Global Journal of Economic and Finance Research

e-ISSN: 3050-5348
p-ISSN: 3050-533X

Vol. 02(04): 191-200, April 2025

Home Page: https://gjefr.com/index.php/gjefr

Analyzing the Effects of Buyer's Outsourcing Policies on Supplier's Performance Using the System Dynamics Approach

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KEYWORDS: Outsourcing, supplier, buyer, policies, system dynamics

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Publication Date: 14 April-2025
DOI: 10.55677/GJEFR/03-2025-Vol02E4

ABSTRACT

Outsourcing is one of the most important activities in many organizations. It involves at least two organizations, which have similar goals and a relatively long relationship with each other. The active presence of several companies with the individual objectives that each seeks to achieve them, creates a complex system. The purpose of this paper is to use modeling and simulation to identify and define appropriate outsourcing policies affecting supplier's performance which sometimes get plagued by poor delivery condition, low productivity rate, decreased financial level etc. System dynamics modeling is used as a managerial approach in order to illustrate the existing relations among buyer's outsourcing policies and supplier's performance indicators. Using this model, polices are defined and set so that suitable performance levels are resulted. The main finding of this research is that having a short-term approach to outsourcing policies will lead to poor performances by suppliers. The long-term attitude towards suppliers will have a significant effect on improving the performance of suppliers.

1. INTRODUCTION

Outsourcing has been associated with the organizational interests and also criticized for its disadvantages. Nevertheless, in many organizations, outsourcing is one of the most important activities. It involves at least two organizations, which have similar goals and a relatively long relationship with each other. The active presence of several companies with the individual objectives that each seeks to achieve them, creates a complex system (Morecroft, 2007). Given that these relationships are developed within a time span, many changes occur in these relationships and create a complex dynamic environment. Thus a feedback system of thinking perspectives has a lot to offer in understanding the terrain in terms of learning facilitation and generating insights which are the mantra of system dynamics (Pruyt, 2013). One of the major goals of all leaders and managers is to achieve a better insight and understanding of how their organizations work. Such understandings help them to make better decisions, interventions, policies and strategies. These insights and understandings are derived from the mental models of how their organizations work, thus the quality of policies and strategies depends on the accuracy of these models. However, these models are limited by the inherent cognitive ability of the human brain (Marois , Ivanoff, 2005; Vennix, 1999) which are further restrained when dealing with complex systems (Sterman, 1994, 2006). System dynamics modeling is Forrester's (1961) response to human learning disability and inaccuracy of mental models. It is an approach that is characterized by its ability to assist learning by visualizing how various components in an organization fit together, interact and change over time (Morecroft, 2007; Pruyt, 2013). System dynamics modeling is based on the feedback interaction between various components of a system (Forrester, 1968). Unlike other modeling approaches, system dynamics seeks to capture the operation of the system of interests and attempts to model it based on the dynamic interactions between the various components. Conventional management approaches cannot effectively solve the problems associated with complex social systems, because more often than not, they take a static view of social systems and are unable to capture their dynamics and feedback structures (Forrester, 1971), whereas many of the problems we encounter today in reality are reflections of the undesirable aspects of the non-linear behavior of social systems (Plate, 2010) or the accumulations of delays and interruptions (Lyneis, Madnick, 2008).This paper's aim is to demonstrate the use and application of a system dynamics-based simulation approach as a research methodology to suggest and examine policies in outsourcing, and to analyze

the performance effect of different variabilities in parameters and production alternatives on the results of outsourcing. In line with all this, this work considers recommendations and action strategies for outsourcing which not only provide an understanding of performance, but improve decision-making process and the obtained results. What is newly attempted in this study is, primarily, the use of some of the important variables that have a qualitative nature in quantification; secondly, a surfacing of that part of hidden costs that is usually neglected in the relationship between the buyer and suppliers. It also reveals the structure for that part of the hidden costs that are rooted in the buyer's policies and can be reduced by consciously-taken measures.

The paper is set out as follows: section 2 is a overview of the system dynamics simulation models related to outsourcing context. Section 3 discusses the model conceptualization and its formulation. Section 4 includes the following parts; initial simulation, validation of the simulation model, simulation of policies and analysis, in that order. Section 5 presents some suggestions based on the analysis of the simulation results. Section 6 presents suggestions for future research and Section 7 concludes the points discussed.

2. AN OVERVIEW OF 'OUTSOURCING'

Outsourcing, generally, "is the process of purchasing goods or services on specification from an external supplier that were previously produced in-house" (McIvor, 2005). Outsourcing of public sector services to private firms is not uncommon world over (Mol, 2004). Outsourcing has become a necessity in today's business, and if a company fails to do some of its activities at the best level and still do it within the organization, it will lose the chance to stay at the edges of the competition market (O'Keeffe & Vanlanding, 2004). It is a held view that the several benefits of outsourcing include cost and time saving and inter-organizational learning (Yakhlef, 2009; Young, 2005) among many others. Government organizations tend to outsource both core and non-core functions depending on business needs and strategic goals. Some benefits of outsourcing, as gathered from above, are boost in efficiency**,** focus on core competence**,** cost reduction, and constancy in flexibility (Young, 2005). Despite the numerous advantages of outsourcing for organizations, there may be several problems if it is not done properly (Kric, tukel& rom,2006) and if its challenges are ignored, they can bring in many negative consequences for the organization (Ghandi, 2010). It has been argued that outsourcing often leads to poor working conditions and increased costs in the long run, including many switching costs proposed by the available literature (Besanko, 2000), transaction costs to change a supplier, learning costs, know-how costs, employee morale, loss of internal expertise and reduced work quality among many others (Aubert et al., 1998; Barthélemy, 2003;Quiggin, 2002). Other important challenges of outsourcing are unrealistic savings in costs and a potential cost increase, loss of corporate memory, loss of control over core competence in the organization, transfer of power toward suppliers, lack of employee motivation, and a reduction in credit, according to Kremic (2006). However, many experts believe that the failures and challenges of outsourcing have nothing to do with its nature; rather, it is lack of guidance patterns and the skills required to manage and monitor outsourcing activities that cause many of the problems (Gao,1997; Lonsdale,1999).

