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**FACULTY OF GRADUATE AND
POSTDOCTORAL STUDIES**

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Understanding Key Performance Indicators Through Driver Measures

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Understanding Key Performance Indicators through Driver Measures

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Abstract

Performance management is a vital part of every organization for its success and long term survival in the current competitive global market place. An organization needs a sound performance management framework to analyze its data to make strategic and tactical decisions. The weaknesses in today's performance management frameworks are linked to their inability to integrate strategy formulation with implementation.

In our thesis, we introduce Driver Measure Models that can define cause-and-effect relationship between driver measures and Key Performance Indicators (KPIs) for effective performance management and strategic alignment. Driver Measure Models make the performance management more dynamic as the operational activities are linked to strategies.

Another contribution of the thesis is the identification of mathematical techniques to quantify relationships between KPIs and driver measures. Thesis makes an effort to show how mathematical techniques can be used for planning and forecasting outcomes while changing strategies. After conducting analysis using the mathematical techniques, organization can arrive at a set of operational tasks associated to driver measures which need to be executed to achieve its optimal result.

Finally, we identified the essential set of criteria that a performance management framework needs to address through a literature survey and a gap analysis of existing frameworks. We created an extension to the Balanced Scorecard framework based on

Driver Measure Models and support for the management of external factors to address these criteria and compared it to existing frameworks using a case study.

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1 Introduction

1.1 Thesis Motivation

Performance management is a vital part of every organization for its success and long term survival in the current competitive global market place. An organization needs a sound performance management framework to analyze its data to make strategic and tactical decisions. Bob Kaplan and David Norton, the creators of the Balanced Scorecard performance management framework and a proven methodology used for performance management, recently published in the Harvard Business Review that “breakdowns in a company’s management system, not managers’ lack of ability or effort, are what cause a company’s underperformance” [Kaplan and Norton, 2008]. They refer to a management system as the “integrated set of processes and tools that a company uses to develop its strategy, translate it into operational actions and monitor and improve the effectiveness of both” [Kaplan and Norton, 2008] and also point out that “the failure to balance the tensions between strategy and operations is pervasive”. They have also highlighted that various studies published in the past 25 years indicate that 60 percent to 80 percent of companies fall short of the success predicted from their strategies [Kaplan and Norton, 2008].

So where does the breakdown happen in a company’s performance management system? Why do 60 percent to 80 percent of companies fall short of the success predicted from their strategies? How do we balance the tensions between strategy and operations? We have come a long way from running reports to measure business operations based on

an operational data store (ODS) to using best-in-class Balanced Scorecards to analyze the strategic business performance. ODS reporting can help to analyze some parts of business operations. The scopes of these are limited to one or more departments and useful for tactical decision making. They do not provide a vision into a company's strategic performance management. The Balanced Scorecard can address these ODS reporting shortcomings. It can help to align business objectives to the vision and strategy of an organization. It can improve internal and external communications, and monitor organization performance against its strategic goals.

However, according to Lunger, more is needed. "The issue is that although organizations are spending a lot of time and money on implementing and evolving these systems, the systems are still failing to meet the needs of companies to accurately assess the drivers of strategic outcomes. Systems that enable a process to link the measurement and management of drivers to outcomes are the next generation of Business Intelligence (BI) and performance management technologies" [Lunger, 2008]. Performance management systems should be able to illustrate cause-and-effect relationships between operational and strategic objectives and processes. They should also be able to quantify these relationships.

1.2 Problem Statement

It is commonly agreed that the weaknesses in today's performance management frameworks are linked to their ability to integrate strategy formulation and implementation [Kaplan and Norton, 2000a]. The leading representatives of the scientific community and management practitioner surveys believed that the balanced measure

based performance management frameworks can overcome these weaknesses [Kaplan and Norton, 1996a; Eschenbach, 2001]. However, empirical evidence highlights that the current frameworks including the Balanced Scorecard do not meet that expectation [Ruhtz, 2001] and that these frameworks lack operational qualities and effectiveness [Krause, 2003]. For example, a study of the top 200 companies in Germany, of which 46% had implemented a Balanced Scorecard framework, reported that only a small percentage of participants felt that the Balanced Scorecard improved their planning and budgeting (12%), resource allocation (32%), strategic learning (31%) or bottom line (10%) [Krause, 2003]. Participants reported particular difficulties in developing cause-and-effect chains and in defining meaningful measures [Krause, 2003].

