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Modelling The Cloud Computing Adoption Market Scenarios Using System Dynamics

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ABSTRACT

The current and future cloud computing adoption scenarios have been modelled using stock-and-flow concept of systems dynamics. The three stock variables identified in this research note are Potential Adopters, Early Adopters and Late Adopters of cloud computing technology. The behaviour of the identified stock adopters in the long run owing to the impact of rate of adoption identified as flow variable, and, external factors identified as auxiliary variable which have an impact on the flow variable and in turn will affect stock variables have been analysed and simulated to create various cloud adoption market scenarios. The major implication emerges for cloud service provider as the need to explore product-market expansion grid for long term sustainability.

Keywords: Cloud Adoption, System Dynamics, Stock-And-Flow, Simulation

INTRODUCTION

The objective of this research note is to analyse current and future cloud adoption market scenarios, through simulation, by deploying stock and flow concept of system dynamics using stella software. In system dynamics stocks represent state variable and flow are known as rates (Sterman, 2000). State variables are considered to be constant, as there rate of change over a given time horizon is very slow and can be treated as constant for the purpose of modelling. Stocks change with inflow or outflow from themselves and this phenomenon is governed by the rate at which this flow happens. A system consists of network of stocks and flows linked by feedbacks. External factors impacting the model are called auxiliary variables; and are defined as exogenous inputs which will have an impact on the flow and thus will affect stock variables. The table below contains the symbol, which depicts stock and flow variables and valve which controls the flow.

Name of Component	Symbol
STOCK	
FLOW	
VALVE	

TABLE 1: Symbols Of Associated Component Of Stock-And- Flow Diagram Of System Dynamics

METHODOLOGY

Researcher has defined three stock variables to simulate cloud adoption in business organization, fundamentally based on the principal of Bass Model. The three stock variables are Potential Adopters, Early Adopters and Late Adopters. Potential Adopters, represents those organization who seeks continuous development in technology

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and value technology as principal factor of sustained competitive advantage. Early Adopters represent those organizations that are technological leaders and always look to either optimize their cost structure through disruptive technology or look for product enhancement through technological innovation; and therefore; will make the first move towards cloud adoption. The rate of this adoption or "flow" has been termed as "ROEA" which stands for rate of early adoption. ROEA will be impacted by auxiliary variables, which at this phase of cloud adoption market can typically be portfolio of cloud product offering and quality of offering, the cost of cloud offering and associated statutory regulation.

Researcher has captured these market variables in essence through the term like, vendor quality (VQ), total cost of ownership and statutory regulation (SR). Vendor Quality (VQ) which relates to cloud product offering and service quality includes cloud product portfolio, customization capability of product offerings, lead time (time to deployment) and service level agreement. Total Cost of Ownership (TCO) relates to the two fundamental cost aspect of cloud offerings, firstly, the primary cost of ownership which typically converts traditional capital cost of procuring information technology into operational cost due to service model delivery promise of cloud computing and features like metered service of paying for the usage of any given service; and secondly, the switching cost of changing cloud service provider. Statutory Regulation (SR) which relates to government regulations regarding operational side of cloud offerings which include security, standardization and lock-in concerns of cloud offerings. "CCE", acronym has been coined by the researcher to capture the impact of these auxiliary variables on the rate of flow from potential adopters to early adopters, and stands for cloud computing ecology.

As the market performance of early adopters of cloud computing will improve in terms of cost of operation, faster time to market etc. Late adopters will look to adopt cloud computing for enhanced business performance based on the experience of early adopters. This phenomenon will typically represents a cascading model with a pattern of adoption flowing through from potential adopters to early adopters to late adopters, and, which has been depicted in simulation model. The rate of adoption from early adopters to late adopters has been termed as "ROIA" which stands for rate of industry adoption. This rate of industry adoption will typically be influenced by technological ecosystem, innovation index and innovation index. Technological Ecosystem relates to speed of network connectivity, performance and penetration of internet, and, the readiness of adopting organization to imbibe cloud computing. Innovation Index relates to rate and level of innovation and disruptive technology percolation in organizations looking to deploy cloud computing. Industry Index relates to the kind of industry the cloud adopting organization belongs and size, structure and strategy of cloud adopting organization. Researcher has coined the term "ADOP" to capture the effect of the above stated variables on cloud adoption.

