

Study of Virtual Organizations Performance using System Dynamics

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Abstract— Nowadays, virtual organizations become essential for business survival in global markets particularly after the Covid-19 global pandemic has drastically affected how people work. However, one of the most challenges facing this most contemporary form of organizations is the design of a e-collaboration work system that ensures trust among team members and between organization and its customers. In this paper system dynamics model is proposed for better understanding of the influences of various aspects such as trust in employee, centralization, professionalism on virtual work system performance, in addition, studies the consequences of the interrelationships among the incorporating variables in customer, decision area, organization reputation and profitability. This in turn, can provide insights into, to which extent does the lack of trust in the customer affect the profit and reputation of the virtual organization. A causal loop that is relating these characteristics is developed. Then stock and flow parameters are identified to build the stock flow diagram

Keywords—Virtual organization, system dynamics, trust in employee, trust in organization, centralization, professionalism, decision area, profitability

INTRODUCTION

Due to the global lockdown caused by the Corona pandemic, most employees around the world have shifted to remote work, as a result, most business managers around the world have realized the importance of creating virtual teams to survive in the global market. In Virtual teams workgroups are working in an electronic collaboration environment through the use of electronic platform and communication media to achieve common goals[1]. However, the growing interest in building virtual organizations is not in recent past. In 2012 the Society for Human Resource Management (SHRM) conducted a survey for 379 HR. this survey revealed that nearly half of the polled member organizations apply the concepts of virtual organization[2]. virtual organizations can be defined as a set of agents that are distant in location, connected by advanced information and communication technology, especially internet to produce one giant virtual network organization integrates different team members and expertise who are sharing resources for operating massive activities [3]. Creating network between different business entities allows integration of various types of knowledge and sharing of different resources that individual organizations do not have [4]. while, the concept of virtuality is offering wide opportunity to organization to decrease cost by concentrating on countries of low cost of workforce instead of countries which has high cost of working staff [5]. However, this type

of organizations not following the main features of traditional organizations as it broke down the traditional boundaries of time and location. Where, the location in virtual organization is not limited in one place and the working hours are flexible and not restricted by any zone time as traditional organizations [6]. Therefore, various researchers have drawn their attention to identify a bundle of different characteristics of this new model of organizations [7].

From macro-ergonomics researches perspective a well-designed work system for virtual organizations greatly influence the efficiency, competitiveness and creativity of the organization by controlling the behavior of the participants in this entity [8]. It was found that, flexibility is one of the crucial factors leading to an effective and efficient virtual organizations work system as it provide simple, non-hierarchical structure which reduces the time of making decisions and minimizes the respond time to any changes [3]. Another essential factor is decentralization which is required for obtaining fast and flexible response to changing in business needs, other characteristics of virtual organization work system are team based and network structure however the main feature of the virtual organization work system is collaboration and cooperation[9]. However, many academic researchers and business managers agree that trust is a governance factor in virtual organization work system especially e-commerce one, represented by business to consumer (B2C) type of online shopping mall as it impact directly the e-service quality [10]. A general definition of trust is the willing of truster party to be susceptible to opportunistic behavior by the trustee party, regardless of the truster's ability to observe the trustee's behavior [4]. Accordingly, lack of trust represent a real threat faces to the survival of e-commerce market place due to low level of certainty in the e-market place since the involved partners are faceless [11]. Consequently, trust becomes an essential ingredient in e-commerce virtual organizations success as they focus further exacerbates the demands and requirements for trustworthy environments [12]. Therefore, building and maintain long-lasting relationship between the online retailer and online consumer based on trust, is one of the major challenges that faces e-commerce organization [13].

