Abstract

Balanced Scorecard (BSC) makes both practitioner and academic take notice these years. The reason is that BSC rethinks performance measurement system of organizations. And furthermore, BSC has become a strategic management system that can facilitate organizations to identify the operational factors which driving future success, to align their strategic objectives and actions, and to accumulate the resources that can create long term competitive advantage.

This research adopts case study method and focuses on the feedback structures of developing a balanced scorecard. The purpose is to find key success factors of building and implementing BSC from a feedback loops perspective. We choose one typical case that implementing BSC successfully and study on its feedback structure by performing feedback loops analysis. We hope for accumulating knowledge of facilitating organizations to implement BSC more effectively by exploring and learning to understand the nature of dynamic complexity that formed by building and implementing BSC.

The result represents and explores the feedback structures of the case. We find some dynamic issues which including the critical forces that reinforce organizational growth, the constraints that may limit its growth in the future, the delays that cause more difficulties in aligning resource allocation, the interconnectedness among the above, and the mechanism that implements BSC and causes organizational change smoothly. By building a feedback loops model of the case, we can deeply understand the dynamic complexity of developing BSC and the difficulties of achieving dynamic strategic alignment in this case. And we find some dynamic principles to implement BSC effectively.

KEYWORDS: *Balanced Scorecard; Dynamic Complexity; Case Study; Feedback Loops*

The Issue of BSC Is Noticed

Balanced Scorecard (BSC) advocated by Kaplan and Norton (1992, 1993, 1996ab, 2000ab, 2001ab), is a management method and tools which highlight the strategic alignment of organization. In order to transfer vision into action and implement strategy effectively, BSC can help managers to notice a diverse set of strategic focuses, including financial perspective, customer perspective, internal process perspective, and learning and growth perspective.

And the iterative process of developing, implementing, and reviewing BSC is clarifying vision and translating vision into strategic agenda, objectives, measures, target score, and strategic action etc., communicating and linking strategy from top level to lower, developing and implementing operational budgets and plans, and exploring and learning from the operating information feedback and reviewing BSC.

BSC is not just a performance measurement system to build scorecards for management control and performance evaluation. BSC becomes a strategic management system that can facilitate finding performance drivers, exploring and describing strategic action map precisely, and implementing strategy effectively. Furthermore BSC could initiate continuous improvement, organizational change, resource accumulation, and organizational learning. Aforementioned management activities could bring competitive advantage to organizations.

According to Kaplan and Norton's book (Kaplan and Norton, 2000b), many organizations throughout the world now have adopted or are using the BSC to develop, implement, and manage strategy. Kaplan and Norton share the practical experience of more than 200 companies that have implemented the BSC, and the research results by in-depth case studies- including Mobil, CIGNA, Nova Scotia Power, and AT&T Canada.

Recently many academic literatures studied on the issues of the BSC. Including Kaplan and Norton focused on clarifying and presenting the BSC's theory, method and tools for the practice and position of management, and on publishing the practical experience, by combining academic research with consulting practice in these ten years. (Kaplan, 1990, 1998; Kaplan and Norton, 1992, 1993, 1996ab, 2000ab, 2001ab)

BSC Is a Strategic Management System

Some literatures regard the BSC as the integrated management control system (Clinton and Hsu, 1997). And Atkinson et al. (1997) positioned that the importance of BSC is that it ties strategy, process and managers together and, in so doing, provides an integrated system of planning and control. Kaplan and Norton (2001ab) proposed that BSC is transforming from performance measurement system to strategic management system.

BSC Emphasizing the Cause-And-Effect Relationships

In these years, Kaplan and Norton (2000ab, 2001ab) develop the tool of "Strategy

Map" for BSC's adopters to communicate both their strategy and the processes and systems that will help them implement that strategy. Strategy maps show the cause-and-effect links by which specific improvements create desired outcomes. And in their latest book "*The Strategy-Focused Organization"*, from their practical consulting experience, Kaplan and Norton presented some cases that using strategy map as a tool of mapping, testing, communicating, and implementing strategy successfully.

But in Malmi's (2001) research, they performed some interviews in 17 Finnish companies that adopted BSC. This research found that BSC are used in two ways. The first is as a method of approaching MBO. The second is to use BSC as an information system. And they found that the idea of linking measures together based on assumed cause-and-effect relationships was not well understood by the early adopters of BSC. The above observation may fail the BSC implementation without considering the problems of "BSC measures lacking cause-and-effect relations (Olve et al., 1999)".

"Too Many Measures" or "Overlooking Some Critical Measures" Decreasing the Effectiveness of BSC

Some literatures mentioned the issue of "too many measures may cause the BSC implementations failed "(Ittner and Larcker, 1998; Lingle and Schiemann, 1996; Olve et al., 1999). Lipe and Satlterio(2000) use experiment method to examine judgmental effects of the BSC and find that unique measures in a business unit's BSC may be under weighted in performance evaluation. The result that unique measures are disregarded in the *ex post* performance evaluation of a business unit's manager has significant implications for the unit manager's *ex ante* decision-making strategy. And Kaplan and Norton (1996b) note that lagging measures are often rather generic, while leading measures are more likely to be customized for each business unit. Thus, evaluators who focus on common measures may largely overlook or disregard leading measures. Underweighting nonfinancial and leading measures undermines the goals of the BSC, which was expressly designed to incorporate such measures into managerial thought and decision-making (Kaplan and Norton, 1996ab).

Find the Pitfalls and Commandments of Developing the BSC, and Suggest Some Management Principles.

Some literatures showed that the BSC involved adopters into a complex system of organizational change. Including the change of clarifying vision, formulating strategy and objectives, communicating strategy, the budgeting system and resource allocation, strategy implementation, performance evaluation and reward system, and reviewing

strategy and learning et al.

Lewy(1998) claims that 70% of scorecard implementations fail. Professor Lewy and Lex du Mee of KPMG Management Consulting perform some research by using European companies as case studies. The research showed the ten commandments of BSC implementation. And then following the above observation, MuCunn (1998), as the leader of KPMG Management Consulting in the UK, proposed an eleventh commandment: "Do not start implementing BSC unless it is known what is hoped to be achieved".

Rousseau and Rousseau (2000) focused on why the BSC has not always managed to deliver the required results. And they identified several pitfalls of the BSC and provided an integrated way to solve these problems.

In order to solve the problem of failing to achieve the goal of developing the BSC, some literatures formulated some management principles, processes, and stages (Chow et al., 1997). According to the above viewpoints, the direction of successful BSC implementation suggested by those authors is much more similar to the latest ideas of Kaplan and Norton (2000b).

1. Translate the Strategy to Operational Terms: using the strategy map to clarify the hypothesis of strategy and to communicate and test the cause-and-effect relationships of strategy.
2. Align the Organization to the Strategy: using aligned strategic themes and priorities to break through the barrier of functional organization
3. "Make Strategy Everyone's Everyday Job", "Make Strategy a Continual Process", and "Mobilize Change through Executive Leadership" show that the BSC involved organizations into a complex system of organizational change, and they need everyone's commitments and continuous change.

