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Implementing Balanced Scorecard with System Dynamics Approach

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Abstract

This paper discusses the potential of system dynamics modelling to support balanced scorecard. The balanced scorecard is a conceptual framework for translating an organisation's strategy into a set of performance indicators. These performance indicators are distributed across the 'classic' model's four perspective: Customers, Internal Business Processes, Financial, and Learning and Growth. This balanced scorecard, whilst having significant strength, suffers from the limitation of all performance indicator systems, namely that the interrelationships between indicators are overlooked and there is no way of taking into account the impact of delayed feedback which flows from introduction of new policy and legislative changes.

System Dynamics is a methodology for understanding complex problems where there is dynamic behaviour and where feedback impacts significantly on system outcomes. System dynamics provides a rigorous basis for qualitative testing of the effects of performance indicators in complex environments such as health or social security. This can be supplemented with quantitative system dynamics simulation tools that further test the validity of indicators and the business rules implicit in them. System dynamics modelling has an important role to play in extending feedback cycle in performance measurements to a full systems approach.

Introduction

Beyond Bean Counting [1] reported that an MAB benchmarking survey *"confirmed the view that Australian Commonwealth financial management practice is behind best practice as exhibited in the private sector and in some other public sector jurisdictions"*. The report went on to recommend the "Balanced Scorecard" (BSC) approach to performance measurement.

The BSC approach, developed by Kaplan and Norton of Harvard School of Management, for the private sector environment, stresses the need to balance the traditional focus on internal process and financial aspects with a focus on customer satisfaction and organisational learning and growth.[2]

The uptake of the BSC has been phenomenal. Some 40 % of Fortune 1000 companies have implemented, or sector, at least in the US, has also been extensive. However, a limitation of BSC as implemented, especially in Australia, is the failure to take account of feedback relationships between performance indicators that make up each of the sectors of the BSC, and between the sectors.

This paper aims at reviewing BSC and System Dynamics and at suggesting Dynamics Balanced Scorecard with System Dynamics Approach.

Overview of the Balanced Scorecard Approach

The balanced scorecard (BSC) methodology, developed by Kaplan and Norton in 1992, has found wide acceptance in the private sector. Also, with its focus on customer satisfaction and organisational learning and growth in addition to internal process and financial aspects. it appears to provide a way forward in the public sector.

Balanced Scorecard is a conceptual framework for translating an organisation's strategic objectives into a set of performance indicators distributed in the "classic" model among four perspective: Financial, Customers, Internal Business Processes, and Learning and Growth. Some indicators are maintained to measure an organisation's progress toward achieving its vision; other indicators are maintained to measure the long-term drivers of success. Through the balanced scorecard, an organisation monitors both its current performance (finance, customer satisfaction, and business process results) and its efforts to improve processes, motivate and educate employees and enhance information systems – its ability to learn and improve.

The idea behind the BSC concept is that no single fact or key indicators can reveal where the organisation is headed in relation to the overall strategy. An organisation must develop a balanced model, that focuses on the internal and external indicators as well as the related performance drivers and outcome measures, which describe the cause-and –effect relationships behind the strategy.

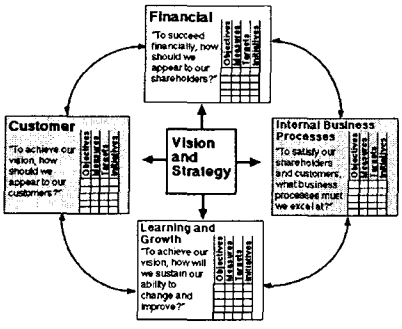

Figure 1. Balanced Scorecard (Kaplan and Norton)

The BSC lets managers introduce four new management processes that contribute to linking long-term strategic objectives with short term actions. The first new process – translating the vision- helps managers build a consensus around the organisation's vision and strategy. The second process – communication and linking- lets managers communicate their strategy up and down the organisation and link it to departmental and individual objectives. The third process – business planning – enables companies to integrate their business and financial plans. The fourth process – feedback and learning – gives companies the capacity for what we call before "strategic learning".

The BSC defines and assesses the critical success factors considered necessary to fulfil the corporate goals to ensure future success. This is achieved by close scrutiny and subsequent understanding of cause and effect relationships.

This method represents a first step in holistic thinking by recognising the existence and importance of the full breath of operational aspects of business and the idea of measuring future potential. Additionally, users of the approach are increasingly recognising another systems concept- that such performance measures are interdependent.