It should be noted that in order to effectively manage the outsourcing engagement, generally, and the service provider, in particular, a decision-making hierarchy needs adequate amount of information as the basis of decisions (Weimer & Seuring, 2009) to effectively cater for future performance and organization learning. Such decisions can best be arrived at via a system dynamics modeling as it entails testing whether particular decisions fit into the organizational goal and projection, and monitoring their impact and implications over time (Lyneis et al., 2001).

2.1 The basis for applying system dynamics modeling to outsourcing

Most organizations that outsource seek to have greater gains and reduce their outsourcing problems. A way to achieve this is through obtaining knowledge and a good understanding of the intricacies of the concept. This requires those in charge of administering and making decisions about the outsourcing practice to have sufficient information in order to guide their directions and be aware of the possible consequences (Weimer ; Seuring, 2009). A plausible way to arrive at such information (considering the complex and dynamic nature of outsourcing) is through a virtual environment where experiments can be conducted and "what-if" scenarios be generated, as provided by system dynamics models (Sterman, 2006).

The system dynamics (SD) methodology pioneered by Jay Forrester aims at identifying the underlying structure of a system and understanding how the policies or other influencing factors can affect system behavior. SD captures information feedback (or relationships) between components of a system in order to decipher its structure and behavior (Forrester, 1961; Sterman, 2000). The SD approach helps one to understand and address system level issues effectively. SD models are intuitive, easy to develop, less data-intensive and potently represent dynamic systems. These characteristics of SD models make them best suited for corporate policy design and as tools to help understand and solve management problems (Forrester, 1975; Rabelo et al., 2007). Therefore, system dynamics is an excellent tool for representing management policies and their effects on other important organizational variables under various conditions and time frames (McCray & Clark, 1999). Though extant outsourcing literature has gone a long way in identifying various trends that have characterized outsourcing engagements, these have largely been based on the black-box method that relies majorly on input-output manipulation or observation. Getting better insight via actual understanding of what goes on in the "black-box" is where system dynamics comes into play (Dutta & Roy, 2005). System dynamics can actually explain the mechanisms of the various factors interacting to produce the observed trend in outsourcing.

While the conventional literature has done a great job in exploring and identifying trends and issues in outsourcing, most of the efforts fail to detail the reasons for the observed trends. System dynamics has been of use here. For example, Liu et al. (2012) show that the various risk elements in outsourcing engagements often are accumulated to become a huge "risk pile" which will inadvertently be translated into huge risk mitigation cost, in some instances, to give white-box descriptions of the reasons and causes for the observed behaviors.

Raul Arellano et al. (2016) used the system dynamics approach to study and analyze costs and logistics outsourcing policies in a consumer commodity packing industry. They simulated the costs of the company before and after outsourcing using system dynamics. They also provided policies to reduce outsourcing costs. Ojugbele e Bodhanya, (2015) used the managerial application of system dynamics to identify the reinforcing loops of poor conditions of quality and delivery time in the outsourcing projects. Liu et al. (2012) used the system's dynamics to simulate the risk costs of outsourcing projects. They also provided solutions to reduce the risk costs of outsourcing projects. Arjun Duvvuru et al. (2012) have also developed the dynamics of outsourcing costs in a simulation model.

Below, using system dynamics approach we intend to have a better grasp of the structure of supplier's performance problems which are rooted in the outsourcing policies of the buyer's company. By using the system dynamics approach, we seek to provide solutions in order to maintain long-term and stable relationships with suppliers, rather than the constant replacement of suppliers, who face the challenges posed.

3. MODEL CONCEPTUALIZATION AND FORMULATION

In this study, an industrial company forms a collaboration network with its suppliers. The main objective of establishing such a network is to build and develop sustainable relationships with suppliers. Giving a number of activities to suppliers will provide the opportunity to focus on the core activities and the field of growth for an organization. In some cases, the company outsource their major activities to suppliers. This is either because of their confidence in suppliers or because of weakness in identifying the company's competitive advantage. However, the firm's competitive advantage is itself a highly dynamic entity, in today's changing environment (Warren, 2005), that changes rapidly with time.

After a while, it turns out that while outsourcing strategies achieve their goals in a given period, the rate of achievement declines later on. The productivity rates of the suppliers, the delivery rates and the financial benefits resulting from outsourcing become worse after a period of time. On the other hand, with the pressure of the company's customers regarding delivery of products increasing, the buyer is forced to cut down collaboration with some suppliers who have had a low delivery rate over a period of time. It is imperative to start collaboration with the new suppliers in order to meet demands of customers, but to make new contracts with suppliers, the buyer company must spend time and money, and monitoring the activities of suppliers requires time and cost as well. This contradicts the main objectives of outsourcing, such as focusing on core activities, as continuous monitoring on suppliers' performance will distract the focus on the core activities.

