

System Dynamics Simulation Model for Higher Education Strategic Planning

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Abstract. *Strategic planning is vital to higher education institution viability. Universities face challenges related to academic affairs, scientific knowledge development, programs quality, market tendencies among others, which make necessary to maintain a continuous learning cycle to check, assess, modify, redesign and restructure policies and procedures in order to meet national accreditation standards. A great portion of the existing research on university management problems does not have a quantitative foundation, primarily because such problems involve qualitative (human) elements that are difficult to quantify and model. A truly valuable approach to developing and directing strategy should therefore say something about earnings, not just explaining today's results but showing how to built performance through time. Many institutions do not meet their goals because the planning process uses tools that are particularly inadequate for present day environment of complexity and rapid change. The purpose of this paper is to present the conceptual framework for higher education strategic planning problem. This paper aim at matching the System Dynamics methodology with the Balanced Scorecard framework towards higher education strategic planning which is believed could significantly improve the planning process in a strategic learning perspective. The potential value of system dynamics for higher education strategic planning is in incorporating nonlinear and iterative view, hard and soft issues, strategic objectives, and changes in educational process. System dynamics approach offers rigorous, fact based explanations for performance through time, and confident insights for the future, easily communicated to colleagues and stakeholders.*

Keywords. System Dynamics, Higher Education, Strategic Planning

1.0 Introduction

In recent years, Malaysia has emerged as an unexpected contender in the world market for international students in higher education. Recognizing this sector as a potential new source of growth and export revenue, Malaysia aims to become a regional hub for higher education (Tham, 2010). In the new economy when changes are inevitable and competition is ever increasing, the existence of every organization depends on its ability to adjust quickly and keep pace with the change. Any organization that is not capable of responding to the transformation will probably not be able to develop in the long run. In the world today, higher education is a complex, demanding and competitive reality (Montez, 2004). Universities are driven to engage in a strategic planning process in order to survive and prosper in higher education provision.

A pioneer of strategic planning, Mintzberg (1978), defined planning as a formalized procedure to produce an articulate result in the form of an integrated system of decisions, with emphasis on process before product. Strategic planning is a discipline effort to produce fundamental decisions and actions that shape and guide what an organization is, what it does, and why it does it; as well as the process of developing and maintaining strategic fit between the organization and its changing marketing opportunities (Kotler & Murphy, 1981; Bryson, 1996; Pacios, 2004).

Strategic planning assumes that an organization must be proactively adaptable and flexible to a dynamic, changing environment. Further, Stueart and Moran (1993 cited in Pacios 2004) stated that 'strategic planning deliberately tries to concentrate resources in areas that may produce a substantial improvement in future capacity and performance.' They also considered strategic planning as 'a framework and a way of thinking' rather than 'a set of procedures'.

In a university setting, strategic planning is the process of defining goals, the critical success factors, and establishing procedures to reach these goals; thereby providing an institution with mechanisms to control its size,

shape, and character. It's a formal process designed to help a university to identify and maintain an optimal alignment with the most important elements within which the university resides. Strategic planning focuses on the institution as a whole, raising fundamental questions about direction and emphasis. It addresses those factors that will have the most effect on continuing activities, without sacrificing quality. Thus, strategic planning is vital to higher education institution viability and it is obvious that strategic planning must be considered as a continuous process.

With respect to higher education institutions in Malaysia, a parallel development was foreshadowed in a National Higher Education Strategic Plan: Laying the Foundation Beyond 2020 (2007):

The well thought off strategic planning done by the national higher education institutions (HEI) is a vital roadmap to create, instill and benefit from the academic knowledge for the purpose of economic growth. The heading of higher education covers the aspects of university management, research and development, teaching quality and learning as well as human capital development which is in line with the National Mission. HEI performance critically depends on effective leadership as well as excellent work culture in every level to achieve the vision, mission, strategic objectives and headway of the organization.

When all is said and done, the purpose of designing and implementing strategy is to improve performance over time.