This research is focused on the complexity system of developing the BSC. The complexity system is including the issue of changing the objective systems, the strategy management system, the performance evaluation system, the reward system, and organizational learning system. And such a system may mislead the managers to make wrong judgment and wrong decisions. Therefore, in order to enhance the effectiveness of developing the BSC and to achieve the goal of the BSC successfully,

we try to explore the complexity of developing the BSC by case study method.

Rethinking the Process of Developing and Implementing BSC from a Feedback Loops Perspective

In a holistic view, the process of developing and implementing the BSC is a goal seeking feedback mechanism. By setting the goal and recognizing the reality, we find the gap between the expected performance and reality, and then we can have some plans and actions to decrease the gap. After that, the current reality improved, and the iterative process continues.

We can realize that there are multiple loops in the above feedback mechanism, including self-reinforcing feedback loops and goal-seeking feedback loops. And when we considering another element "feedback loop with delay", we can be sure that the dynamic complexity (Senge, 1990; Sterman, 1994, 2000) and the counterintuitive behavior (Forrester, 1975) would make the decision makers not be able to understand the whole systems and mislead them to make wrong decisions that might cause the implementation of BSC to fail.

This research explores the complex system of developing BSC from a feedback loops perspective. The System Dynamics emphasized the multi-loops, multi-state, nonlinear character of the feedback systems (Forrester, 1961), and it is to recognize the underlying structures of systems and to find the high leverage policies (Lyneis, 1980; Morecroft, 1985; Wolstenholme, 1990; Richardson, 1991; Coyle, 1996). In this research we adopt the Qualitative System Dynamics (Wolstenholme, 1990; Coyle, 1996; Vennix, 1996).

This research reviewed some literatures about developing BSC from a feedback loops perspective to understand and manage the dynamic complexity. According to some literatures review, Akkermans and Oorschot (2002) find two advantages and five limitations about BSC. The advantages are "Checking just a few numbers" to lead manager to focus on critical indicators, and the second "Bridging the gap between different fields" to combine different aspects of a company into one scorecard and facilitate strategic conversation. The limitations are "Unidirectional causality too simplistic (Nørreklit, 2000)", "Does not separate cause and effect in time (Nørreklit, 2000)", "No mechanisms for validation", "Insufficient between strategy and operations", and "Too internally focused". The before-mentioned view concerned that the cause and effect linkages of developing BSC would generate the dynamic complexity to have impact on the BSC's effectiveness. And Akkermans and Oorschot advocate the use of system dynamics as a method to overcome the limitations to

current BSC theory.

Sterman et al. (1997) built a system dynamics simulation model based on the BSC used at Analog Devices, Inc. (Kaplan, 1990) The model helped to explain why Analog experienced difficulties initially translating dramatic improvements in the BSC's operational measures into improved financial performance. (Kaplan and Norton, 2000b) The reason is the dynamic complexity that caused by multiple loops with delays and nonlinear, intangible factors (for example: morale) generated critical impact, difficulty in dynamic aligning resource allocation. And by SD modeling we can have a deep understanding about the complexity we faced in the system of developing BSC.

Wolstenholme (1998) proposed that SD is being used to support the design, testing and use of BSC. The scope to apply a SD approach lies in three areas. The first is to use a very generic model in the visioning stage across all BSC perspectives. The second is to create specific sub models within each perspective that can support systems thinking by combining four perspectives. The third is to create a specific high-level model to assess the magnitude of the trade-offs in performance measures and hence shed some light on the most significant measures. Therefore, SD models can allow insights to develop and lead to both the definition of alternative measures that may become more important in the future.

Olve et al. (1999) integrated the fields of SD and BSC to develop the third generation by building SD simulation models. The above can provide a structure that helps managers to identify and understand the cause-and-effect relationships among BSC strategy objectives and actions, some tests of future results by introducing simulation into the BSC process, a foundation for learning by reflecting the strategy in holistic view, and a basis for strategy discussion.

Sloper et al. (1999) showed that BSC implementations often fail (up to 70% fail to achieve management expectations). Some factors of failures are that "practitioners separate the sectors in developing BSC for each, and fail to re-capture the holistic view", "BSC is intuitive simple and elegant, implementers tend to underestimate the difficult and complexity of generating a good BSC", and "Even experienced managers have great difficulty in understanding the implications of change in multiple interrelated decision variables". That is to say developing the BSC could lead organizations into a complex system of generating multiple feedback loops with delays and resource constrains. Therefore, Sloper et al. suggest that applying systems concepts in all aspects of the design and development of a BSC is important.

Roy and Roy (2000) propose the system dynamics as a tool to support the BSC process. SD can support to understand the complex system of developing BSC, to test the strategy before implementation, and to simplify the communication of the BSC strategy.

After reviewing the above literatures, we recognized that the dynamic complexity

generated by the complex cause-and-effect relationships, the trade-offs among multiple objectives and measures, the resource and capacity constraints, and the time delays. And we believed that the dynamic complexity might mislead the decision maker to focus on short-term profit not for long-term development, to generate misperceptions of feedback information, and then to perform wrong strategy to allocate resources. The before-mentioned issue must decrease the effectiveness of developing and implementing BSC. Therefore, in order to enhance the long-term effectiveness of developing BSC, we need to use the feedback loops perspective and system dynamics method to clarify and inquire the complex systems of developing BSC. By the above process, we can facilitate the organization to implement BSC effectively.

Case Study: The Nova Scotia Power Inc. NSPI

Case Description

The Nova Scotia Power Inc. (NSPI) is the primary electricity supplier in Nova Scotia of Canada for almost 80 years. NSPI is a regulated, investor-owned public utility. In 1996, David Mann as the CEO of NSPI, was faced with the challenge of positioning NSPI for a new world of deregulation, not increasing price, and cost pressures. In 2000, NSPI was providing 97% of the generation, 99% of the transmission and 95% of the distribution of electricity in Nova Scotia (Kaplan and Norton, 2000b; Emera Inc. 2000 Annual Report, Nova Scotia Power Inc. website).

Even though NSPI was faced with challenge of managing strategy from 1996 to 1999 the performance was impressive (Kaplan and Norton, 2000b)*•Sales volume increase of more than 13% •Productivity improvement of nearly 36% (kilowatt-hours of sales per employee)•Deliver the higher revenues with 20% fewer employees•Power interruptions and customer hours without power decreased to record low levels•Customer satisfaction increased steadily• Accidents dropped by 25% to a record low•Environmental incidents decreased• Employee commitment surveys showed large year-to-year increases*

NSPI's Vision

NSPI's vision is to be the customer's choice in energy and services and it continues to invest in new technologies and services to further enhance reliability and increase efficiency. (Nova Scotia Power Inc. website, http://www.emera.com)

Strategic Analysis

1. Focusing on operational excellence and cost management without an electricity price increase in Nova Scotia from1997 to 2000. (Emera Inc. 2000 Annual Report)

1.1 Manage Costs: controlling fuel cost; increasing utilization of generation facilities.

1.2 Customer focused strategy: investment OM&G expense to ensure customer reliability (including maintenance expenditures); investment in new IT and building customer processes and capabilities; partnering with customers.