System dynamics research helps us to understand and learn existing situations and to identify leverage points and suggest policies to improve the situation.

3.1 The system dynamics model

The major assumption behind this modeling exercise is that having a short-term attitude towards suppliers and no long-term strategies reduces the productivity of the suppliers and as a result, the delivery rate of tasks declines. Other hypotheses of this study are as follows:

If there is no financial support from the buyer, most suppliers make new contracts with other buyers because of weakness in the financial level and other sources. They provide financial resources required for the previous contracts from new contracts. Owing to the increasing number of contracts and restrictions on resources, suppliers will try to do all the commitments with limited resources.

By decreasing the financial level of suppliers, their level of satisfaction will also be reduced and the continuation of collaboration discouraged, as it will be less financial income for them as they try to do tasks, and their productivity rates will decline. Therefore, suppliers can't complete all obligations in deadlines.

With delay in delivery, hidden costs will be imposed on the buyer. The increase in the hidden costs will follow the decline of outsourcing income, thus, reducing the needed amount of attention and ability to strengthen the supplier's finances. There is also a direct connection between the amount of delay in hand delivery on the part of suppliers and the time to receive their payments. With the supplier's delay in delivery, the buyer's payment time is prolonged.

In addition, due to weakness in technical and financial assessment of suppliers, the outsourcing tasks will not be fit for most of the supplier's capabilities; consequently, the rate of task delivery will decline. With decreasing rates of delivery and increasing pressure from the company's clients, contract termination rates increase with those suppliers which have low delivery rates. Furthermore, replacing suppliers and collaborating with new ones will require time and cost and, as a result, hidden costs will increase.

The outsourcing of the key tasks considered competitive advantages for the buyer increases the supplier's competitive advantage and their expectations of the employer. When the level of supplier's expectations goes higher, they will not be willing to work with the buyer with prior earnings anymore. As a result, the supplier's satisfaction level and their productivity and delivery rate diminish.