The Balanced Scorecard performance management framework reports measures from four different perspectives; financial, customer, internal business and innovation and learning perspectives. It reports key performance indicators (KPIs) from the above four perspectives for strategic performance management.

Financial and customer perspectives are measured as outcomes of a business. These perspectives are measured by transactional, generally historical, data which is stored in companies ERP and CRM systems. Internal business and innovation and learning perspectives are hard to measure. These are the strategic drivers for the financial and customer objectives. The data which is required to measure these drivers are not readily available in a consolidated system. In some cases they are not available at all.

Financial and customer perspective measures can be considered the key performance indicators of a business which are used to make strategic decisions. These

are lagging indicators and used to measure the outcome of a business. Internal business and innovation and learning perspectives measures, considered as leading key performance indicators, are used to measure the operative effectiveness in achieving strategic goals.

When a Balanced Scorecard is presented to an executive, how would the executive interpret these numbers? An executive can look at the targets and find out if the organization has met its goals. What happens if the numbers are below expectations? How would one be able to understand why the performance is poor? What drives these KPIs? What driver measures the organization needs to change to achieve the expected results? How can the executives make effective decisions to change strategies and objectives when necessary? Can they predict results based on the changes made? What are the relationships between these driver measures and KPIs? How do we quantify the relationship between KPIs and driver measures which drive the KPIs?

There is a real need to find a process which can link the driver measures to KPIs. Current BI infrastructure does not provide a process to identify and link the drivers which fuel the KPIs. If an organization can identify the drivers which affect the KPIs then it can start tracking them and be able to do data analysis on them. When an executive is making a strategic decision, if there is a framework to link the drivers to KPIs, executive can look at the drivers and see which drivers need to be changed to improve the KPIs. For an example, if one of the KPIs in a hospital is the “average waiting time”, one needs a process to identify what drives the waiting time. It could be the number of patients, doctors, beds, etc. One can plan, predict and forecast the waiting time when the values of

these drivers change if there is a framework to identify and quantify the cause-and-effect relationships between driver measures and KPIs. Such a framework could also be used to make appropriate strategic decisions to improve the waiting time.

1.3 Research Objectives and Contributions

The primary objective of this research is to develop a performance management framework which can link driver measures to KPIs. Current frameworks are not effective in linking driver measures to KPIs, which results in a lack of operational effectiveness. The Driver Measures Enhanced Framework we are introducing in the thesis is an extension to the Balanced Scorecard based on Driver Measure Models.

The Research contributions of this thesis are:

1) Identification of criteria that a performance management framework needs to provide to be effective based on research and a gap analysis of existing frameworks. In particular defining cause-and-effect relationships between driver measures and KPIs for strategic alignment and effective decision making and recognition of external factors as a fifth perspective were two gaps that needed addressing.

2) Creation of Driver Measure Models as means of addressing the gaps found in existing frameworks e.g. linking operational decisions to strategies, quantification of measure relationships. Driver Measure Models provide methodologies to define cause-and-effect relationships between KPIs and driver measures.

3) Identification of mathematical techniques to quantify relationships between KPIs and driver measures in a Driver Measure Model. This is essential for planning,

predicting and forecasting outcomes while changing strategies. Mathematical techniques are vast and these techniques are not discussed in details in the thesis. The idea is to show how these techniques can be applied to performance management. In depth analysis of mathematical techniques and how they can be applied to performance management are suggested for future study. Quantification of measure relationships using mathematical techniques allows an organization to recognize the sensitivities of the cause-and-effect relationship between KPI and its driver measures. After conducting analysis using the mathematical techniques, organization can arrive at a set of actions which are associated to driver measures and need to be executed to achieve its optimal result or goal. This can help executives to make better decision by selecting the most effective drivers to improve performance.

4) Development of a performance management framework which supports identifying and defining cause-and-effect relationships between KPIs and driver measures. This Driver Measures Enhanced Framework contains Driver Measure Models which can link KPIs and its driver measures. It also monitors and reports KPIs from the external environment of an organization. These external factors are considered while making decisions using Driver Measure Models. This framework makes the performance management system dynamic as the operational activities are linked to both to strategies and factors in the external environment. It allows the performance management system to plan, predict and forecast results based on driver measures and able to adapt to changes in the internal and external environment of an organization.

1.4 Thesis Methodology

The methodology enabled in the thesis as follows.