FINDING AND ANALYSIS

Cloud Adoption

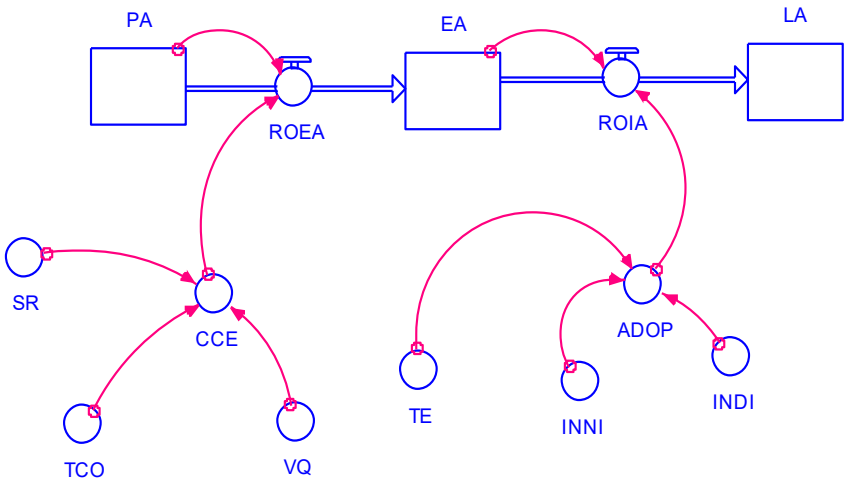

FIGURE 1: Stock-And-Flow Diagram Of Cloud Adoption 1.0 With Auxillary Variables

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In order to simulate the cloud adoption scenario using stella software, researched has assigned weights as per the opinion of industry experts to all associated auxiliary variable. The value for potential adopters has been considered as absolute one or 100 in terms of percentage. The assigned weights of auxiliary variable and the assume value of potential adopters are dynamic in nature and can be assigned values as per specific adoption situation by the modeller.