4. SIMULATIONS AND ANALYSIS

Below is the flow diagram of the issues discussed in Figure 1

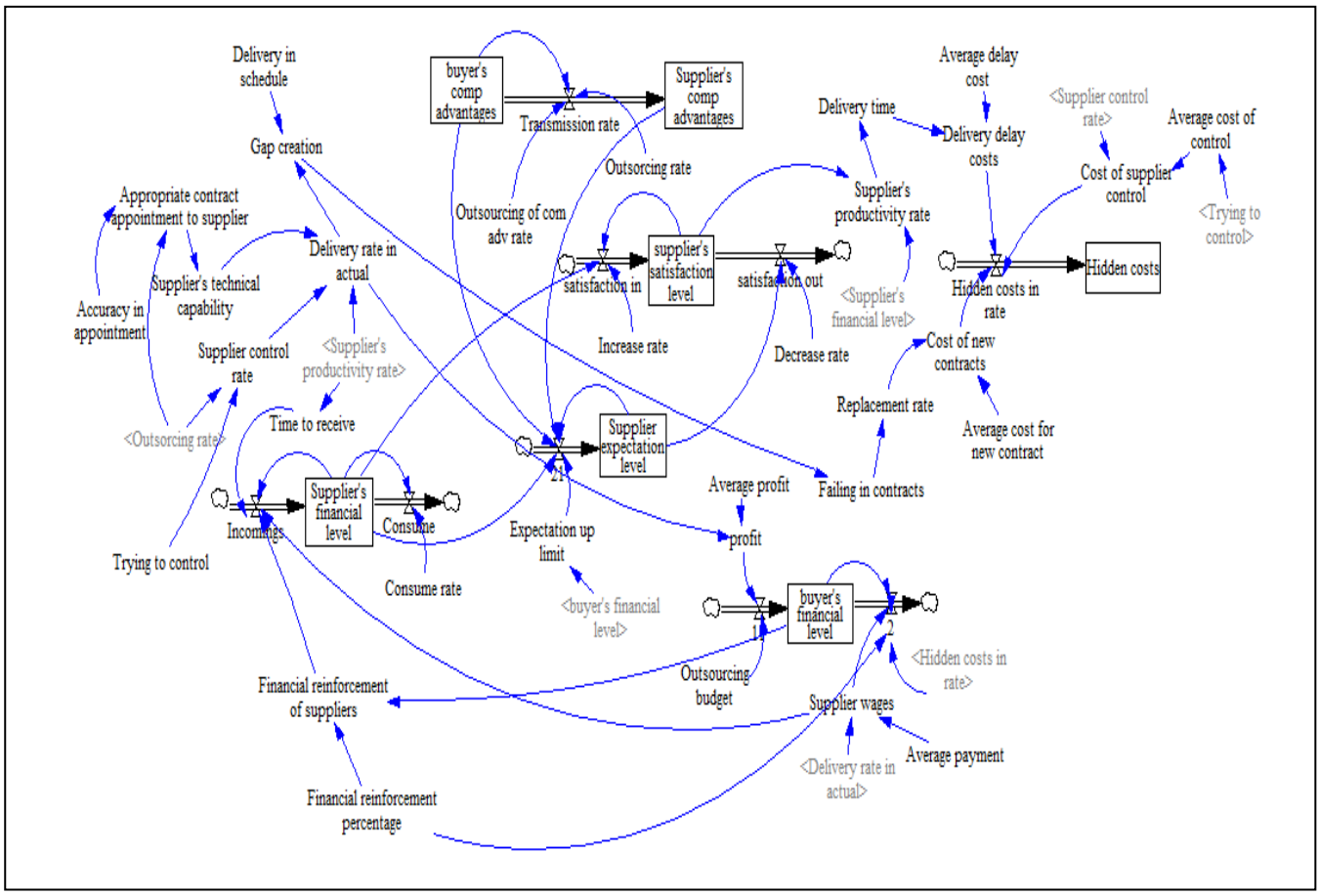

Figure 1. Flow diagram for the proposed model

4.1 Base simulation run

It should be noted that in spite of the fact that many factors affect the supplier's productivity rate, in this model, to make things simpler, two variables, namely, supplier's satisfaction level and supplier's financial level are considered as the main influential factors on supplier productivity rate.

As for the buyer's financial level, the financial inputs and outputs related to suppliers are considered pertaining and internal revenues and costs of the company are not taken into account, because the other financial inputs and outputs of a company are not related to the purpose of this Moreover, despite the effect of various factors on the hidden costs, in order to simplify and achieve the purpose of study, delay costs in delivery of tasks, costs of supplier control and new contract costs are the ones considered as important influences on hidden costs. The duration of simulation is set at 100 months. After the modeling, it turned out that a period of one hundred months is enough to show the trends in the main variables of the model. Table I shows a list of parameters and initial values used in calibrating the model.

The base simulation run closely mirrored the situation of the problems faced by the company. Table 1, contains the model parameters and the initial values of the model level variables.

Table 1. Model parameters and Initial values

Parameters	value	comment/notes
delivery in schedule	100	estimated by historical data
supplier expectation level	5	initial value (max=100, min=0)
buyer's comp advantages	200	initial value
supplier's comp advantages	0	initial value
outsourcing of comp advantage rate	0 .0 5	estimated by historical data
outsourcing rate	100	estimated by historical data
supplier satisfaction level	50	initial value (max=100, min=0)
accuracy in appointment	0 .85	estimated by historical data
trying to control	0 .85	estimated by historical data
suppliers financial level	30000 (unit)	estimated by interview
accuracy in appointment	0 .85	estimated by historical data
trying to control	0 .85	estimated by historical data
suppliers financial level	30000 (unit)	estimated by interview
consume rate	0.02	estimated by interview
financial reinforcement of suppliers	0.003	estimated by interview
buyer's financial level	100000 (unit)	estimated by historical data
average profit	30 (unit)	estimated by historical data
outsourcing budget	2000 (unit)	estimated by historical data
average payment (per each)	40 (unit)	estimated by historical data
average cost of control (per each)	0.5 (unit)	estimated by historical data
average cost for new contracts	200 (unit)	estimated by historical data
length of simulation (months)	100	based on available data and reasonable outsourcing into the future

The simulation results show that the productivity rate of the suppliers are in decline from month 40 until the end of month 100. Similarly, the level of satisfaction of the suppliers is in tedium and downtrend from nearly month 40 onwards. Due to the qualitative nature of the satisfaction variable, the zero number is considered as the minimum and the number 100 as the maximum level of satisfaction. The downtrend in the financial level of suppliers is evident. In this model, the actual delivery rate is affected by factors such as the productivity rate, the supplier control rate for delivery according to the contents of the contract and accuracy in the allocation of tasks to suppliers at the beginning of the outsourcing. The hidden costs in rate are affected by the costs of delay in delivery by suppliers, cost of supplier's control and the costs of new contracts as replacements for failed ones. Figure 2 illustrates the trend of changes for the important variables of the model in the initial state.