1. Analysis of existing performance management frameworks.
2. Identify shortcomings of these frameworks and evaluate the existing frameworks to decide on the most effective one to propose improvement based on effective performance management criteria identified in the thesis.
3. Propose an approach to address the shortcomings. In particular, the thesis takes the following steps.
 - i. Identify and analyze the problem
 - ii. Review literature and industry approaches to problem
 - iii. Identify shortcomings and define objectives
 - iv. Define a new framework for performance management to address shortcomings and meet objectives
 - v. Make a case study using the new framework
 - vi. Evaluate the approach and compare it the existing frameworks
4. Draw conclusions and identify future work

The thesis is organized into six chapters as follows:

Chapter 1: Introduction presents the motivation, problem statement, research objectives and the research contributions of the thesis.

Chapter 2: Background covers the relevant information on performance management frameworks. This chapter introduces many important concepts which lead to our problem solution.

Chapter 3: Driver Measures Enhanced Framework for KPIs provides a depiction of research methods used. This chapter includes details on the research methodology and framework.

Chapter 4: Case Study presents the details on a prototype. This chapter contains details on how the case study is set up and the focus area of the case study. It demonstrates how the case study can help to understand the Driver Measures Enhanced Framework for KPIs. Case study is based on an imaginary company named ABC Company, although the numbers and analysis done is representative of current practices in industry. ABC Company and its numbers are an example situation which was constructed based on my years of experience working in industry with similar data.

Chapter 5: Evaluation presents experimental results and discussions based on these results. In this chapter, using the outlined criteria, we compare existing frameworks, EFQM Excellence ModelTM, Prism and Balanced Scorecard with Driver Measures Enhanced Framework and show how adding Driver Measure Models to Balanced Scorecard is more effective than existing frameworks.

Chapter 6: Conclusions contains the main contributions, conclusions, limitations and future work.

2 Background

This chapter reviews the literature on performance management frameworks and provides a rationale for a new framework to better manage corporate performance. The first section of this chapter discusses performance management and its relevant concepts. Section 2.2 lists the various questions which need to be answered by a performance management framework. Section 2.3 describes the main characteristics of the existing performance management frameworks. Section 2.4 details three existing performance measurement frameworks related to our work. Section 2.5 discusses the relevant aspects of enterprise data architecture needed to support performance management frameworks.

2.1 Business Performance Management

Business Performance Management provides insight into how well an organization is doing in relation to its strategic goals [Bose, 2006]. It enables an organization to define measures and manage its performance against its strategic goals. Business performance management is developed using two components: a performance management framework and the underlying enterprise data architecture that supports it. Business Performance Management contains key elements such as strategic planning, budgeting, forecasting, monitoring, reporting, analyzing and generating scorecards [Walker, 1996]. Executions of these key elements are made possible through an enterprise data architecture.

The effectiveness of business performance management depends heavily on these two components. Figure 1 below shows a high level business performance management

architecture. The Performance Management Framework provides software and methodology for executives and managers to analyze and track the performance of the business in terms of strategic objectives. To do this, it interacts with the Enterprise Data Architecture of the organization that can collect, integrate, store and deliver all the data required by the Performance Management Framework. Enterprise data architecture also receives, stores, and delivers data created by the Performance Management Framework that communicates the performance status of the business. IT infrastructure is required by both components to support the services they provide to the organizations.