This paper introduces a dynamic framework for higher education strategic planning in the context of adopting balanced scorecard as performance indicator. The proposed framework is built on system dynamics methodology. The greatest advantage in adopting system dynamics as an analytical tool is that it exposes the many interrelationships (structure) that influence the behaviour of a complex system.

2.0 Planning for higher education's strategy through balanced scorecards

Since its introduction in 1992 (Kaplan and Norton, 1992), the application of Balanced Scorecards (BSC) has spread widely across many sectors, as a performance measurement system enabling managers to translate strategy into a correlated set of performance indicators from several business perspectives. The BSC approach is aimed at overcoming strategic management limitation of traditional performance measurement systems, as too narrowly focused on financial measures.

Recently, Kaplan and Norton (2000) have developed the notion of a strategy map as a complementary concept next to the BSC. A strategy map links measures of process performance or key performance indicators (KPIs), together in a causal chain that leads through all four perspectives: measures of organisational learning and growth influence measures of internal business processes, which in turn, act upon measures of the customer perspective, which ultimately drive financial measures.

A more recent study (Kaplan and Norton, 2004) states that, "We now realized that the strategy map, a visual representation of the cause-and-effect relationships among the components of an organization's strategy, is as big an insight to executives as the balanced scorecard itself."

3.0 Current practice shortcoming

In spite of its widely recognized advantages, the BSC presents some conceptual and structural shortcomings. Sloper *et al.* (1999) remarks that the BSC is a static approach. The links among the parameters inside the four perspectives do not express their dynamic relationships. As result, in the analysis of the strategy delays between actions and their effects on the system are ignored.

In addition, these relationships follow an open-loop logic and, hence, they do not consider feedbacks (Linard and Dvorsky, 2001). Although Norton and Kaplan stress the importance of feedback relationships between scorecard variables to describe the trajectory of the strategy, the cause-and-effect chain is always conceived as a bottom-up causality, which totally ignores feedbacks, where only the variables in the lower perspectives affect the variables in the upper perspectives.

Furthermore, according to Bianchi and Montemaggiore (2008), the BSC approach does not help policy makers in understanding whether a given performance measure ought to be considered as an outcome (or lag) indicator or as a driver (or lead) indicator. Moreover, it does not support organisations in understanding how to affect performance drivers, which in turn will influence the outcome measures.

In particular, the BSC approach does not support in understanding (Kaplan and Norton, 1996a):

- how strategic asset accumulation and depletion processes triggered by the use of different policy levers affect performance drivers;
- how performance drivers affect outcome indicators;
- how outcomes will affect strategic asset accumulation and depletion processes.

In order to cope with the above-mentioned flaws, "the BSC can be captured in a system dynamics model that provides a comprehensive, quantified model of a business's value creation process" (Kaplan and Norton, 1996b). Therefore, "dynamic systems simulation would be the ultimate expression of an organization's strategy and the perfect foundation for a Balanced Scorecards" (Norton, 2000).

4.0 System dynamics as a modelling method for BSC development

In this paper, we suggest the use of system dynamics (SD) as an approach to overcome the limitations to current BSC practice in higher education strategic planning. The SD approach enables the creation of interactive learning environments. The use of such simulators can help university's management understand the dynamic relationships between performance variables included in the BSC. In fact, the elicitation of the causal chain between performance drivers and outcomes may enhance university management's learning process and, thus, their ability to comprehend how different strategies might affect university performance over time.

We believed that higher education institution can successfully apply the SD approach in the formulation of BSC for:

- assessing university strategy and vision and their coherences in order to detect potential side effects;
- validating the causal map representing university's strategy against reality;
- filtering performance measures in order to select the smallest number of proper indicators of a university's progress towards strategic goals;
- simulating the effect of performance drivers on financial and non-financial outcomes in order to detect the most opportune policy levers;
- implementing what-if analysis to learn about potential future scenarios and threats.

