must be followed to and all changes implemented during approved maintenance based workflow systems and It must be tracked, monitored, and validated. Knowing the details of CMDB associations authorize change and incident administrator to determine that a modification to one service may affect several other related activities and the mechanism of those services. Another solution to fruitfully working in the Cloud has to do with the SLAs established between the service provider and service consumer.

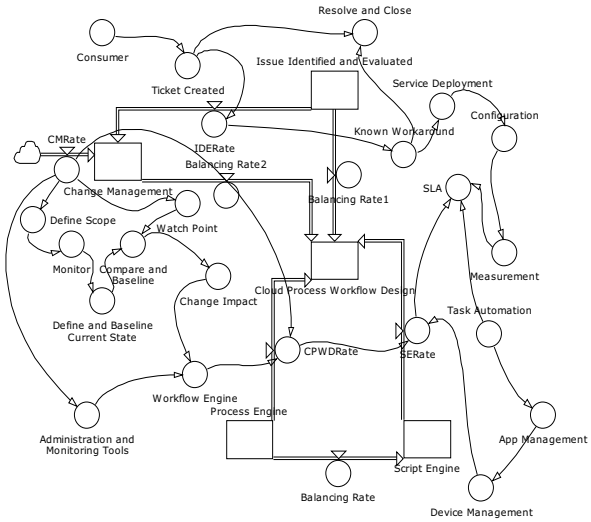

Figure 11. Cloud Service Management Flow Diagram

Figure 10 (Causal Loop) and Figure 11(Flow Diagram) gives insights for the Cloud service management. The factors are shown from ticket creation, issue identification, known workaround, resolution and closure. The causal loop is also designed for change management that starts from scope to monitoring, base lining and taking help to resolve it through workflow engine, process and script engine for any cloud environment.

VII. CONCLUSION

The emergence of cloud computing as a prominent agility-enhancing technology raised the fundamental question of how new technologies such as cloud computing can shape a firm's competitive advantage over time has yet to be resolved. The complexity associated with the dynamic interactions among the many factors in the business environment, organizational, technology adoption, and Information Technology (IT) contributes to a lack of clear strategy for implementing new technologies cloud computing system dynamics BPM and ITSM modeling approach. This research attempts to examine the impact of potential strategies surrounding cloud computing BPM and ITSM situations under changing conditions, and provide guidance for managerial decisions, using a systems dynamics approach. In this study, we intend to develop a computational model of the mechanics underlying the strategic and business value aspect of IT service, representing this as dynamic interactions among the multi-faceted factors that shape the focal problem domain.

The benefits of using system dynamics models for forecasting: System dynamics models can provide more reliable forecasts of short-to-mid-term trends than statistical models and thus lead to better decisions. System dynamics models provide a means of understanding the causes of industry behavior, and thereby changes in industry structure, as part of an early warning or on-going learning system. System dynamics models allow the determination of reasonable scenarios as input to decisions and policies. Once calibrated for a specific cloud deployment, the models and causal loop diagrams can be used to provide practical decision support to identify suitable strategic decisions underneath the adoption and implementation of Cloud. Environmental and organizational conditions can be manipulated to permit systematic what-if analysis. The ability to a-priori assess strategic decisions on cloud BPM and ITSM management models, as opposed to relying on lagged post-hoc analysis, affords managers the ability to make more informed decisions. The model permits evaluation of the multi-faceted, dynamically changing, and interactive factors that affect Cloud BPM and ITSM models related strategy formulation. It can be calibrated to reflect different organization contexts and emerging features of cloud computing.

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