1.3 Strong earnings and cash flow, and reliable dividends appealing to investors.

1.4 Taking responsibility for communities and environment.

2. Developing Balanced Scorecard (Kaplan and Norton, 2000b)

2.1 Formulate a new strategic plan: developing by senior management team and a strategy consulting firm.
2.2 Build a strategic measurement system: to guild and gauge the success of the plan.
2.3 Unite the plans of the SBUs and lead them to work toward the same overall goals.
2.4 Developing scorecard based on four perspectives.
2.5 Starting from the corporate-level scorecard.
2.6 Aligning the strategic themes, strategic objectives, measures, and action plans.
2.7 Communicating and linking BSC strategy.
2.8 Incentive compensation plans linked to the BSC.

Table 1: NSPI developing BSC four perspectives

Manage Costs		Build Customer Loyalty	
Objective	Measure	Objective	Measure
Environmental Performance	1. Environmental performance index	Increase Customer Loyalty	Customer loyalty rating
Operating Efficiency	1. Total manageable costs/kWh sold 2. Fuel cost/kWh generated	Customer Growth and Retention	Sales volume (GWh sold)
Optimize Capital Utilization	1. Percentage of actual capital spending economically justified 2. Percentage of 2000 ACE plan approved on basis of economic justification	Reliability	Outage performance index
Build the Business		**Develop Employee Commitment**	
Objective	Measure	Objective	Measure
Maintain Confidence of Investment Community	Net earnings	Safety	1. All-injury frequency rate 2. High potential incident ratio 3. Reduction in public electrical contact incidents
		Competency Attainment	1. Percentage of employees with development plans 2. Percentage of employees with development plans achieving one or more development goals
		Employee Commitment	Employee commitment survey results

Source: Kaplan and Norton(2000b)

Assume the Pattern of Behavior of the KPI

After reviewing the secondary data of NSPI (Emera Inc. 2000 Annual Report, Nova Scotia Power Inc. website) and its experience of developing BSC in Kaplan and Norton's book (Kaplan and Norton, 2000b), we try to assume the pattern of behavior of the key performance indicators. We choose the impressive performance that NSPI made by operational excellence and developing BSC from 1996 to 1999. We assumed the pattern of behavior of KPIs as followed.

- *Sales volume increase of more than 13%*
- *Productivity improvement of nearly 36% (kilowatt-hours of sales per employee)*
- *Customer satisfaction increased steadily*
- *Employee commitment surveys showed large year-to-year increases*

- *Deliver the higher revenues with 20% fewer employees*
- *Power interruptions and customer hours without power decreased to record low levels*
- *Accidents dropped by 25% to a record low*
- *Environmental incidents decreased*

Figure 1: Pattern of Behavior of Key Performance Indicator

Adapted from Kaplan and Norton(2000b)

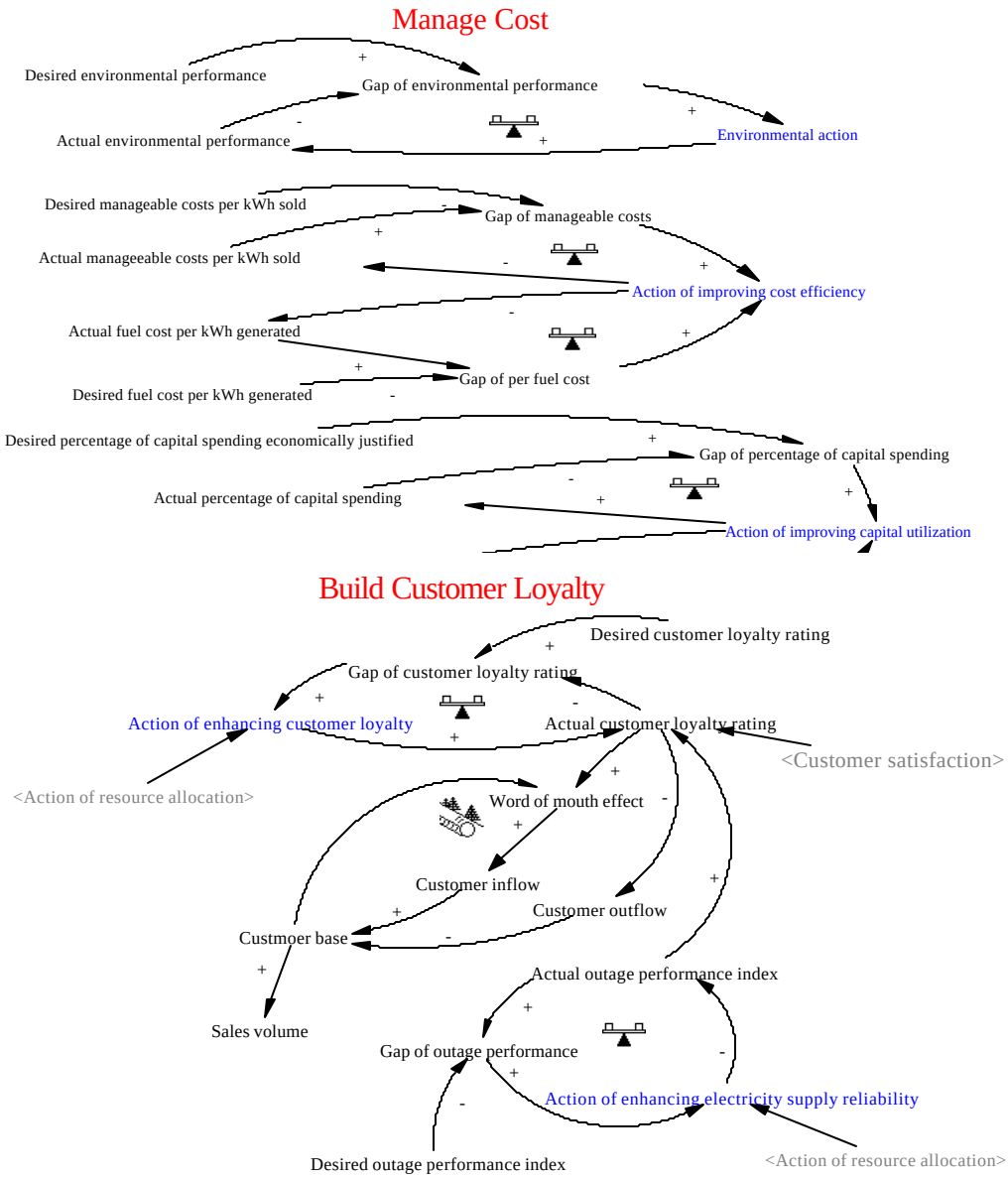
Strategic Analysis from a Feedback Loops Perspective

This research rethinks the records of Kaplan and Norton's book (Kaplan and Norton, 2000b) about NSPI developing BSC and performs reviewing NSPI's 2000 annual report and information on its website.