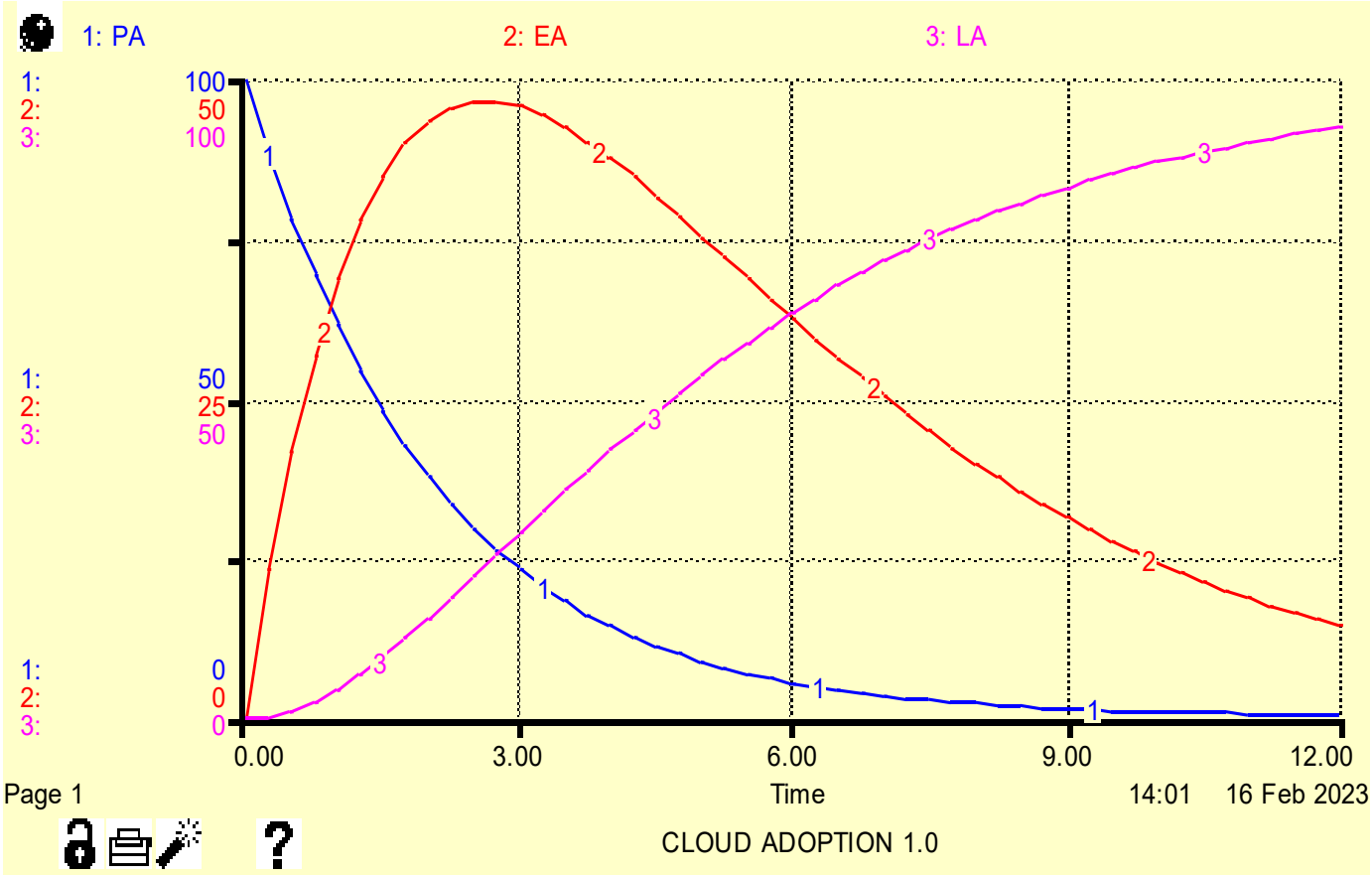

Figure 2: Simulation Of Cloud Adoption 1.0 Over Time Horizon

As evident from the above simulation graph, that over a period of time all potential adopters will adopt cloud computing and hence the stock variable of potential adopters is slowly tending towards zero and also the adoption rate of cloud computing is saturating with S- curve. Researcher has coined the term Cloud Adoption 1.0 for this adoption scenario.

Cloud Adoption 2.0

At this juncture, when the cloud adoption market will moves towards saturation, the cloud providers will deploy typical product market expansion fundamentals of product development and market development. Product development encompasses cloud offering such as Infrastructure as Service, Platform as Service, Software as Service and more recently Function as Service. Market development includes moving towards new market like Telecommunication and offering their services in these markets. A typical example of market development is Amazon-Ericsson collaboration for deploying 5G telecommunication networks. Researcher has coined cloud adoption 2.0 for this phenomenon.

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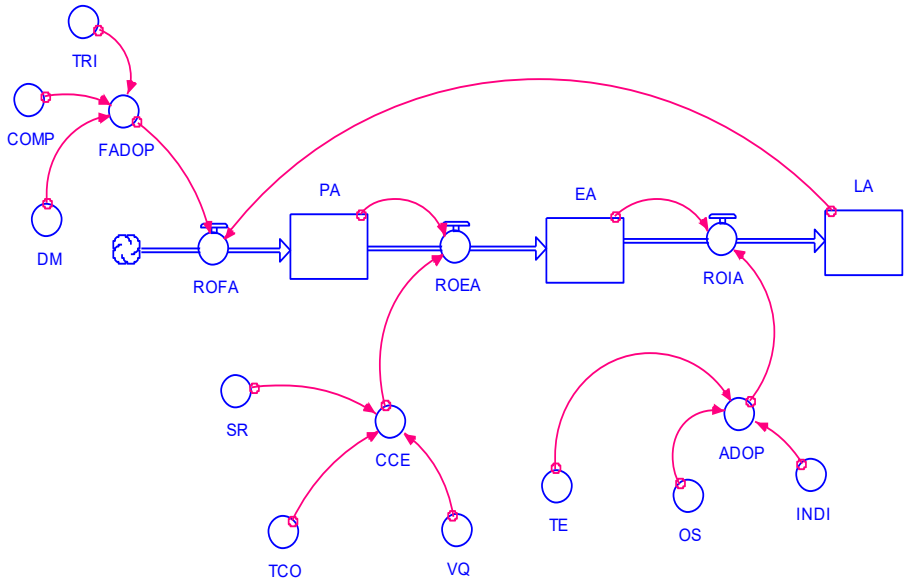

Figure 3: Stock-And-Flow Diagram Of Cloud Adoption 2.0 With Auxillary Variables

Product development is represented by feedback form late adopters to inflow towards potential adopters, as organizations which has reached saturation for one kind of cloud product offering, can become the next potential adopters for new types of cloud offerings or may even order a repeat purchase of current offerings. Market development is represented by the sink, and represents possibilities of finding new potential adopters from other markets such as telecommunication etc. The rate of this conversation will be impacted by "ROFA" which stands for rate of future adoption. Auxiliary variable which will impact this conversion can typically be trialability, compatibility and data management. Trialability relates to ease of using cloud offering for cloud adopting organization. Compatibility relates to integration of cloud services with legacy information technology infrastructure, interoperability and heterogeneity of cloud offerings. Data Management which relates to issues of data privacy & security, once data resides on cloud service provider platform.