In this paper we are focusing on investigating the work system characteristics of virtual organizations that have no location or time boundaries. Electronic commerce as stated by Zwass is the organization that depends mainly on "sharing of business information, maintaining business relationships and

the conducting business transactions by means of telecommunications networks” [14]. Today's, this type of virtual organizations are driven primarily by The Internet's World Wide Web [6]. Many researchers identified different features that are supposed to be more or less characteristic of the work system of this type of organizations. However, there is not a clear conceptual management theory about the role of trust in work system environment of virtual organization. Despite that, there are numerous studies focuses on e-commerce customer trust, satisfaction, and loyalty attitudes in various countries. Nevertheless, there are limited studies on the interrelation between virtual organizations' work systems and their impact on customer trust and loyalty and hence organization profitability and reputation. This paper aim is to develop virtual organizations' work system model representing the interrelationship among some work system's characteristics such as centralization and decision area, and trust in employees and professionalism of virtual team, trust in customers and organization reputation and profitability. This study has three main objectives.

1. Investigate the impact of the interrelation between two types of trust: trust in virtual team and trust in customer.
2. Analyze the impact of the interrelation between two types of trust and professionally and centralization that are main managerial variables affecting virtual organization work system.
3. Study the interrelationship among work system characteristics (i.e., centralization, area of decision of VO team, and trust in employees) and the degree of trust or over trust in customers and how it affects the customer loyalty to the organization, and the VO profitability.

I. SYSTEM THINKING MODELLING

A. Problem structuring

From the Macro-ergonomics perspective virtual organization is a socio-technical system that consists of three major sub-systems; the technological sub-system, personal sub-system and external environment sub-system [15]. Consequently, virtual organization like any social science system consists of many variables are mutually connected in complicated way [16].

A. Key variables in Causal loop

1) Professionalism

Professionalism is defined as the ability of the team members to create their internal formalization of behavior through a socialization process that is an integral part of their education and training process [17], [18].

2) Level of centralization:

Centralization refers to the concentration of decision-making authority at the upper levels of an organization [18], [19]

3) Profitability:

The state or condition of yielding a financial profit or gain, it's often measured by price to earning ratios

4) Organization reputation:

The beliefs or opinions that are generally held about organization

5) No. of unpaid orders:

The orders which the customer ordered but didn't pay its price

6) Trust in organization:

The degree of confidence born of the character and competence of the organization

7) Trust in employee:

A trust fund established by an employer on behalf of its employees in which the company is the grantor and its employees are the beneficiaries.

8) Trust in customer:

Attainment of satisfaction level that and results in customer's loyalty at which customers are comfortable forgoing problem solving behavior. Rather, they repurchase a particular product or set of products in a routinized or habitual fashion.

9) No of orders:

No of customers' orders per day

10) Profitable customer:

A profitable customer is any client for whom the resources utilized to acquire and maintain his or her business is exceeded by the profits earned from having that business.

As shown from the proposed causal loop diagram, as the head manger of virtual organization increases the trust in his/her virtual team 'trust in employee', he/she gives them more authorities which decreases the level of centralization and this by time increases the degree of professionalism of team. As a result, the team shares the same trust with their manager. From the other hand, increasing the decision span of the team speeds their response to the customer. This appears obviously when the team member faces problem related to return and refund which is one of the major problems faces ecommerce business. In solving such a problem, the team member relay mainly on the degree of trust he is willing to give to the customer and on the degree of trust that manger gives to the team member to take a decisions relevant to refund and return problem. More trust the team member gives to the e-customer may increase the revenue loses. However, it increases the customer satisfaction resulting on building customer loyalty which in turn increases number of orders and therefore the profitability.

B. The Internal Structure of VO Work System:

As previously mention the VO work system causal loop includes four feedback loops, they are:

1. Centralization feedback loop.
2. Profitability feedback loop.

3. Over-trust in customer feedback loop.
4. No. of unpaid orders feedback loop.

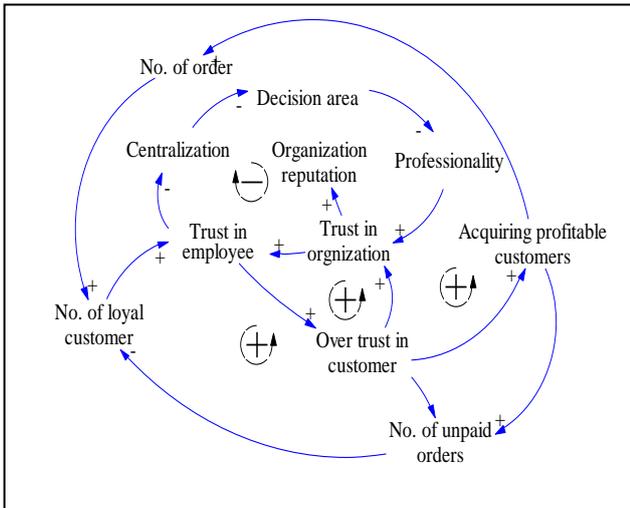


Fig. 1. Vvirtual organization causal loop

The proposed causal loop shows that, there are too many interrelationships within the model which indicates the complexity of the system and emphasizes the importance of the holistic view of the virtual organization work system in order to have a more realistic vision of the organization work system design and its influence on the organization profitability. CLD is a very useful mapping tool in representing the interdependencies and feedback structure of the system, capturing the mental model of the modeler, and communicating the results of a completed modeling effort [18]. However, CLD has a number of limitations, one of the most important limitations of causal diagram is its inability to capture the stock and flow structure of systems. Stocks and flows, along with feedback, are the two central concepts of dynamic systems modeling [20]. Therefore, in the next step, the stock-flow diagram for the NPD work system is proposed.

III. DYNAMIC MODELING

In system dynamics modeling, it is essential to distinguish between two types of variables: Stocks and flows. Stocks represent the results of accumulations over time. Their values are “levels” of the accumulations[21]. They are also called “states” as they collectively represent the state of the system at time t. The standard symbolic shape of a stock is a rectangle. Flows directly flow in and out of the stocks, thus changing their values. They represent the “rate of change” of stocks. The symbol for a flow is an arrow (representing the direction of flow) or a valve or T representing the fact that the flow quantity is being regulated [21], [22], [23].

Thus the stock and flow diagram has a precise and unambiguous mathematical meaning. As stocks accumulate or integrate their flows; the net flow into the stock is the rate of change of the stock. This is the description can expressed mathematically by the following integral equation[21], [22], [23]:-

$$stock(t) = stock(t_0) + \int_{t_0}^t inflows - outflows dt$$

Where stock (t) is the initial value of the stock at time to and $\int_{t_0}^t inflows - outflows dt$ represents the net flow at any time between the initial time to and the current time (t) [21],[23].

Some first order differential equations and algebraic equations including nonlinear and/or time-delay relations were developed considering the dimension consistency, real-life meaning and valid results even in extreme conditions. Figure 2 represents the stock flow diagram for the virtual organization work system.

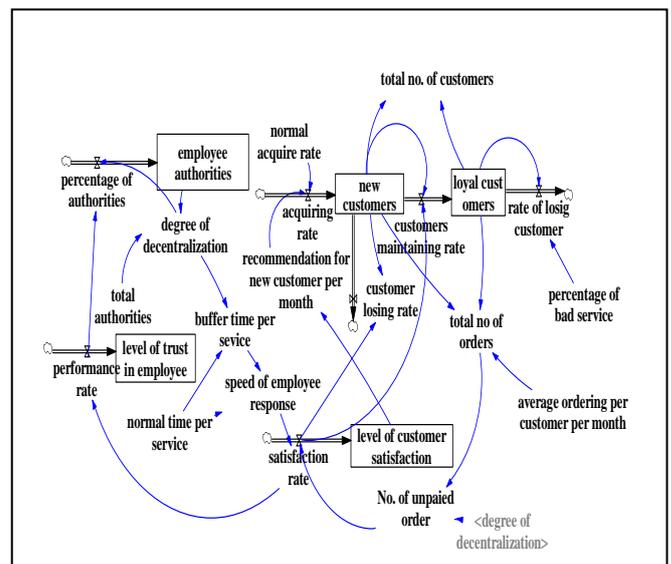


Fig.2: Stock flow diagram of VOs work system

The charts show the results of running the simulation model for 50 runs. The results imply that trust in employee and consequently trust in customers over time increases the number of loyal customers and also the number of new customers. The following charts depict the increase of number of recurrent customers and number of new customers over time.

When running the model the results showed increase in customers’ satisfaction with the increase of trust in employees. As both show progress over time of a running organization.