First of all, we try to map the dynamic assumption with feedback loops to represent the NSPI's strategic objectives in BSC's four perspectives individually. For example, NSPI focused on the strategic theme "Manage Costs". One of the strategic objectives was enhancing the operating efficiency. And NSPI needed some measures to monitor the performance. The description above can also translate into some negative feedback loops to represent the BSC's nature of goal seeking as followed Figure 2.

1. Mapping the strategic theme "Manage Cost" of BSC (Adapted from Kaplan and Norton, 2000b)

We translate the strategic theme (*Manage Cost*) of NSPI's BSC into feedback loops as followed Figure 3. There are some goal-seeking feedback loops to set desired performance, aware the gap between desired performance and reality, and implement some actions to improve the current condition.



3. Mapping the strategic theme "Build the Business" of BSC (Adapted from Kaplan and Norton, 2000b)

We translate the strategic theme (*Build the Business*) of NSPI's BSC into feedback loops as followed Figure 5. We represent one goal-seeking feedback loop regarding to enhance earnings and cost competitiveness. And we also construct some cause-and-effect relationships and one self-reinforcing feedback loop regarding to the confidence of investment community.

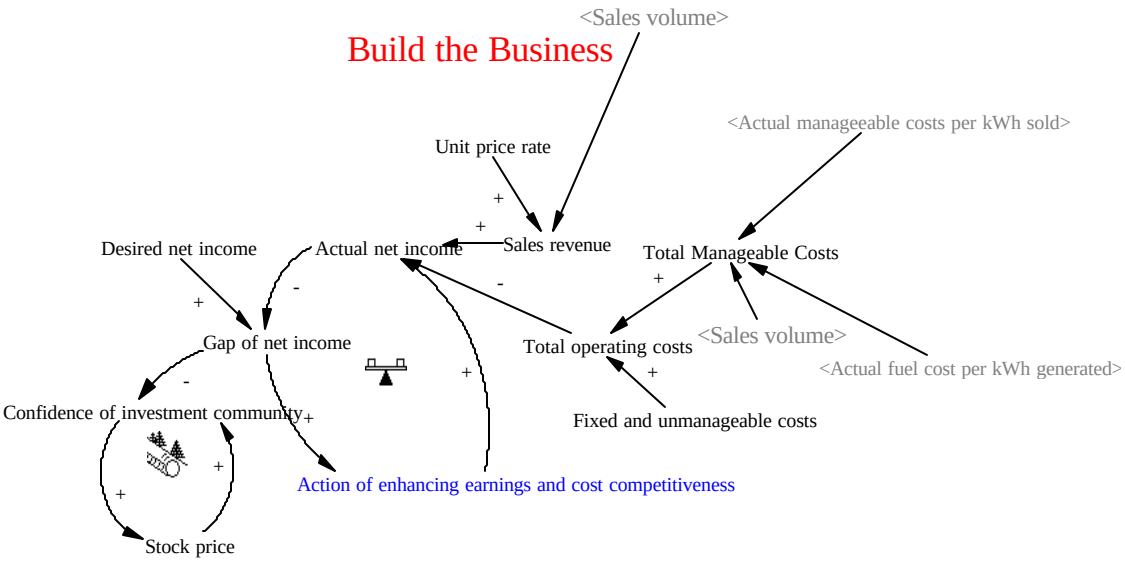


Figure 5: Mapping the strategic theme "Build the Business" of BSC in feedback loops Adapted from Kaplan and Norton (2000b)

4. Mapping the strategic theme "Develop Employee Commitment" of BSC (Adapted from Kaplan and Norton, 2000b)

We translate the strategic theme (*Develop Employee Commitment*) of NSPI's BSC into feedback loops as followed Figure 6. We represent two goal-seeking feedback loops regarding to improve safety of work environment and enhance competency of employees. And we also construct some cause-and-effect relationships. The less actual injury or incident frequency rate affects the more employee trustfulness and satisfaction, and then enhances employee commitment, and the more employees involving development plans affects the more employee motivation, and then increases employee commitment.

Figure 6: Mapping the strategic theme "Develop Employee Commitment" of BSC in feedback loops
Adapted from Kaplan and Norton (2000b)

Integrating Four Perspectives of BSC with Feedback Loops

After mapping the feedback loops of BSC's strategic themes, objectives, and actions individually, we need a holistic view to understand the interconnectedness of NSPI's strategy. And we integrate Figure 3 to 6 and represent the whole complex system as followed Figure 7.

As Figure 7 showed from ***Casual Link 1*** to ***Casual Link 4***, we could capture the whole picture of NSPI's BSC strategy. And we tried to use feedback loops analysis to understand the nature of the dynamic complexity.

The area of ***Casual Link 1*** focused on the more employee commitment affecting the more effectiveness of strategic action, the more improving the quality of product and service, and then the more satisfying customers and enhancing customer loyalty.

The area of ***Casual Link 2*** focused on the more satisfied customers increasing sales volume and sales revenue, and improving the financial condition.

The area of ***Casual Link 3*** focused that the more enhancing net income and improving the utilization of capital, increased disposable capitals and enabled the actions of resource allocation (including A: action of enhancing customer loyalty, B: action of enhancing electricity supply reliability, C: action of improving safety, and D: enhancing competency of employees). By continuous investing in these actions, NSPI can create the reinforcing feedback loops to start the growth engine.

The area of ***Casual Link 4*** had no significant impact on financial management and resource allocation only when NSPI had enough disposable capitals. But when NSPI fell into financial constraints, the more financing capital needs increased liabilities with interest and interest expenditures. And then interest expense increased depletion of disposable capitals. The above casual linkage was a self-reinforcing feedback mechanism that generated financial stress circularly.