5.0 BSC chart as a starting of university strategic planning process

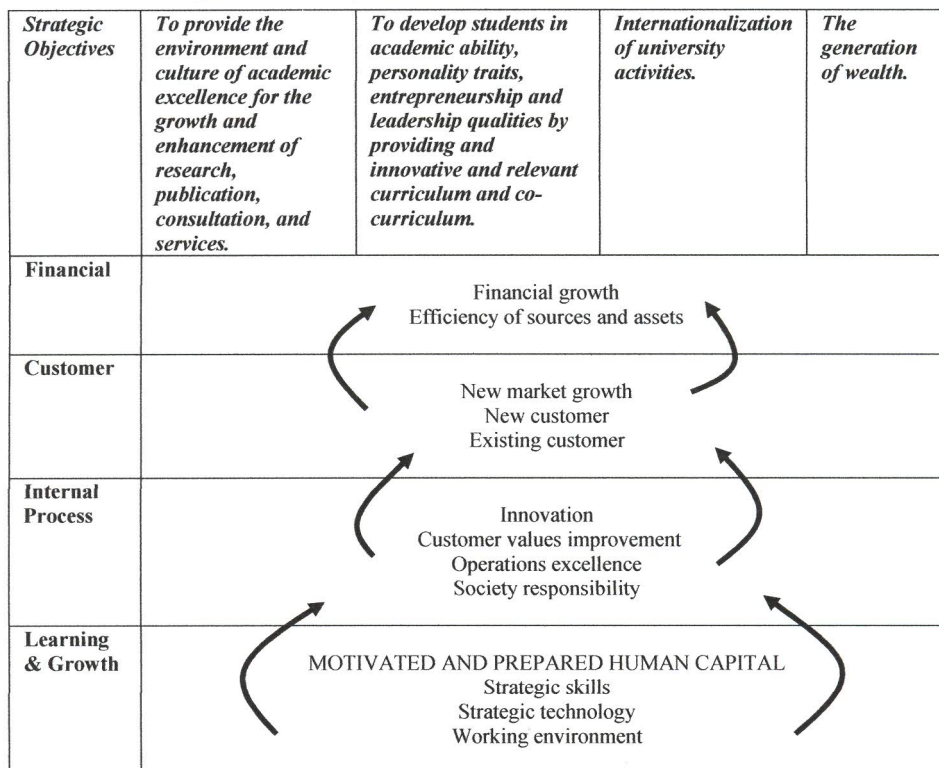
In order to create a shared vision of university strategy, to stimulate communication among university management, and to avoid strategy disconnections among different constituencies and competing priorities, we suggest the implementation of the integrated system dynamics simulation model for higher education strategic planning.

With the aim of achieving university strategic objectives, which were defined at before hand, a bounded range of relevant and selective performance measures was framed through a BSC chart, according to the traditional bottom-up approach (Figure 1). More specifically, Figure 1 shows how a university's proposed strategy mainly consisted in improving the university image by higher efficiency and effectiveness in provision of education in order to increase its competitiveness among the higher education institution in Malaysia.

According to university management's mental models, such goals could have been achieved by having motivated and prepared human capital, which might contribute to having operations excellence, innovation, customer values improvement, and society responsibility. An increase in the effectiveness and efficiency of human capital and internal process would have improved both customer satisfaction and financial results.

The above framework was very supportive to university management in order to articulate their own views about strategies to undertake. However, as already discussed, the traditional BSC approach is not sufficient to figure out either the strategic resources to build, or the processes through which they will interact to effect university performance. Therefore, the BSC chart portrayed in Figure 1 only suggested what policy levers the management should use, and not how and when the company should act on these policy levers to balance the conflicting objectives of both shareholders and customers and community.