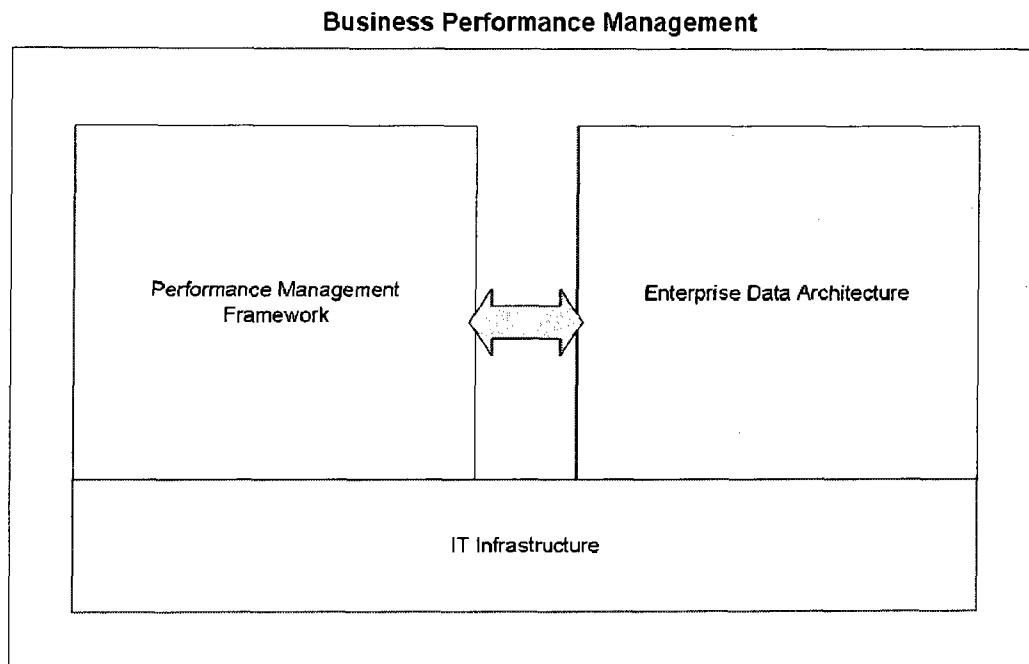


Figure 1 – Business Performance Management Architecture

Some of the key concepts of business performance management are discussed in the following subsections.

2.1.1 Measures

An organization needs a barometer to understand how well its strategies are working and how effectively its objectives are being executed at any given point in time. Collection of well developed measures or metrics can provide this measurement tool. Often the word “metrics” and the word “measures” are used interchangeably. To be consistent, we will only use the word “measure” throughout the thesis. Organizations use measures for key decision making purposes. Measures such as market share, sales revenue and customer satisfaction ratio enable an organization to understand its current position and make necessary improvement to achieve its targets. Measures such as projected revenue and sales volume forecast can provide insight into future performance. Choosing the right measures is vital for success. However the process of selecting the right measures is very complex. According to Hauser and Katz, “Metrics are good if the actions and decisions which improve the metrics also improve the firm’s desired long-term outcomes” [Hauser and Katz, 1998]

2.1.2 Key Performance Indicators

What is a Key Performance Indicator (KPI)? A KPI is a measure of an objective or process which is key or central to an organization’s success. Once an organization develops its vision, mission, business strategy, objectives and targets, it needs a mechanism to monitor progress toward those targets. KPIs can be the answer to this.

According to Chan and Chan, “KPIs are general indicators of performance that focus on critical aspects of outputs or outcomes. Only a limited, manageable number of KPIs is maintainable for regular use. For performance measurement to be effective, the

measures or indicators must be accepted, understood and owned across the organization. KPIs will need to evolve and it is likely that a set of KPIs will be subject to change and refinement” [Chan and Chan, 2004].

2.1.3 Driver Measures

Driver measures are measures which have direct influence on the outcome of the key performance indicators. Outcome of the KPIs are dependent on driver measures. Driver measures are often also referred to as “business drivers” in the literature. According to Walsh, business drivers are the leading indicators which provide the means to run business operations [Walsh, 1996]. Through cause-and-effect mechanisms, relationships between KPIs and driver measures can be attained.

2.1.4 Planning and Forecasting

Planning and Forecasting are critical elements of an organization. “An organization can improve its effectiveness if it can forecast its environment, anticipate problems, and develop plans to respond to those problems” [Armstrong, 1983]. There exists a reciprocal relationship between planning and forecasting. Planning provides the strategies and actions which need to be taken based on the current and forecasted results. Organizations can predict and estimate the outcome of key performance indicators by forecasting with leading indicators such as driver measures. “Forecasting relates to what will happen if the firm tries to implement a given strategy in a possible environment. Forecasting also helps to determine the likelihood of the possible environments” [Armstrong, 1983]. Organizations need pertinent data from government regulations,

demographic, sales, resources, competitors and production for the planning and forecasting activities.

Figure 2 below, based on Armstrong's article "Strategic planning and forecasting fundamentals" [Armstrong, 1983] provides an excellent framework for strategic planning within an organization. The reciprocal relationship is articulated clearly in figure 2. An organization creates a plan based on the data (resources, environmental, historical results, current results, forecasted results and constraints) available and then it tries to forecast the outcome based on the plan. If forecasted results are not the expected outcome, then the forecasted results are fed back into the planning process. This closed loop process goes on till the expected outcome is forecasted. Once management is satisfied with the forecasted outcome, decisions are made, action plans are drawn for execution. It is also important to highlight that the actual results achieved may not be equivalent to the predicted outcome. If the lagging indicators are not producing the expected results then the organization can go through another cycle of planning and forecasting. This is a very dynamic process and it evolves as the business requirements and needs change.