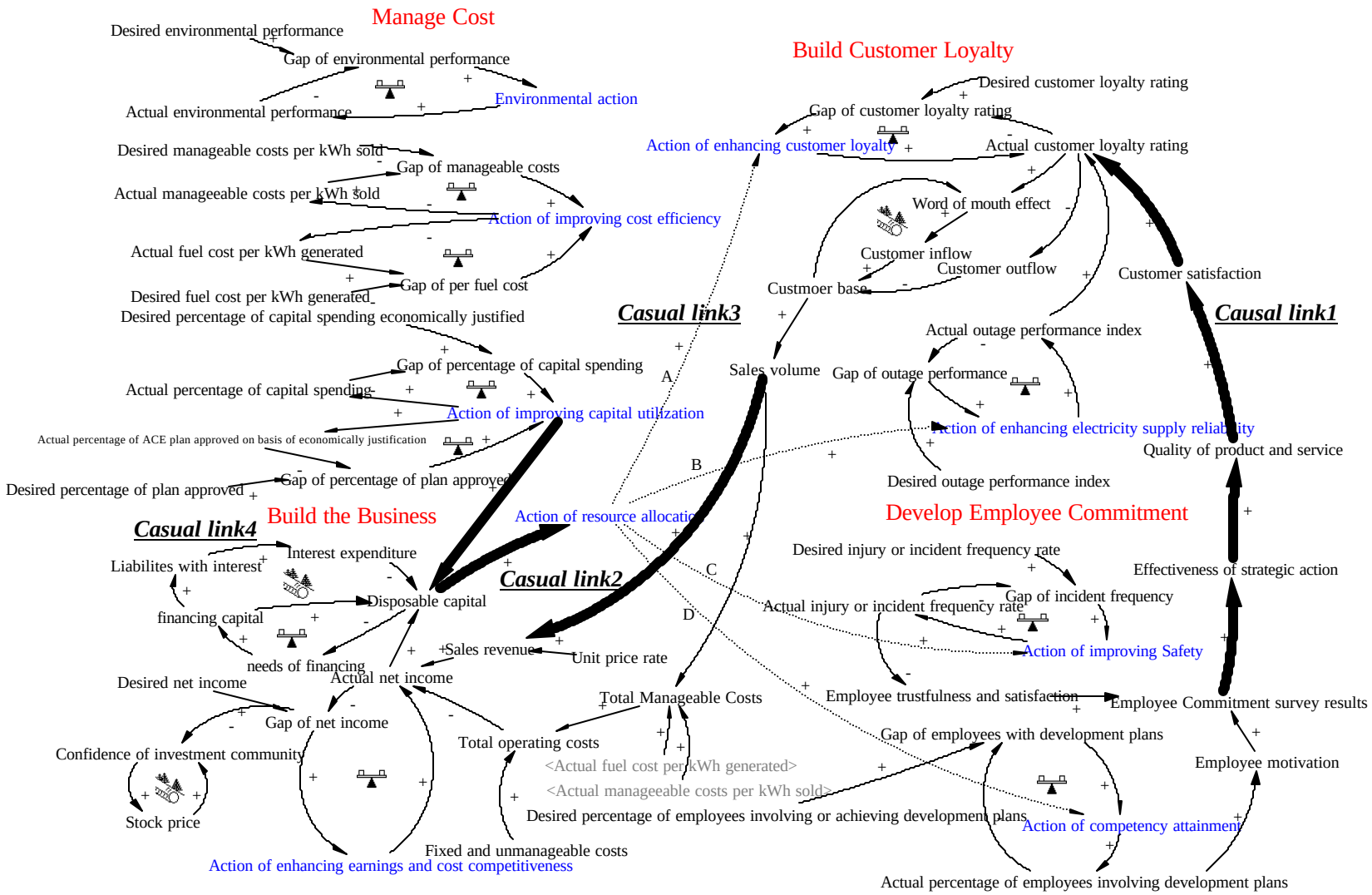


Figure 7: Integrating N SPI's BSC Strategy in Feedback Loops

Adapted from Kaplan and Norton (2000b)

Finding Underlying Structure

1. NSPI's Growth Engine

From 1996 to 1999, the excellent performance was generated by a series of strategic objectives, measures, and actions, which interconnected with one another. And the interconnectedness relationships could be translated into feedback loops to explain the pattern of behavior of KPI's excellence. We recognized the driving force that pushed NSPI's investment and performance. We called such a driving force as "Figure 8: NSPI's growth engine". And Figure 8 was extracted from Figure 7.

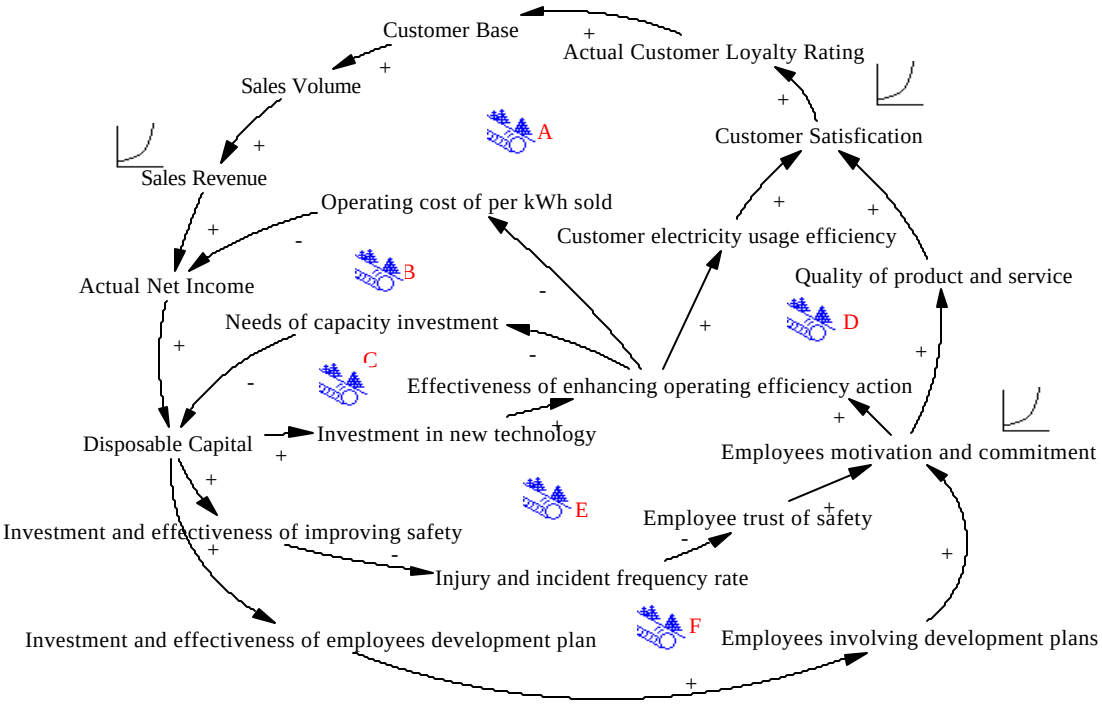


Figure 8: NSPI's Growth Engine (extracted from Figure 7)

As Figure 8, from a feedback loops perspective, there are some self-reinforcing feedback loops (A to F). Aligning Loop A, B and C is the driving growth force to push NSPI's goal setting and investment in some critical resources or competence of financial, customer, and internal process perspective. And the above is not enough. Enhancing the quality of earnings, allocating resources to some critical investments, enhancing customers satisfaction and loyalty, and bringing more financial resources, the above circle must be supported by the employees commitment or growth and learning perspective. The feedback loops (Loop D, E, and F) are critical to start the driving force of Loop A-C. And the growth engine drove the excellent performance from 1996 to 1999, and it is composed of some self-reinforcing feedback loops (Loop A-F)

2. Aligning Resource Allocation, Or Meeting the Limits

In Figure 8, the growth engine needs strategic alignment in all of the financial, customer, internal process, and learning and growth perspective. Therefore, we can simulate the situation "what if these four BSC's perspectives are not aligned", and "what if the resources allocation are not aligned in investing the capacity of safety and employees development".