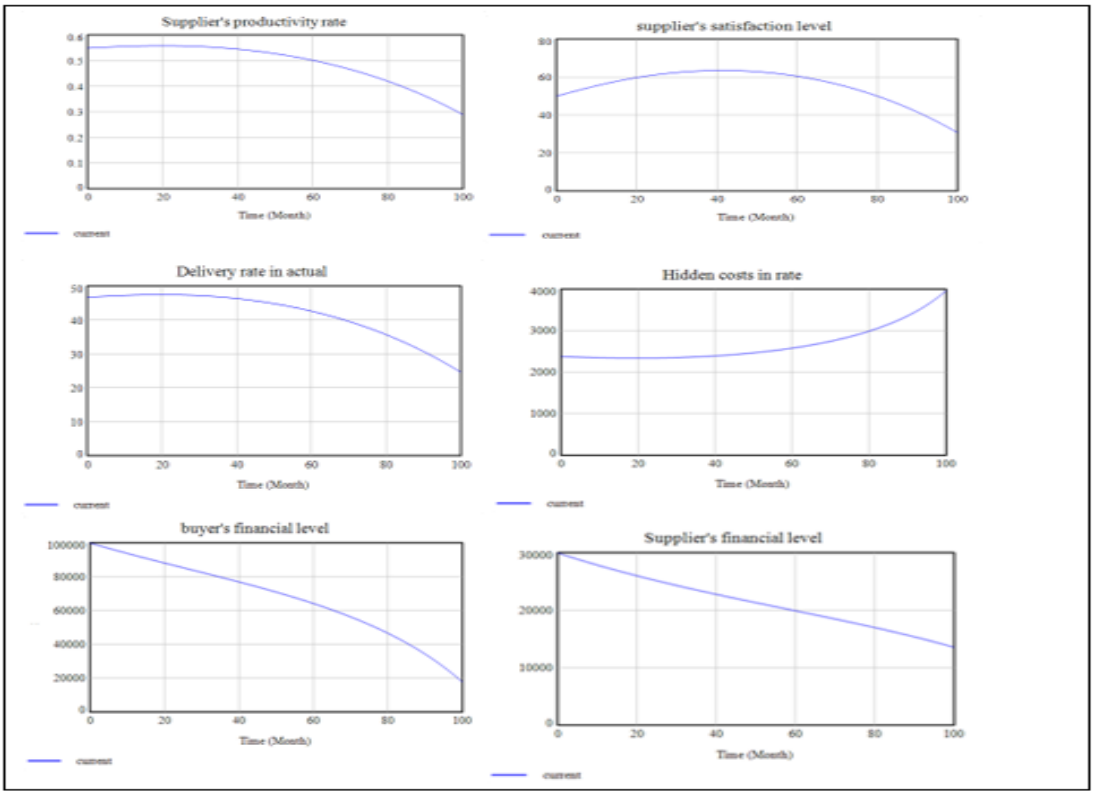

Figure 2. The trend of the main variables in the current state

4.2 Validation

The validation of this model is rather challenging due to the use of qualitative variables that assume a quantitative function. The qualitative variables used in this model are the "level of satisfaction of the suppliers" and the "level of the supplier's expectations," which have a direct effect on the main variables of the model, such as the productivity rate, and consequently the delivery rate in actuality. However, expert opinion acts decisively in validation and the trends in the main variables of the issue are confirmed during the simulation period. Therefore, expert opinion was used to validate the behavior of main variables of the model and in order to verify the structural validity of the model, we used the boundary conditions test. Based on the boundary conditions test, after an extreme increase or decrease has occurred in key parameters of the model, we examine the behavior of the main variables of the model and make sure this behavior is consistent with our expectations.

In order to test the boundary conditions, the parameter value of the percentage of reinforcement, shifted from 0.003 to 1. It is expected that with the intense increase in this parameter, and with increase in the supplier's financial level and supplier expectations level, the supplier's satisfaction level will keep decreasing. As a result, the supplier's productivity rate will have a severe drop. The sharp decline in the supplier's productivity rate will lead to a sharp rise in delivery time, which will lead to a sharp rise in hidden costs. Consequently, the abrupt rise in hidden costs will result in a sharp decline in the buyer's financial level. In Figure 3, the boundary conditions test results are shown to demonstrate the buyer's financial; level and the hidden costs in rate.

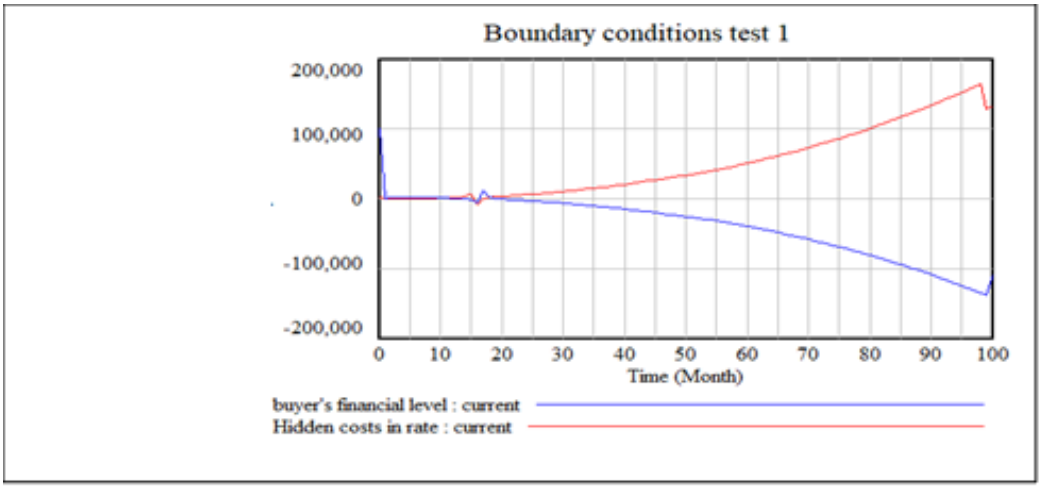

Figure 3. boundary conditions test 1 result

In the second part, with an increase in the rate of outsourcing of competitive advantages up to 50, we expect an increase in the level of supplier expectations after time delay with too much rise in outsourcing of competitive advantages. Consequently, after a delayed period, we expect a drastic decrease in the satisfaction level of the suppliers and their productivity rates. As a result, we anticipate an increase in hidden costs due to a plunge in the supplier's productivity rate. The drastic changes in these variables occur in the last five months of the simulation time, which is shown in Fig. 4.