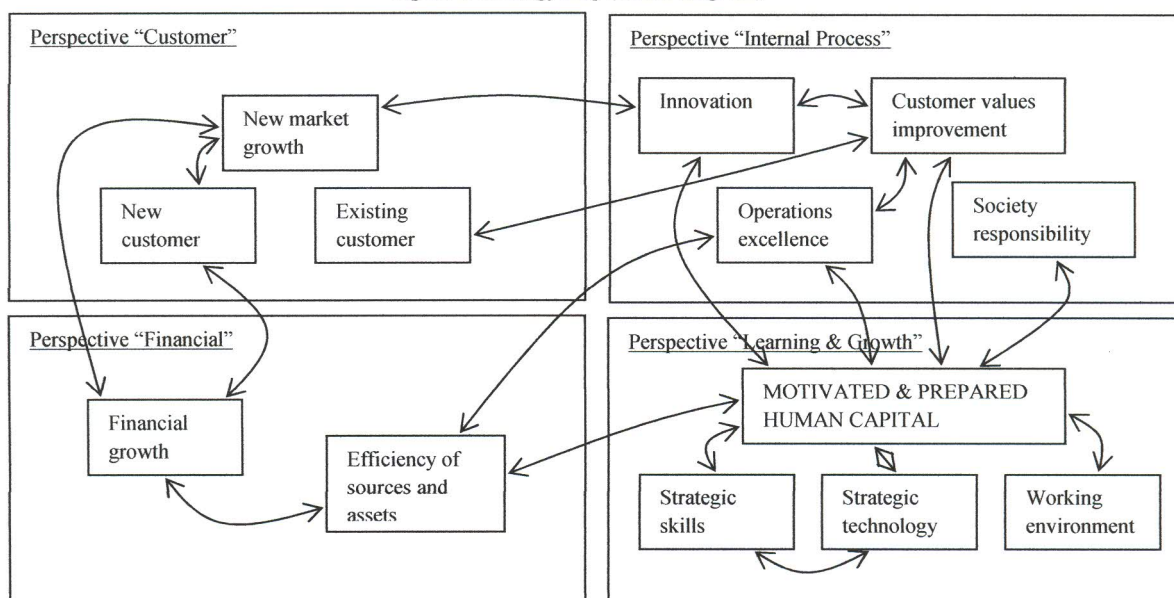
Figure 1: University traditional performance measures BSC chart.



6.0 The “dynamic” BSC

As stated earlier, since the bottom-up causality depicted in Figure 1 does not take into consideration feedback loops between and within the four perspectives, we moved to a more detailed causal loop analysis. Based on the traditional strategy map in Figure 1, a new strategy map is developed, capturing the feedback relationships between variables in the strategy map which are within the four perspectives (Figure 2).