As followed Figure 9, the growth engine encountered ***Limit 1*** and ***Limit 2*** represented that NSPI didn't sufficiently invest resources and accumulate capacity to drive the self-reinforcing feedback loops of employee commitment. So, the balancing feedback loops of employee commitment might limit the growth of financial and customer satisfaction performance.

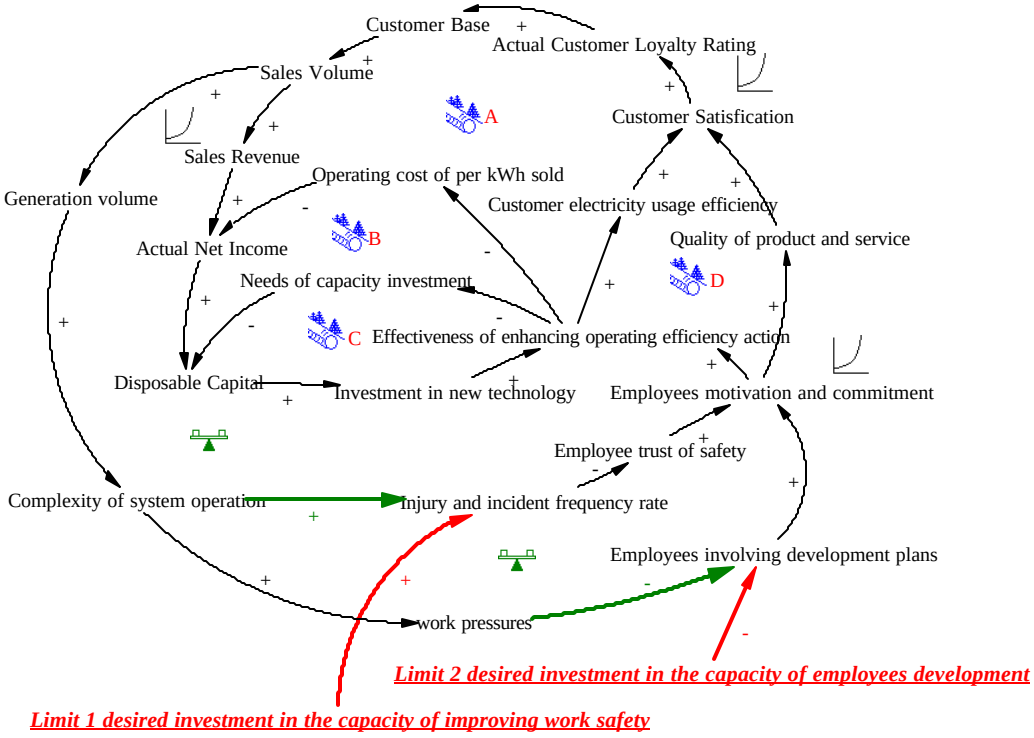


Figure 9: Meet the Limits to Growth

According to Forrester's (1964) opinion "…the solution to product growth lies in the capital investment policies", we realized that the growth engine but under investment would limit the driving growth forces. And the solution of this feedback mechanism should focus on the investment in critical resource and capacity, and anticipate preparing the investment.

3. Considering the Impact of Delay

Figure 10 considers the cause-and-effect relationships with the impact of delays. Delay A to Delay E are including information processing delay, decision delay, capacity and new technology finished delay, experience learning delay, customer and employees' cognitive delay et al.

The above delays accompany the self-reinforcing feedback loops, which have to increase the difficulties in aligning the dynamic of strategic objectives and actions. And lack of dynamic strategic alignment will generate the limits to growth. At last, the effectiveness of developing BSC must decrease and the experience must fail in implementation in the long run.

We also consider the feedback structure as some goal seeking feedback loops with delays. Therefore, the goal seeking process with delays may mislead the decision makers to have wrong information judgment. Not enough patient to execute actions failed to achieve the strategic goals. Overreacting and making wrong decisions will make the system unbalancing, oscillating, and fixing that fail.

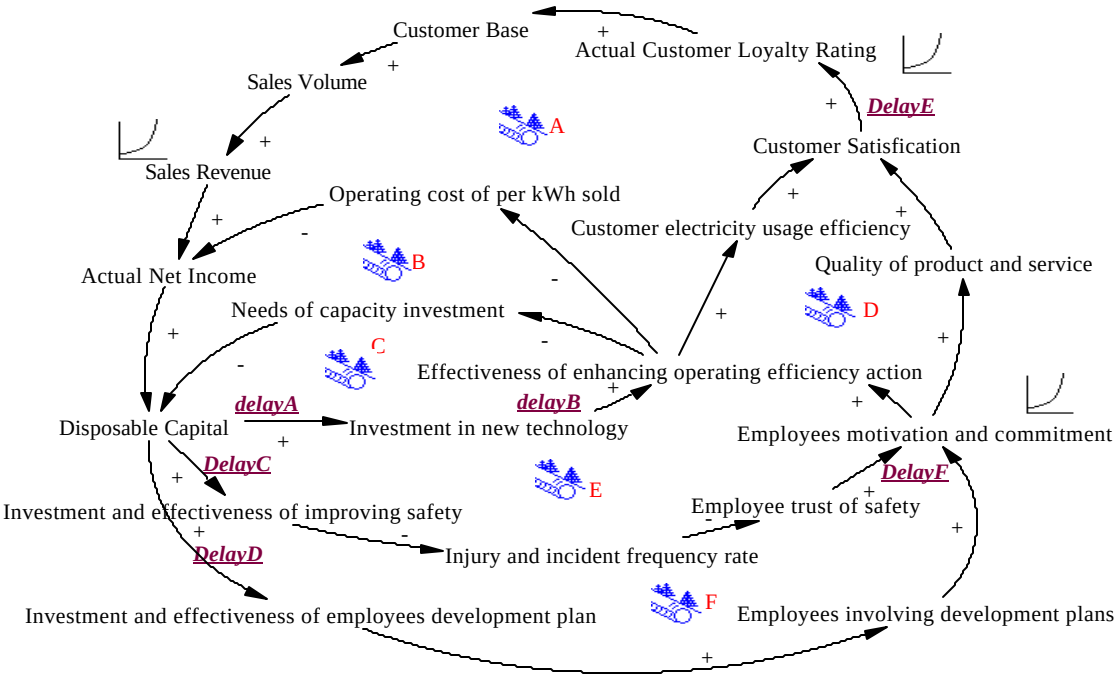


Figure 10: Feedback Loops with Delays

We also concerned the delays of capacity investment approving, building, and finishing might cause the construction cycle (Ford, 2001, 2000, 1999) in the long run. And that will bring the system into an unsteady structure with capacity constraints and electricity price oscillation.