The Balanced Scorecard and public sector performance

As Arie de Geus has emphasised so dramatically, there is something dramatically wrong with corporate business survival rates. *"A full one-third of the (Fortune '500' list of industrials) listed in 1970 had vanished by 1983. ... The demographics of companies, their birth and death rates, seem to indicate that their average life expectancy is no more than 40-50 years. This finding seems to be valid in countries as wide apart as the USA, Europe and Japan."* De Geus argues persuasively that attention to systemic issues, and in particular to 'lead indicators' through use of business 'flight simulators' is critical to survival: *"we will*

not perceive a signal from the outside world, unless it is relevant for an option for the future which we have worked out[3,4].

De Geus' conclusions parallel the findings, from a different standpoint, of Kaplan and Norton. Dr. Robert Kaplan, Professor of Leadership Development at the Harvard Business School, and Dr. David Norton, co-founder of Renaissance Inc., spent years researching the elements of successful organizations. They found that most organizations focus too heavily on "lag" indicators, such as financial statements and market share surveys, rather than on "lead" indicators to reveal the health of their organisations.

The product of this research was the BSC, which is an outcomes oriented performance management system that seeks to link the short and long term activities of an organization with the vision, mission, and strategy of the organization through the establishment measurable, consensus-driven goals.

Kaplan and Norton explicitly recognised the systemic inter-relationship within and between four sectors, incorporating both lead and lag indicators, which impact on organisational performance. In their classic model, two of these have an inward oriented dimension, a learning sector and a processes sector, and two an external focus, a customer sector and the traditional financial sector.

Given the often blind acceptance of BSC by many managers, at least in Australia, without a full appreciation of Kaplan and Norton's work, the following points need emphasis:

- BSC is an approach to the implementation of strategy – it does not take the place of strategy development or planning;
- BSC cannot be disaggregated into sectors (the 4 quadrants of Figure 2) considered in isolation - it is the relationships within and between the BSC sectors that are the fundamentally important breakthrough in this methodology;
- BSC creates / requires a systems view of the company's strategy and its implementation;
- the 4 quadrants in Figure 2 are not 'mandatory' - neither Kaplan and Norton's book nor its preceding academic papers impose such a rigid requirement;
- the performance indicators which are used to form the sectors include a combination of both forward looking and lag (backward looking) indicators.

Kaplan and Norton's emphasis on 'cause and effect', where acknowledged, is often expressed in a deterministic 'cause and effect chain' (i.e. flowing only to the top) as depicted in Figure 3. Few implementations recognise feedback and delay. Especially in the public sector, the time lag between program inputs and measurable outputs are very significant and ignored with peril.

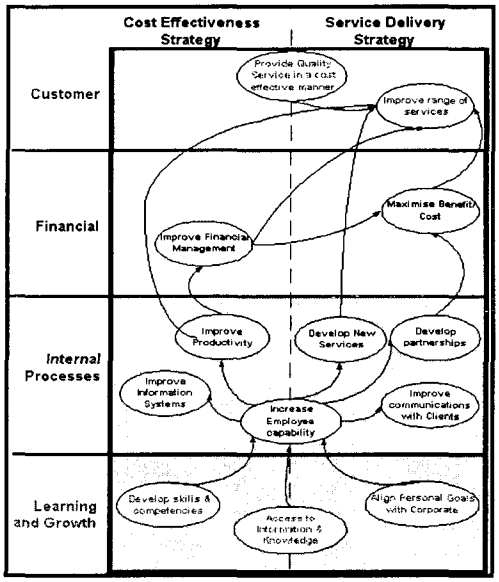

Figure 2: Balanced Scorecard 'cause and effect chart'

One study[5] of full and prototype implementations has shown that BSC implementations often 'fail' (reports internationally suggest that up to 70% fail to achieve management expectations). Our initial review suggests the following factors are significant in these failures:

- practitioners blindly follow the four quadrant model even though there may be valid reasons for departing from this in specific public sector cases
  - particularly at the top Government level, which forms the strategic focus for Government policy departments, the four sector model seems inadequate – although the necessity for both lead and lag indicators remain
  - a first cut at the top level 'whole of government' model is addressed later
- practitioners separate the sectors in their process of identifying performance measures for each, and fail to re-capture the holistic view
  - the 'stovepipe' result largely ignores interaction between sectors, which is particularly incongruous in the case of lead indicators
- practitioners also work in a 'bottom up' fashion resulting in masses of tactical, operational and a few strategic performance indicators
  - in fact, scorecards with several thousands of indicators have been found
- even if a 'reasonable' BSC is developed, it will still suffer from the problem that even experienced managers, have great difficulty in understanding the implications of change in multiple interrelated decision variables (a well designed BSC will have 15 to 20 key first line indicators)
  - when delayed feedback is involved in complex systems it is virtually impossible for the human mind, unaided, to assess the consequences[6]