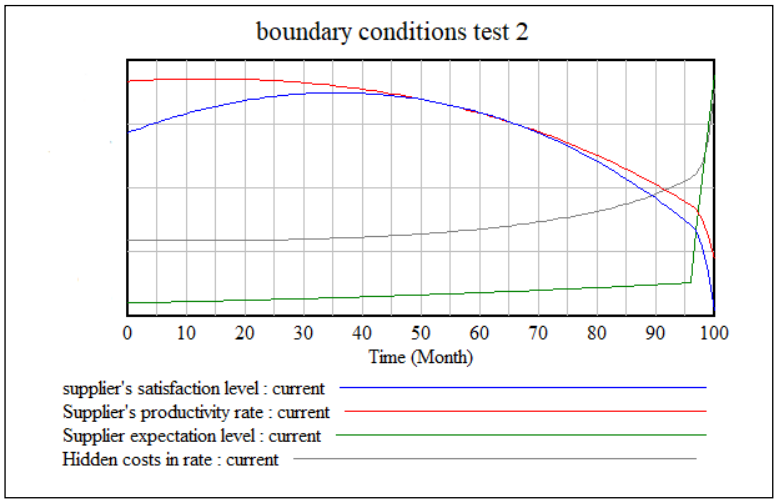

Figure 4. boundary conditions test 2 results

Two of the above boundary conditions tests, indicate the proper functioning of the model components with each other. As a result, the proposed model has sufficient validity to apply policies in it.

4.3 Simulations to test policy options

A series of simulations were implemented, in our study, to test various policies on improving the current situation performance. The options explored include those suggested by experts at the study site and inspired by the conventional literature on outsourcing and system dynamics. Also, sensitivity analysis test was used to identify leverage points of the model. The proposed policies, which have been validated through the analysis of sensitivity analysis and passed the approval of experts in terms of feasibility, consist of three general policies.

These policies include reduction in the outsourcing of competitive advantages, increasing the accuracy in the appointment of tasks to suppliers and increasing the rate of supplier control, and increasing the financial reinforcement of suppliers.

4.3.1 Reduction in the outsourcing of competitive advantages

A popular view is that outsourcing should be based on preserving the firm's competitive advantage (Mankins; Steele, 2005), but the firm's competitive advantage itself in today's changing environment is a highly dynamic entity (Warren, 2005) that changes rapidly with time.

The reduction in the outsourcing rates of the company's competitive advantages will initially prevent a lot of challenges. The buyer can reduce the supplier expectations level and thus an increase will ensue in the supplier's satisfaction level, which itself will increase supplier's productivity rates. Figure 5 shows the improvement in supplier productivity rates and supplier satisfaction level in both pre- and post-policy tests in the outsourcing of competitive advantages when this variable reduced from 0.05 to 0.01.

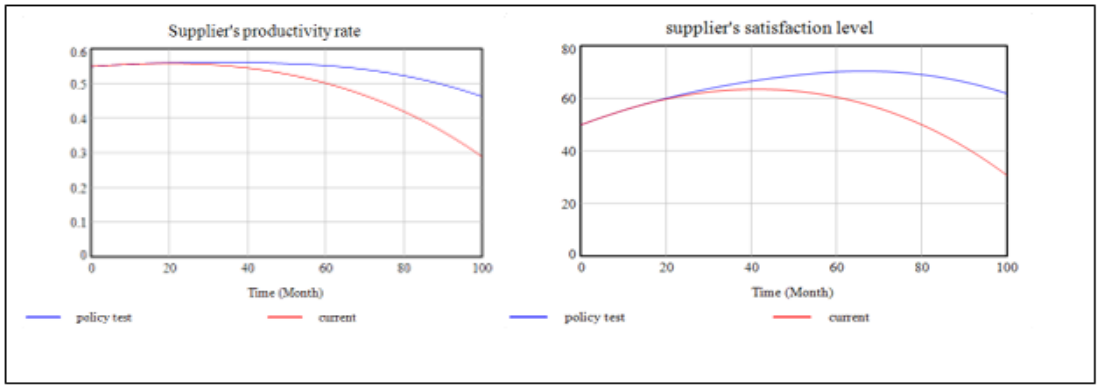

Figure 5. The results of applying the policy to reduce the outsourcing of the competitive advantages

4.3.2 Increasing the accuracy in the appointment of tasks to suppliers & increasing the rate of attempts to control

In this policy, the buyer should firstly achieve sufficient insight of tasks that are intended to be outsourced. The buyer should have adequate awareness of funding and required technical capabilities. On the other hand, the buyer should identify the financial and technical capabilities of suppliers. In this case, the buyer will obtain a better performance in allocation of tasks to suppliers. Allocating tasks to suppliers who are not technically capable of carrying them out confronts a dedicated buyer with many challenges. Also, to keep increasing the rate of effort to control suppliers, we seek to increase the delivery rate. Figure 6 shows the simulation result for this policy.