Another issue is concerned about how to recognize the leading indicators of BSC. As we know that BSC's learning and growth perspective is the leading perspective.

But when we consider the leading indicators as desired objectives, we must realize that delays accompany the goal achieving process. Some leading performance drivers which accompanied delays, such as employee competence accumulation, shaping employee commitment and organizational culture, and full utilization of new capacity and technology, have to be considered the difficulties in understanding and managing the feedback loops with delays into the decision making process.

4. The Mechanism That Implementing BSC and Causing Organizational Change Smoothly

As the structure of Figure 11, firstly, NSPI's top management developed a corporate-level balanced scorecard. And in order to communicate the BSC strategy with lower levels and employees, NSPI distributed copies of BSC to every manager and used the company newsletters, presentation in meetings, and forums. Therefore, the more resources of strategic communication and linkage affected the higher degree of lower level recognizing BSC, and then affected the higher degree of lower level involvement, and then affected the more opportunity of strategic conversation and interaction, and then continued the circle. As we knew that is a self-reinforcing feedback loop, and with delays. The above is critical to implement BSC successfully and also including the concept of double loop learning to make NSPI's managers understand BSC's complexity deeply.

Another key factor is that the performance measures of BSC is precise and provides the milestone stage by stage. That can facilitate monitoring the performance result, making the performance evaluation evidentially, and getting the notice and support of top level. And the above might start the self-reinforcing feedback loop to support the top level and employees commitment to BSC.

The last key structure was that NSPI had incentive compensation plans linked to the BSC. That would reinforce the lower level and employees to involve in the BSC and support the commitment to change the planning and control system smoothly.

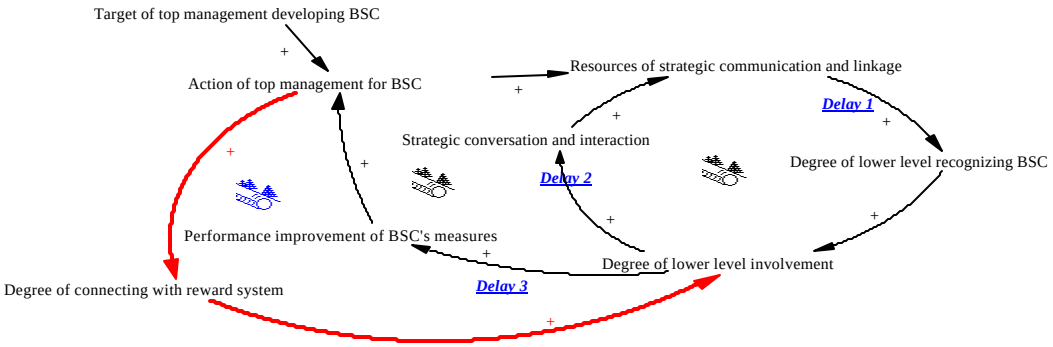


Figure 11: The Mechanism That Implementing BSC and Causing Organizational Change Smoothly
Adapted from Kaplan and Norton (2000b)

Conclusion

The Dynamic Pitfalls of Developing BSC

1. The driving force of growth engine is not strong enough.

The BSC is intended to balance the manager's focus of measuring performance and finding the strategic performance driver. And as Kaplan and Norton said that the perspectives of the BSC don't have to be four. Every company can develop their own perspectives of BSC. But, how can we be sure that we got enough perspectives and objectives?

In this research, we proposed that the interrelationship among the BSC's perspectives, objectives, and actions should be noticed. Only when this interrelationship involves the driving force of growth engine, and strong enough, we can believe that the BSC's strategic perspectives are enough. We also called such a growth engine as the self-reinforcing feedback loop.

According to this research performing the NSPI's case study, we proposed some underlying structures (Figure 8 to Figure 11) to describe and understand the dynamic complexity of developing the BSC. There are some possibilities to cause the situation of "the driving force of growth engine is not strong enough".

1.1 Not enough perspectives, objectives, and actions cut the cause-and-effect relationships and the feedback loops. That will break the completeness of BSC strategy and weaken the driving force.

1.2 Too much concern on financial, customer, and internal process perspective; and overlooking the employee commitment and learning and growth perspective.

1.3 Didn't anticipate managing the limits of capacity, competence, and resource constraints. So encounter the limits to growth.

1.4 Some resource accumulations are with time delays. And without dynamic alignment of resource allocation and accumulation, we could not balance and align the driving forces that interconnected with one another.

2. The difficulties of dynamic strategic alignment.

From a feedback loops perspective, every BSC's strategic objectives had at least one goal seeking feedback loop. By integrating the NSPI's four strategic themes with Figure 7, we discovered a complex system. Such a complex system needed diverse

investments in strategic plans and actions. Therefore, the resource management became more difficult to keep alignment in space and time.

3. Conflicts among strategic objectives.

The conflicts among strategic objectives caused from two or more goal-seeking feedback loops that had trade-off. Therefore, in some cases we got success in some indicators and failed in another. In some other cases we fell into oscillation. And in more dynamic views, we realized that sometime the trade-off was in short term, and we could bring all indicators improvement in the long run only when we recognized the dynamic alignment and allocated resources in proper timing continuously.

4. Growth and underinvestment in capacity causes limits.

The above-mentioned "capacity" is a level variable to represent including the capital capacity, the human competence, the service capacity, average skill capacity, and workforces to share the work lording. The above all need sustaining investments in accumulating the capacity stock. Therefore, we must align our strategic actions in managing diverse "critical flows" that could generate the "rate-in" effect to increase the level variables, and decrease the "rate-out" to avoid the depletion of capacity. Only when the diverse capacities are sufficient, the limits would not constrain the growth. And following Forrester's (1964) opinion, the principle of managing the feedback mechanism of growth and underinvestment in capacity should focus on the investment in critical resource and capacity, and anticipate preparing the investment.

5. Self-reinforcing feedback loops with time delays increasing the difficulties of resource management.

This research mentioned "the growth engine" which was composed of some interrelated self-reinforcing feedback loops. These self-reinforcing feedback loops were composed of some goal-seeking feedback loops that represented the BSC's strategic objectives and actions. As the cause-and-effect links of the self-reinforcing feedback loops are with time delays, managers may misperceive the information feedback and become not enough patient and visionary for long term resource planning. And that also would encounter the problem of lacking alignment to constrain the systemic health and growth.