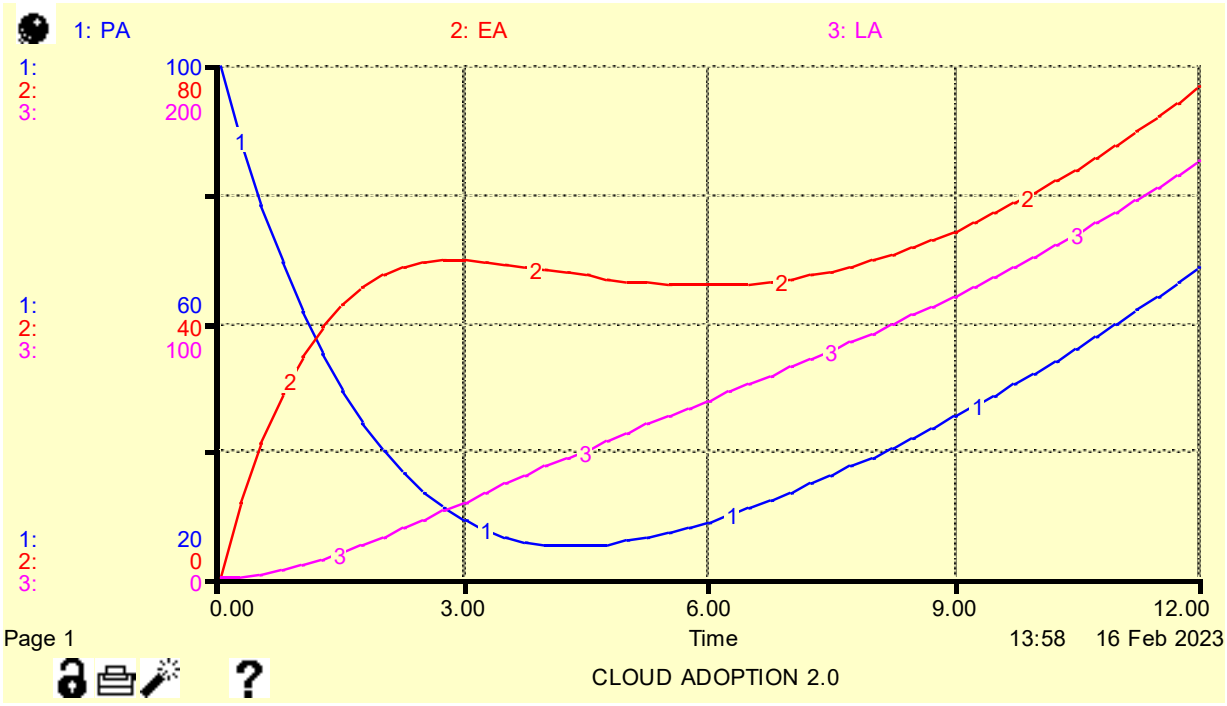

Figure 4: Simulation Of Cloud Adoption 2.0 Over Time Horizon

The above simulation of cloud adoption 2.0 is clearly showing the effect of product-market development of cloud offering as potential adopters are increasing after reaching a point of minima, owing to new cloud offering

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being utilized by them, or new markets representing newer potential adopters being serviced. Potential Adopter being the primary stock of cascading model of cloud adoption will encourage early adoption and late adoption of different cloud offerings.

CONCLUSION

Implications which have emerged from this modelling of cloud computing adoption for cloud service providers are that, a cloud service provider must have diversified product portfolio of cloud offering with focus on service quality. Cloud providers must ensure minimum lead time to provide any cloud solutions; by having easy trialabilty of cloud offerings, compatibility of cloud offering with current information technology setup. Data security and privacy along with scalability of cloud offering will impact cloud provider market. Cloud service provider also need to trade the Product-Market expansion path , as only single product and/or single market will eventually saturate the cloud adoption as all potential adopter will eventually adopt the cloud services , making cloud adoption market stagnant .

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