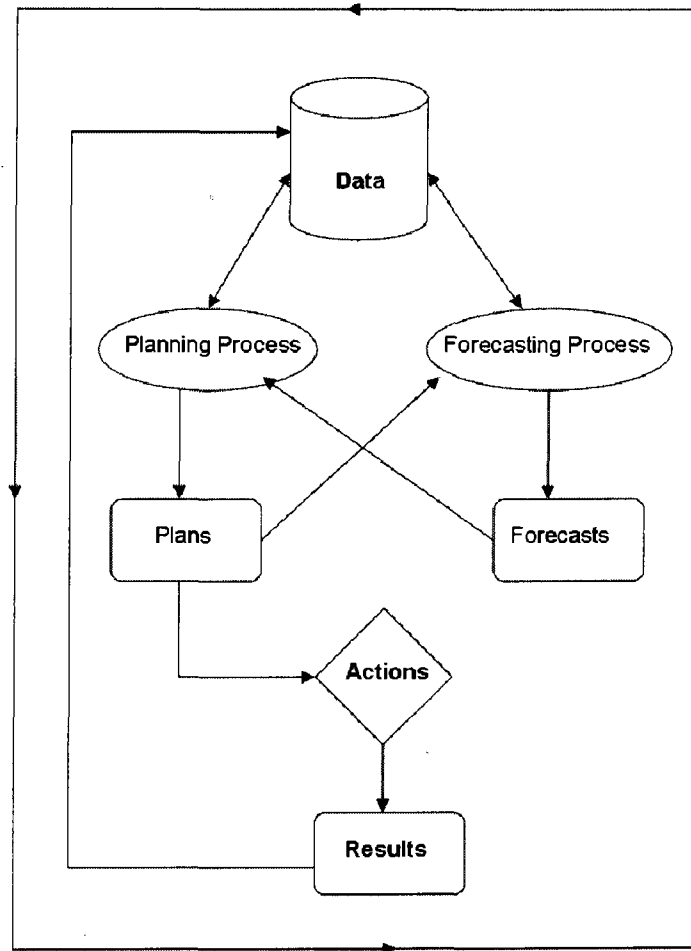


Figure 2 - Planning and Forecasting Framework

2.2 Five Questions a Performance framework needs to answer

According to Otley, the following questions need to be addressed regarding objectives, strategies, plans, target setting, reward and information feedback and feed-forward loops by a performance management framework [Otley, 1999].

Q1. What are the key objectives that are central to the organization's overall future success and how does it go about evaluating its achievement for each of these objectives?

Q2. What strategies and plans has the organization adopted and what are the processes and activities that it has decided will be required for it to successfully implement these? How does it assess and measure the performance of these activities?

Q3. What level of performance does the organization needs to achieve in each of these areas defined in the above two questions and how does it go about setting appropriate performance targets for them?

Q4. What rewards do the managers (and other employees) gain by achieving these targets? (or conversely what penalties will they suffer by failing to achieve them)?

Q5. What are the information flows (feedback and feed-forward loops) that are necessary to enable the organization to learn from its experience and to adapt its current behavior in the light of that experience?