6. BSC's strategic objectives formulating the balancing feedback loops with time delays cause oscillation and difficulties in capacity alignment.

As the cause-and-effect links of the balancing feedback loops are with time delays, the strategic goal achievement process caused manager's misperception of information feedback. The whole system became a more unsteady system just like that Ford (2001, 2000, 1999) said the construction cycle, which appeared an unsteady structure with capacity constraints and electricity price oscillation.

Besides, the balancing loops with delays made more difficulties in capacity alignment.

7. Ignoring the reinforcing feedback loops of causing organizational change smoothly.

As Figure 11 showed, there are some requirements to push members' acceptance of BSC and organizational change smoothly. Including the support and trust of top management, strategy communication and linkage, time and resource budget for strategy conversation, lower level and employees involvement and commitment, sustaining information feedback for monitoring the performance and preparing for adjustment actions, needs of seeing some improvement of indicators, properly designing a reward system for performance evaluation et al. The interconnectedness of the above factors is composed of some self-reinforcing feedback loops with delays. And once lacking one of the requirements or overlooking the time delays, the feedback loops won't sustain to drive the organizational change. And the implementation of the BSC failed.

The Dynamic Key Success Factors

1. Driving the growth engine needs multiple resources allocation and alignment.

As Figure 3, 4, 5, 6, 7 showed, the NSPI's BSC strategy was to achieve a series of strategic goals. And then we clarified that the NSPI's BSC strategy brought the synergy and drove the growth engine as Figure 8. The above was NSPI's top managers who intended to achieve and realized from 1996 to 1999.

From a feedback loops perspective, the BSC strategy that managers intended to achieve might bring the intended consequences, but sometimes cause the unintended consequences. In this research, we use Figure 9, 10 to simulate the unintended consequences that may limit the growth by underinvesting some critical resources and increase the difficulties of resource allocation and accumulation in proper timing.

In order to manage the dynamic alignment in resource allocation, we need to explore and understand the complex system of BSC strategy by feedback loops analysis. By mapping, testing, and communicating the cause-and-effect relationships of the growth engine, managers can test the strategy hypothesis collectively. To ensure the sufficient driving force, testing the synergy of BSC's strategy and checking possible capacity limits and some feedback loops with delays are both required. To relieve the capacity limits, first of all, we need that managers take this noticed, find the critical constraints, set the desired target, and have some actions to improve the current reality. At the same time, by feedback loops analysis, considering the time delays of stock accumulation and investing enough resources can discover the strategy of dynamic alignment. This aligned strategy can direct the resource allocation and accumulation in proper timing and place.

2. Building the reinforcing feedback loops of creating organizational change smoothly.

As Figure 11 showed the NSPI's experience of successful implementation, we discover some management systems to support the BSC implementation. Support of top management, strategy communication and linkage, time and resource budget for strategy conversation, employees involvement and commitment, sustaining information feedback, encouraging by indicator's improvement, and the proper reward system et al., the above are the necessary conditions or key success factors for developing and implementing the BSC. From a feedback loops perspective, these key success factors generate some self-reinforcing feedback loops and drive the force of achieving objectives, only when we understand and manage the dynamic nature of Figure 11's feedback loops with delays. First of all, support of top management and

continuous communication and conversation with members create the main self-reinforcing feedback loop, and that open the gate for accepting and experimenting the BSC. And the most important thing is this main self-reinforcing feedback loop needs time and resource budget for a long time.

Secondly, rebuilding members' perception of "some indicators being monitored by collective", "finding the critical indicators is important", "open for experimenting and testing", "believing the BSC, we also need some performance", and "wanting for seeing some improvement", the above can accumulate the perceived level of involvement and commitment. And as Figure 11, this self-reinforcing feedback loop is also with delay.

The last self-reinforcing feedback loop is about connecting the reward system with the BSC implementation. We believe that the timing issue of connecting the reward system is more important than the issue of connecting or not.

3. Resource management needs dynamic alignment: antedate to invest in capacity and competence

From a system dynamics view, in order to push the growth of driving the self-reinforcing feedback loop, managers need to envision pattern of growth and predate to accumulate the capacity and competence. Investment in tangible capacity (ex: capital capacity, service capacity) and intangible capacity (ex: quality, capability, skill level) are both needed. It is more complex that the stock of one of the capacity has feedback relationships with the stock of some other capacity. And the accumulations of these levels are usually with time delays. Therefore, dynamic resource management becomes more difficult.

By feedback loops analysis, we can firstly find some capacity limits which needing resource investment. Secondly, exploring the impact of time delay to find the time budget plans and to simulate the dynamic resource constrains, the above can support managers to use system dynamics and to test the BSC strategy in more dynamic view.

The last thing is to decide the priorities of resource allocation by focusing on the most critical constraints in feedback loops analysis.

4. Considering the dynamic impacts of time delays.

Feedback loops with delays may mislead managers to perceive the information feedback which being not in a systemic view, and to result in wrong decisions.

The most important thing is to recognize the critical points and cause-and-effect

links that having time delays, and to find out the length of delay time. From the above delay time information, we can try to simulate the interconnectedness of feedback loops and realize the nature of dynamic forces. When some goal-seeking feedback loops with delay dominate the feedback structure, the dynamic alignment of resource investment and capacity accumulation must be emphasized. Managing the time delays is to be patient, not to fall into fixing that fail, to monitor the indicators continuously, not to erode the goal, and to invest in diverse capacity in proper timing.

And when the self-reinforcing feedback loops with delays dominate the feedback structure, to drive the growth forces needs strong links among the cause-and-effect relationships. And managers must surpasses the capacity limits and antedate to invest in critical capacity.

5. Using SD to support testing and communicating strategy and to facilitate double loop learning from BSC strategy.

This research provided a theoretical framework for testing and communicating strategy and to facilitate double loop learning from developing and implementing the BSC strategy, as followed Figure 12.

Figure 12: Testing and communicating BSC strategy with system dynamics and facilitating double loop learning

In Figure 12, the upper circle represents the ordinary process of developing and implementing the BSC. And the learning and feedback process is more emphasized for finding the performance drivers and push managers to reflect the BSC's vision, strategic themes, objectives, measures, and actions.

The suggested framework focuses on the middle and lower circles. By using the system dynamics method to map, test, and communicate the BSC strategy. Management teams could map and test their BSC strategy hypothesis. By system dynamics computer model simulation or systems thinking, we could deeply explore the complex system behind the BSC strategy and performance indicators. And the use of system dynamics models and feedback loop analysis can facilitate operationalizing the BSC strategy management system.

Whenever we build a system dynamics model for BSC and find out some dynamic strategic insight in operational level, we could communicate the dynamic complexity of BSC with the other members. Therefore, we provide the mechanism of "team reflection and conversation", which must become the critical meeting and managers have to budget their time and resource for it. And we expected that this learning field get the effectiveness of double loop learning.

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