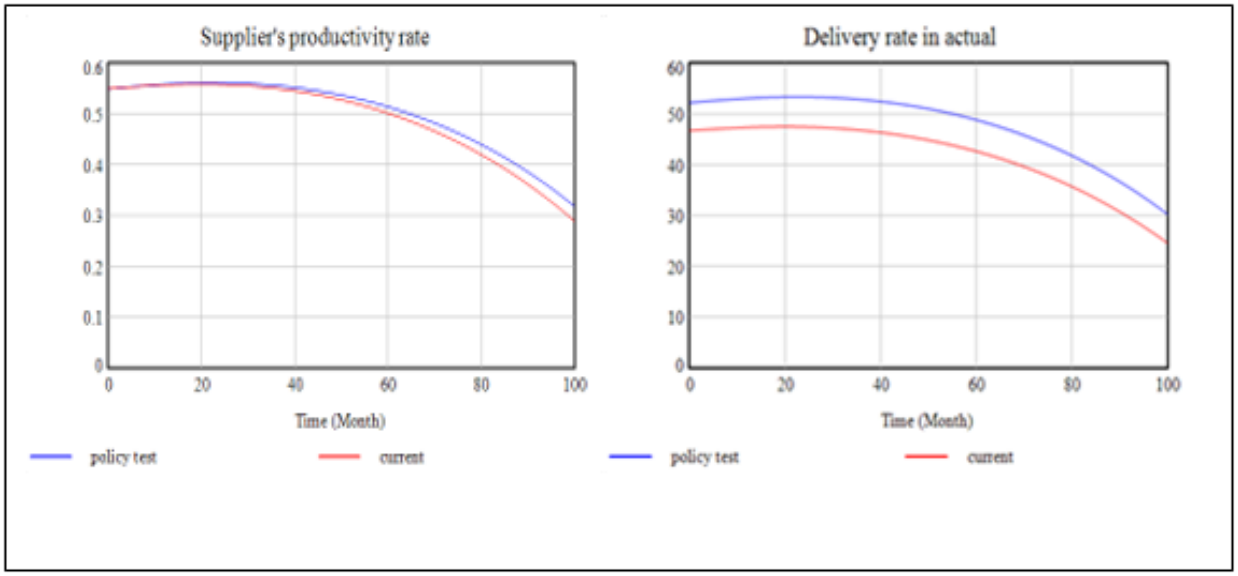

Figure 6. The results of applying the policy of accuracy increasing and controlling the performance of suppliers

4.3.4 Increasing the financial reinforcement of the suppliers

In this policy the financial reinforcing of suppliers is considered as an investment on them. It is expected that this policy has a positive effect on supplier's performance, such that increase in the financial reinforcement rates boosts the financial level of suppliers and the level of satisfaction of the suppliers. Therefore, significant improvement in the productivity rates of suppliers is highly anticipated, which will consequently lead to reduction of hidden costs. As shown in Figure. 7, a mere improvement in the rate of reinforcement from 0.003 to 0.01 results in significant achievements.