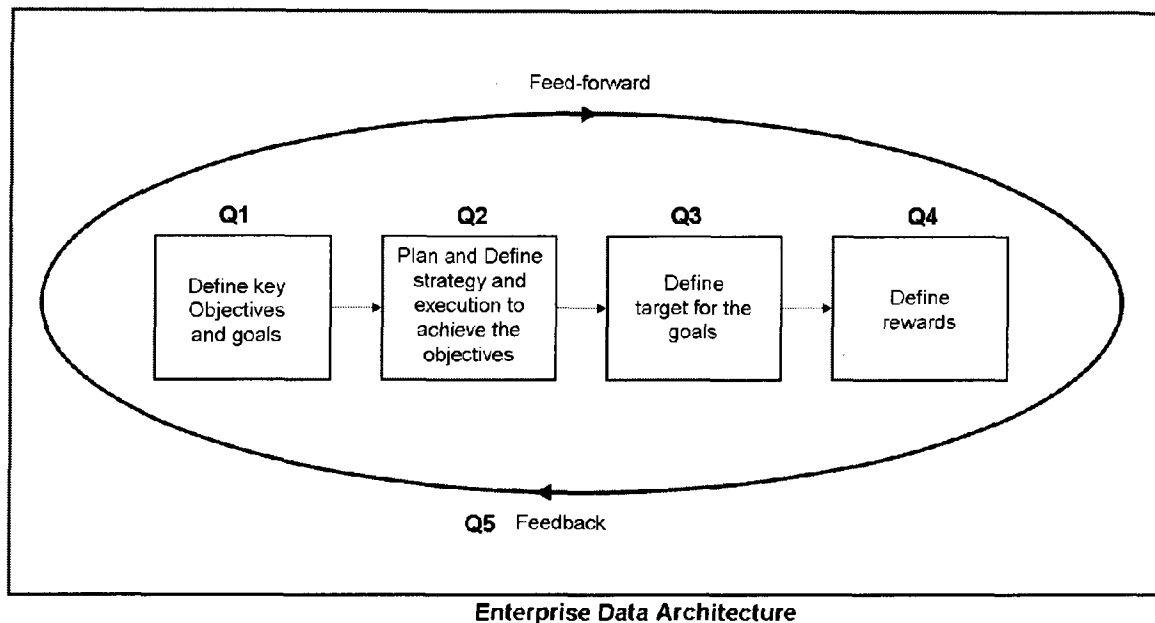


Figure 3 – Otley's Questions on Performance Management

Figure 3 shows the objective of each of Otley's question in performance management and how defining one objective leads to the next question.

The first question is related to defining key objectives and goals to become a successful organization and bring the highest value possible to the shareholders. An answer to this question will lead an organization to vision, mission and overall business strategy.

The second question is related to defining strategies and plans to achieve the defined objectives. Once the strategies are defined the organization requires an implementation plan to execute those strategies.

The third question is related to setting targets for each of the goals. Every goal needs to have a target. Without a target, an organization would not know if it has achieved its objectives. A target can be set based on historical performance, management

domain knowledge experience and industry benchmarks. Industry benchmarking is a good way to set targets. It allows management to compare how well the operations have performed in relation to similar organizations.

The fourth question is related to the motivation factor for an organization to achieve its goals. Employees will be motivated to achieve set out targets if there is a reward system set up which is correlated to achieving these targets.

The last question is related to feedback and feed-forward loops. Results on the actual performance can be used to adjust the targets and take corrective actions as necessary. Feed-forward mechanism will allow an organization to plan, predict and forecast results using what-if-analysis. The “How” in each of these questions requires enterprise data architecture in order to provide the necessary information and data to address each of the “How”. Objectives, strategies, targets and rewards can be defined with proper self assessment for an organization. However monitoring and measuring performance requires solid enterprise data architecture.

2.3 Characteristics of existing Performance Management frameworks

Existing performance management frameworks have the following characteristics:

- Able to support a balanced perspective (financial, customer, internal processes, innovation and learning)
- Able to translate corporate strategy into KPIs
- Able to show cause-and-effect relationships between strategies and KPIs
- Able to set goals, targets and rewards

- Able to support both a feedback and feed-forward processes

Most of the existing performance management frameworks focus on financial and customer performance measures which are lagging indicators. The three existing performance management frameworks discussed later in this chapter take a balanced (financial, customer, internal business processes and innovation and learning) approach to performance management. The financial perspective reports measures from financial performance (e.g. net profit, total revenue). The customer perspective reports measures related customer management (e.g. customer satisfaction ration). The internal business processes perspective is critical for an organization's efficiency, effectiveness and customer satisfaction. It includes measures such as unit cost, cycle time, quality index, time to market, etc. The innovation and learning perspective is another aspect of balanced perspective. This reflects on the ability of an organization to continue improving and creating value for its stakeholders. Measures from the internal business processes and innovation and learning perspectives are the leading indicators of a business [Wongrassamee et al., 2003; Kaplan and Norton, 1996b].

Existing performance management frameworks are able to translate strategies into KPIs. When an organization defines its vision and mission, the vision needs to be translated into strategic goals and linked to KPIs which can be used as the barometer to monitor and report on strategic goals accomplishments [Kaplan and Norton, 1993; Neely et al., 2001].

One of the existing performance management frameworks, Balanced Scorecard, is able to show cause-and-effect relationships between strategies and objectives and its KPIs

using strategy maps [Norton, 1999]. This helps an organization to visualize how the objectives and their respective KPIs are linked to one another at the strategic level and identify performance issue areas.