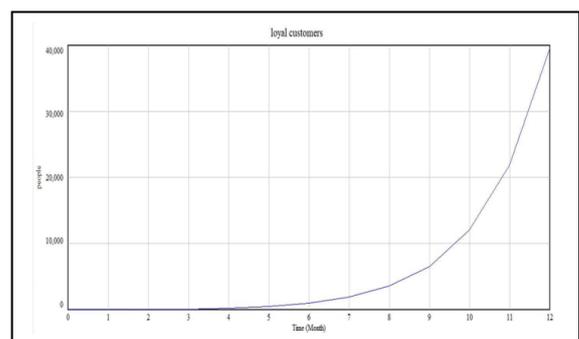


Fig.2: Loyal customers relation with time

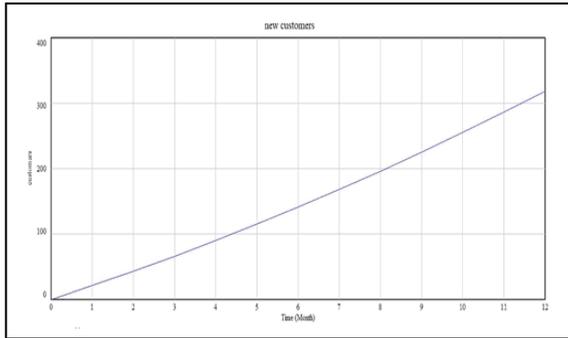


Fig.3: New customers progress over time

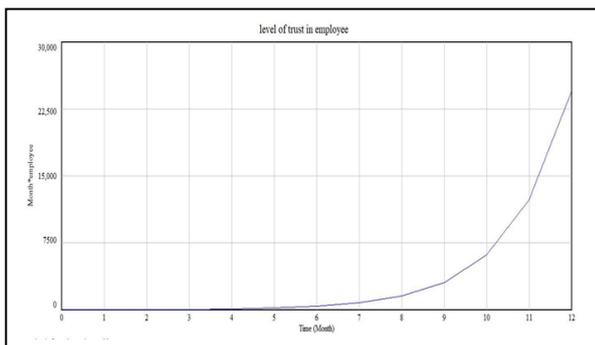


Fig.4: trust in employees over time

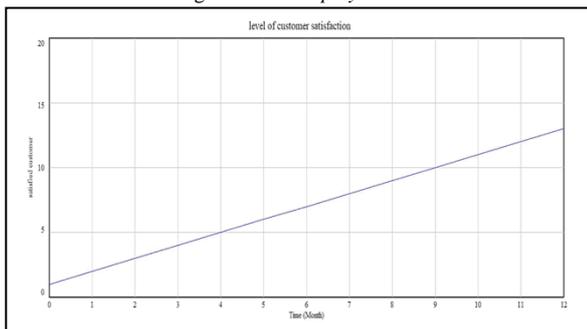


Fig.5: customer satisfaction over time

IV. DISCUSSION AND CONCLUSION

In this work a system dynamic model was developed to study the dynamic behavior of the virtual organization work system and its effect on building e-customer trust and obtaining profitability. The selection of the developed model variables stems from the Macro-ergonomics perspective, where the virtual organization was represented as a socio-technical work system that consists of three major sub-systems. Each subsystem includes a set of factors that interact with each other and each subsystem is interacting with the others subsystems.

In conclusion, this study makes significant contributions where this study provides a new approach for modeling virtual organization work system. The proposed dynamic model provides a platform that can be easily extended to investigate versatile variables in the virtual work system. Moreover, the system dynamics model developed in this study can be used as a “flight simulator” in managerial training. Being used as a simulation tool, the model can help the managers of virtual

organization to understand the dynamic interactions among the different elements in work system and feedback dynamics of trust.

V. LIMITATIONS AND FURTHER RESEARCH

One of the limitations in this study is that, it focuses mainly on trust in work system of virtual in order to decrease the complexity of the model. Future research can be effortlessly extended to include various variables in virtual organization work system. This would enhance our understanding of the role of work system structure in a dynamic management of virtual team.

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