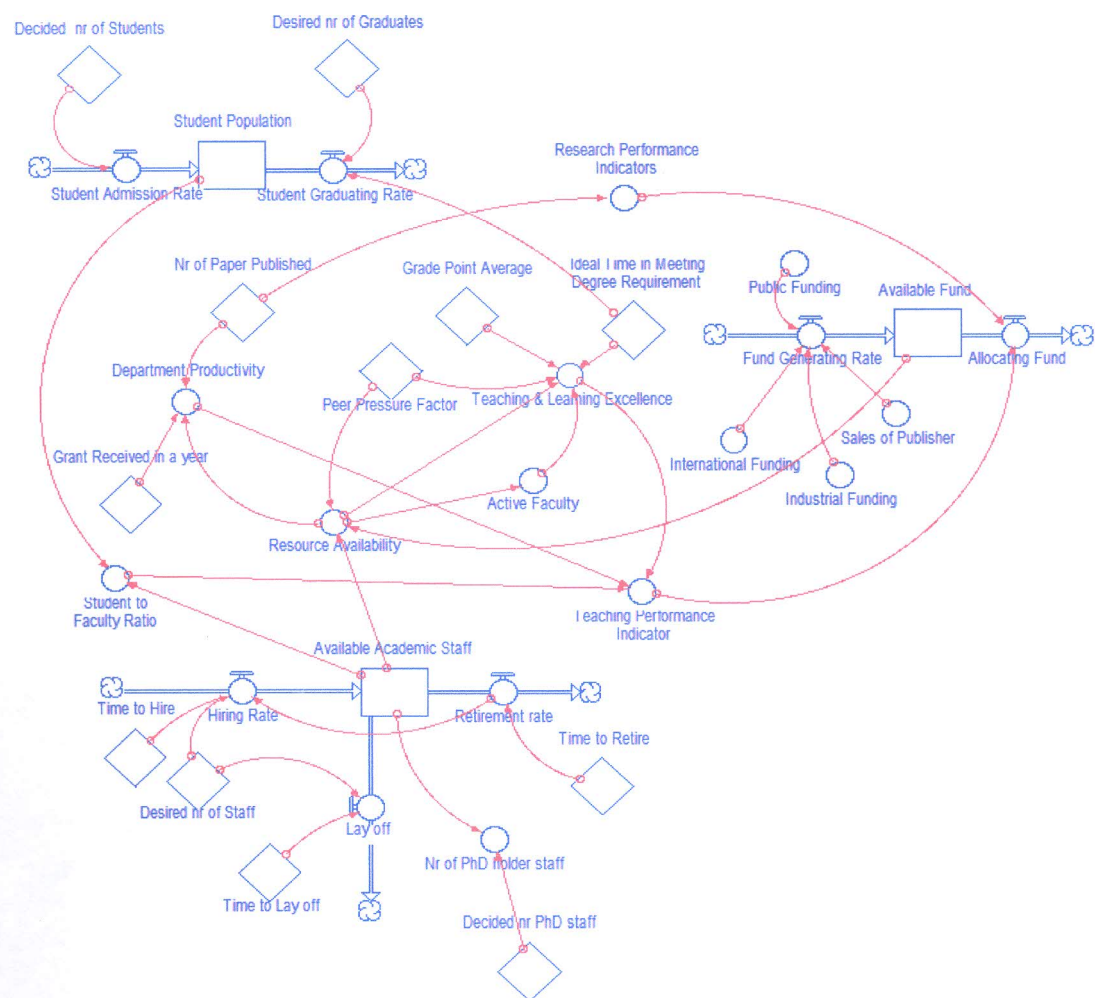
Figure 2: Strategy map (causal diagram)



Later, stock-and-flow model diagram (Figure 3) is constructed. It is beyond the scope of this paper to present detailed context for the developed framework. Figure 3 illustrates a simplified presentation of the stock and flow model of the simulator, showing how the critical resources and other variables are interrelated and its association with the balanced scorecard perspectives.

- *Growth and learning perspective.* This sector consists of framework that explains the underlying behaviour of the faculty system as a result of structure, policies, and feedback. The developed framework may be used to study variety of issues such as ratio issues, policy effects, and university goals.
- *Internal process perspective.* This sector describes the issues that related to university's innovation, customer values improvement, operation excellence, and society responsibility. This sector also shows how parameters interact to achieve academic quality and excellence in research.
- *Customer perspective.* In this sector, a student population framework is constructed for the purpose of understanding the causes of student population variation. This sector shows those variables that would affect the size of the student body from a system dynamics perspective.
- *Financial perspective.* This sector provide a framework that a university department can use as a policy analysis tool in allocating funds to support activities that enhance the quality of teaching and research of the department.

Figure 3: Simplified representation of the simulator model



7.0 Conclusion

This paper has tried to propose the overall framework of a university strategic planning system using the SD methodology towards BSC framework. The development of the conceptual framework can successfully enable university management to better understand cause-and-effect relationships between variables pertaining to the four traditional BSC perspectives. We are currently carrying out further research on the existing conceptual model as well as the design of a computer interface. A second set of interview will be conducted to test whether the model structure and policy implications are adequately representing real management processes. Once enough confident is built in the SD model, what-if analysis and strategy testing will be conducted under different potential scenarios. The developed model can be exploited by stakeholders to design policies that can positively influence the future in the direction of desired goals, and will have minimal side effects.

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