Current performance management frameworks are able to set the target for each of the measures based on the strategic objectives. These targets can be linked to rewards. There are however concerns with linking rewards to targets. According to Kaplan and Norton, setting rewards to attain targets may limit management objectives to short term goals and overlook the long term goals [Kaplan and Norton, 1996a]. This may seed concerns for the long term survival of an organization.

Existing performance management frameworks also contain feedback loop processes which are useful to evaluate the current operations and take corrective actions when targets are not met. Organizations need processes to ensure that the measures and measurement systems are reviewed and modified as the organization's requirements and needs change [Dixon et al., 1990]. Some of the frameworks also have the ability to plan, predict and forecasts potential outcomes using feed-forward loop processes.

2.4 Existing Performance Management Frameworks

Over the years, a number of innovative performance measurement frameworks have been established successfully by organizations [Wongrassamee et al., 2003; Porter et al., 1998; Neely et al., 2001; Kaplan and Norton, 1996a]. However the following are discussed in details as they are more appropriate and relevant to the thesis research. They possess most of the criteria required for a performance measurement system to be effective and efficient.

2.4.1 European Foundation for Quality Management (EFQM) Excellence Model

The European Foundation for Quality Management (EFQM) was founded by fourteen European companies in 1988 to address increasing concern about the lack of quality, productivity and competitiveness in a dynamic world market. The EFQM Excellence Model™ is based on the principals of total quality management (TQM). According to Wongrassamee et al., “the specific purpose of this model is to provide a system perspective for understanding performance management. The Excellence model is a non-prescriptive framework based on nine criteria reflecting validated, leading edge management practices” [Wongrassamee et al., 2003; Porter et al., 1998].

Figure 4 below, re-drawn from [Wongrassamee et al., 2003], shows these nine criteria. Five of these criteria are considered enablers under the direct control of an organization. The other four criteria are results which can be achieved using those enablers effectively. The EFQM Excellence Model™ is used as the tool for assessing the European Quality Award (EQA) which is awarded to companies that demonstrate excellence in management of quality as their fundamental process for continuous improvement [Shergold and Reed, 1996]. The percentage listed in each of the box identifies the weight given to each of the nine criterions for EQA award assessment.

Many organizations have used these nine criteria to self-assess and understand their organizational position. After conducting the self assessment, an organization uses the benchmark to plan out corrective actions for improvement where necessary [Wongrassamee et al., 2003].