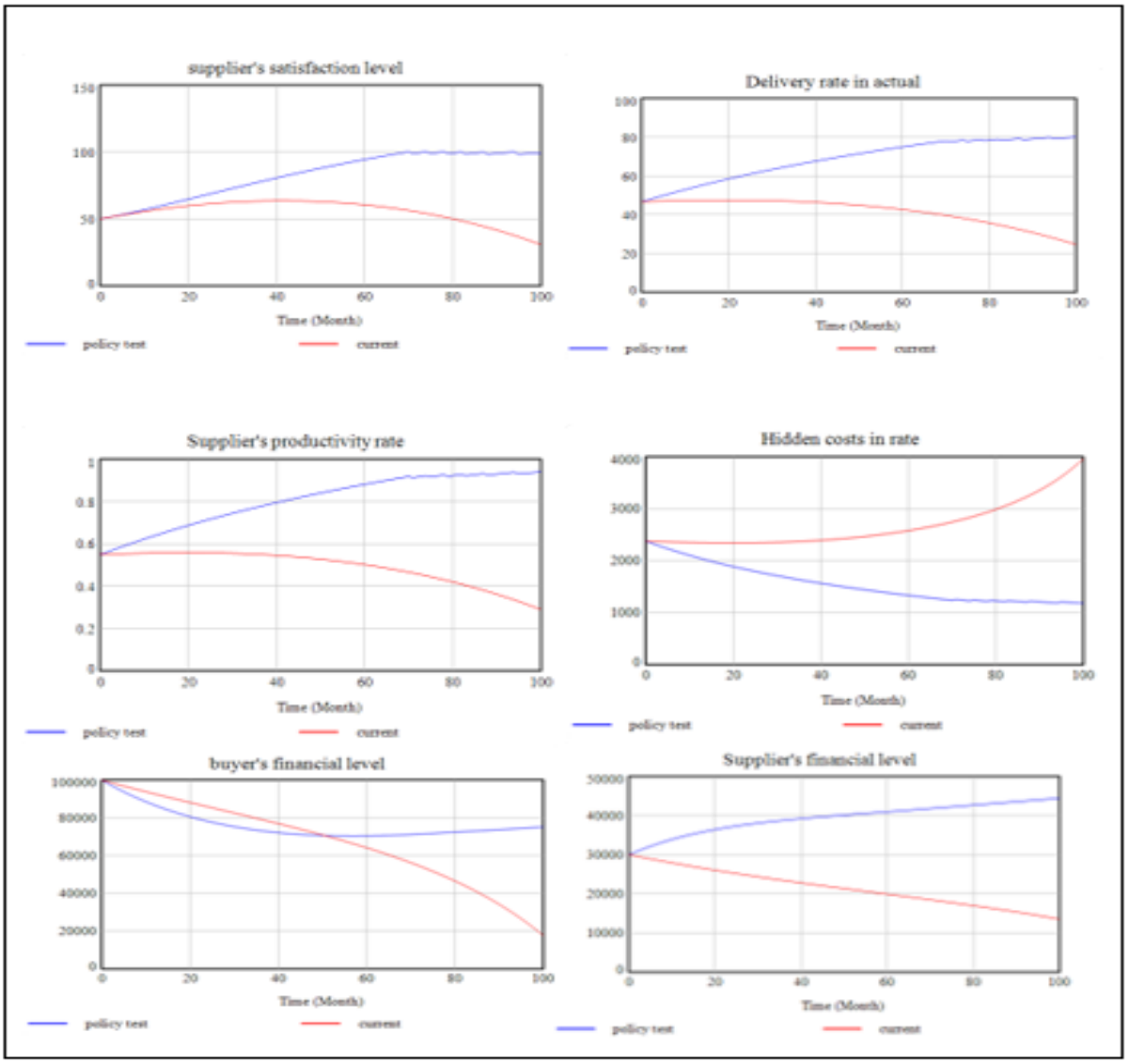

Figure 7. Results from financial reinforcement of the suppliers

5. Implications for practice: suggestions for improving (product) outsourcing

Based on the insight and training approaches generated by the simulated model, we provide the following simple suggestions for improvement in an intended company and any similar companies that outsource and face similar challenges:

- Updating the company's competitive advantages to identify new competitive areas and prevent their outsourcing. If it is necessary to outsource some of them, it is advisable to divide tasks between different suppliers to prevent the full transition of competitive advantage to suppliers.
- Increasing accuracy in the allocation of tasks to suppliers should be according to the technical and financial capabilities of suppliers and the work assigned to them. By proper allocations to suppliers, the number of suppliers who do not have the ability to do tasks will be reduced. As a result, their replacement rate and the hidden costs will be reduced.
- The conscious control of suppliers in a way that does not harm the buyer's core activities, to ensure that tasks are done according to pre-determined technical specifications. By controlling the performance of suppliers, a gradual completion of tasks will be ensured and the completion of tasks will be avoided around the delivery times.
- Developing the financial reinforcement of suppliers; this improves factors such as the level of satisfaction of suppliers and increases the financial capacity for doing tasks and thus positively affecting the productivity rates of the suppliers.

The savings from the increase in the productivity rates of the suppliers, which itself reduces hidden costs, will be greater than the costs incurred by the financial development of the suppliers. This reinforcement loop is shown in Figure 8.

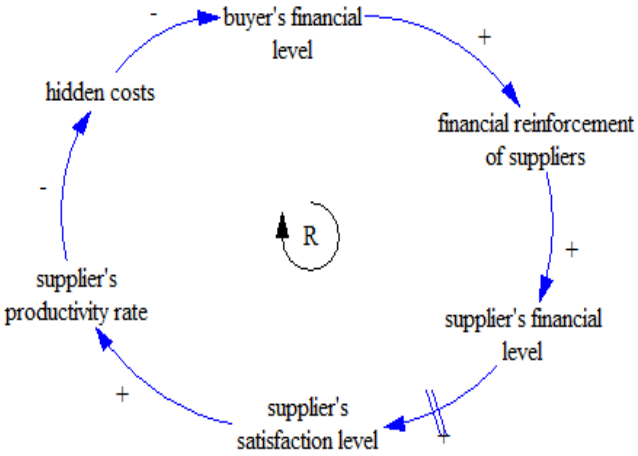

Figure 8. Reinforcement loop of Development in the financial level of suppliers

6. IMPLICATIONS FOR RESEARCH

The system dynamics has yet to contribute to the development of outsourcing literature in both the public and private sectors. While the main concern of most models (not all) has been on the hard and quantitative variables and the soft and important variables have not been given enough attention to, it is suggested that soft variables be also considered in this modeling using a combination of fuzzy logic and system dynamics. The fuzzy approach in modeling can be helpful in illustrating the uncertainty in the data, which delineate the existing trends.

The focus, in this study, was on the effects of buyer policies on the performance of suppliers. Therefore, the development of a system dynamics model that analyzes the effects of buyer policies on the performance of suppliers and internal employees in a model can be considered a useful strategy.

7. CONCLUSION

We have demonstrated using modeling method that outsourcing will tend to fail if the outsourcing policies are not designed carefully. We also discussed that some buyer's goals and supplier's goals can supplement each other. This requires sufficient recognition of the needs of suppliers and identification of the outsourcing policies of the buyer. We also showed that the performance of suppliers is affected by some buyer policies and it can be improved with informed designing of outsourcing policies.

This research also includes the subsequent findings; increasing the accuracy in allocating tasks to suppliers and sufficient attention to the accordance between technical capabilities of suppliers and technical requirements will improve the low delivery rate in the future. Having a long-term attitude in collaboration with suppliers is a sort of future investment on suppliers to the benefit of the company. Briefly, the financial reinforcing of suppliers leads to an increase in the productivity rates of suppliers and therefore reduces hidden costs, which will itself increase the revenues of outsourcing in the long run. In order to reduce their outsourcing rate, it is important to remain updated about and persistently identify the competitive advantages of the company that have a variable nature. Also, the performance of suppliers should be controlled in a way that ensures the gradual completion of tasks in accordance with the predetermined technical and time specifications. By employing the above findings in outsourcing policies, we can be sure to expect sustainable collaboration with suppliers.

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