OVERVIEW OF SYSTEM DYNAMICS

System dynamics as a management discipline developed in the 1950's with its origins in engineering control theory (servo-mechanisms and cybernetics), although underlying systems concepts have been applied rigorously for the past century across most disciplines. In a nutshell, System Dynamics is the rigorous study of organisational problems, from a holistic or system perspective, using the principles of feedback, dynamics and simulation.

System Dynamics is a methodology for understanding complex problems where there is dynamic behaviour and where feedback impacts significantly on system behaviours. It provides a rigorous framework and the rules for qualitative description, exploration and analysis of systems in terms of their processes, business rules and information feedback, facilitating quantitative simulation modelling and analysis for the design of system structure and control.

Models of complex problems require complex mathematics. Models of problems involving change over time and feedback require the solving of multiple differential equations. This new generation of graphically oriented software (e.g. the Powersim software used in these simulation) automatically generates the structure of the 'nth order' differential equations necessary for solving complex feedback problems, cutting development time dramatically and reducing the likelihood of errors. Mathematical knowledge is still critical in fleshing out the interrelationships between parameters, and it is still possible to build erroneous equations. There are four key graphically oriented system dynamics software packages available in the marketplace, all of which are in use at ADFA: Powersim (Norway), Ithink/ STELLA (US), Vensim (US), Cosmos/Cosmic(UK).

Over the past three decades, system dynamics has been applied to such areas as project management, business development , government policy analysis, environmental change , economic development, military strategic and tactical analysis. Since the mid 1980's there has been a corresponding growth in the sophistication of tools and methodologies being developed and applied including computer simulation tools, soft systems methodology,

causal loop diagramming, chaos theory, statistical analysis and interactive learning environments.

The insights and techniques of system dynamics have the potential to enhance greatly both the process of developing the BSC and the efficacy of its use by managers. Structured analysis is used to identify the range of organisation objectives. Cluster analysis is then applied to identify plausible sectors and the nature and strength of interrelationships among the objectives within and between sectors. The indicated sectors are then tested against the 'classic' four sectors and for 'lead-lag' aspects to come up with an agreed suite of sectors. Qualitative SD techniques ('hexagons', influence diagrams etc) are used to identify feedback and delay relationships within and between sectors. A very high level SD model is made of relationships.

Structured analysis is then applied to identify plausible indicators within each sector and qualitative and quantitative SD is used first to model relationships within each sector and then to elaborate the models with the inter-sectoral relationships. Finally, using Monte Carlo simulation and genetic algorithm optimisation techniques in conjunction with the SD models (e.g. using Powersim Solver 2, or more laboriously integrating the SD model with external packages such as @Risk and Evolver) understand the sensitivity of outcomes to changes in the various indicators. The end point of the process is the development of a business flight simulator which can be used by managers both to understand the complexity of their decision environment and as a decision analysis system to test particular options.

SYSTEMS DYNAMICS AND THE BALANCED SCORECARD

The major players in the implementation of the BSC acknowledge the significance of the systemic dimensions necessary to underpin the framework. The Renaissance Group, of which David Norton is a co-founder, state for example:

"Recognizing a "Good" Balanced Scorecard: ...Every measure selected for a Balanced Scorecard should be part of a chain of cause and effect relationships that represent the strategy" [7] and again,

"... one needs to clearly define the fundamental drivers of organizational performance and create a specific cause and effect relationship that links these drivers to company strategy. This activity enables an organization to link performance with effective process design and decision-making, and it will begin to highlight the skills and knowledge required to improve that performance."

The Procurement Executives' Association (PEA), whi ch includes major US Federal Departments, has identified the "Balanced Scorecard" methodology as their chosen me thodology for *"...deploying strategic direction, communic ating expectations, and measuring progress towards agree d-to objectives"*. They also note the importance of identif ying 'cause and effect':

"By illuminating the links between strategies, measures, and expected outcomes at different levels in the organization, and across different operational components, the BSC also encourages cross- functional problem-solving. For example, a Division may identify a Bureau or Department-level policy that impedes its ability to accomplish a certain objective. The Division could raise the issue, using the BSC to demonstrate the cause-and-effect relationship, and work together with the appropriate Bureau or Department management toward a solution." [8]

The uptake of the BSC has been phenomenal. A 1998 study by the Gartner Group found that "at least 40 % of Fo

rtune 1000 companies will implement a new management philosophy...the Balanced Scorecard... by the year 2000." Uptake by the public sector, at least in the US, has also be en extensive, spurred by the 1993 GPRA Bill. In this surge of implementation, however, the systemic dimensions highlighted by Kaplan and Norton seems to have been lost.

DoCITA[9] Causal Loop Diagram

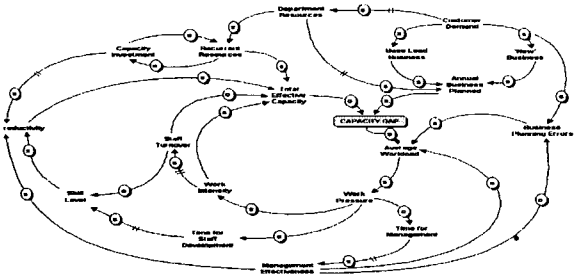

Figure 3: DoCITA Causal Loop Diagram 1

A key element in the CLD is the concept of 'Capacity Gap' which may be defined as the difference between the annual business planned (as measured for example in person months of work) and the Total Effective Capacity (person months of work). This effective capacity relates solely to 'time on task' and is based on the approved staff numbers adjusted for average absences on leave etc, time planned for training and staff development and time planned for managerial activities.

Figure 4 is a CLD which focuses on the typical business process response in any Government Department to a change in the 'Capacity Gap'. Conceptually, outsourced work has a clear contractual relationship between workload at a specified quality level and resources. If the quantum of work is increased, the contractor will demand extra resources.

Within the bureaucracy, an increase in workload typically will be addressed by one or a combination of:

- reduction in time devoted to training and development
- reduction in management activities (through redirection of 'management time' to 'task time')
- unpaid overtime
- deferring some work (which often simply postpones the day of reckoning) and
- reduction in quality of input (e.g. through cutting background research effort etc)

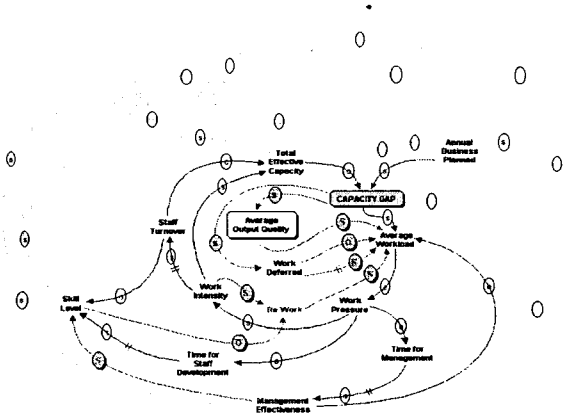

Figure 4: Docita Causal Loop 2

What figure 4 illustrates is that the continued existence of a capacity gap will eventually set up a vicious cycle of loss in skills and increase in staff turnover which result in lowering the total effective capacity and hence further increases the capacity gap.

[1] Public Service & Merit Protection Commission, Beyond Bean counting: Effective Financial Management – 1998 & Beyond in the APS, Canberra (1999)

[2] For the Kaplan,S and Norton, D's papers on BSC, see "The Balanced Scorecard-measures that drive performance", *Harvard Business Review*, January-February, pp.71-9(1992) ; "Putting the balanced scorecard to work", Harvard Business Review, September-October, pp.134-47 (1993) ; "Using the balanced scorecard to work", Harvard Business Review, January-February, pp. 75-85 (1996) ; *The Balanced Scorecard: Translating Strategy into Action*, Harvard Business School Press, Cambridge, MA

[3] De Geus, A. Strategy and Learning. Rotterdam School of Mangement, 1996

[4] Sloper, P, Linard, K, Paterson, D. "System Thinking for the next Millennium", paper for 17th International Conference of the System Dynamics Society, 1999.

[5] Diehl, E and J Sterman. Effects of Feedback Complexity on Dynamic Decision Making. MIT Sloan School of Management, Research Report D-4401-1. March 1994.

[6] Renaissance Worldwide, Inc. *The Balanced Scorecard* – An Overview. 1999. http://www.rens.com/viewpoint/papers/scorecard.html

7 Department of Communication, information technology and the Arts of Australia