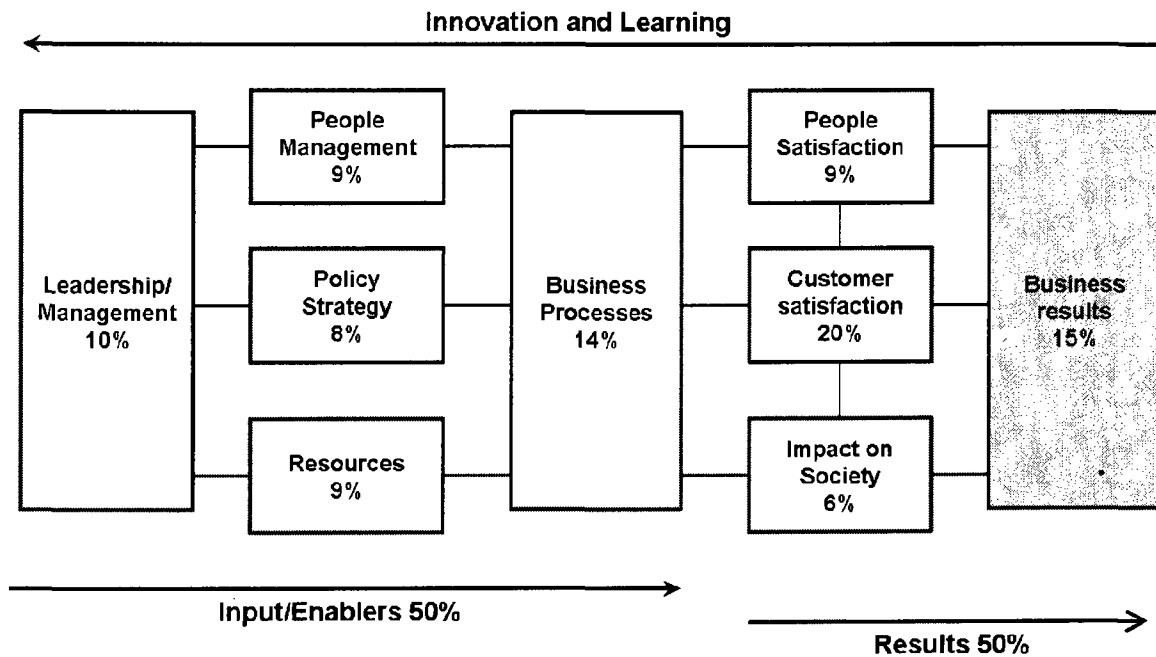


Figure 4– EFQM Excellence Model™

How well does the EFQM model address Otley's questions? Nine criteria of the model addresses Otley's first question regarding defining key objectives or overall business strategy. The nine criteria can help an organization to assess the overall business strategy, understand the current position and then use the industry benchmark to work on improvements when necessary. The EFQM model does not directly address the second question on defining plan and objectives to achieve overall business strategy. However the weighted nine criteria can help to define the objectives. There is no guideline provided in the model on target setting. According to Wongrassamee et al., assessment of the four result criteria can evaluate how well the five enabler criteria are performing. This, along with the benchmark, will provide enough information to set targets. On the question of rewards, there is no guidance provided. Although the model does not provide details on feedback loop, the assessment on how well the organization is doing and comparing it to the benchmark, can provide sufficient details on current performance and

corrective actions for improvement. Figure 5 shows how the feedback loop is established in the EFQM model. Key objectives are defined and actions are deployed using enablers. If the expected results are not achieved further improvement is taken in the form of corrective actions.

From the effective performance framework criteria standpoint which will be discussed in Chapter 3, EFQM model does not provide a mechanism for understanding cause-and-effect relationships and quantification between measures. External environment perspective is not mentioned as well.

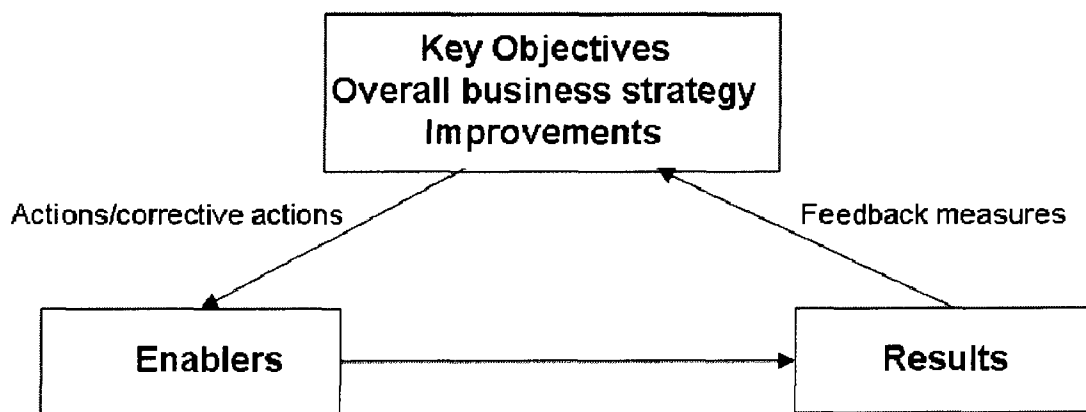


Figure 5– EFQM Excellence Model™ feedback loop

2.4.2 Performance Prism

“Performance Prism addresses the shortcomings of many of the traditional measurement frameworks used by organizations today. The Performance Prism, with its comprehensive stakeholder orientation, encourages executives to consider the wants and needs of all the organization’s stakeholders, rather than a subset, as well as the associated strategies, processes and capabilities” [Neely et al., 2001].

This approach allows an organization to select the right measures to manage performance. According to Neely et al., Performance Prism has five interrelated components. The first component is stakeholder satisfactions – who are the stakeholders and what do they want and need? The second component is the strategies – what strategies need to be in place to meet the stakeholder needs and wants? The third component is the processes – what are the processes needed to deliver on the strategies? The fourth component is the capabilities – what are the capabilities (people, technologies, practices, etc.) needed to operate the processes? The fifth component is the stakeholder contribution – this is a key feature of the Performance Prism. This allows an organization to measure and manage the mutual relationship between an organization and its stakeholders.

As an example, customers want the organization to provide them with quality products for reasonable price on time. In return the organization wants the customers to be loyal and pay on time for its services. According to Neely et al., other measurement models they have researched failed to recognize this critical reciprocal relationship between stakeholder and the organization. Figure 6 below, based on [Neely et al., 2001; Neely, 2002], shows each of the components of the Performance Prism framework and how each component is related to one another [Neely et al., 2001; Neely, 2002].

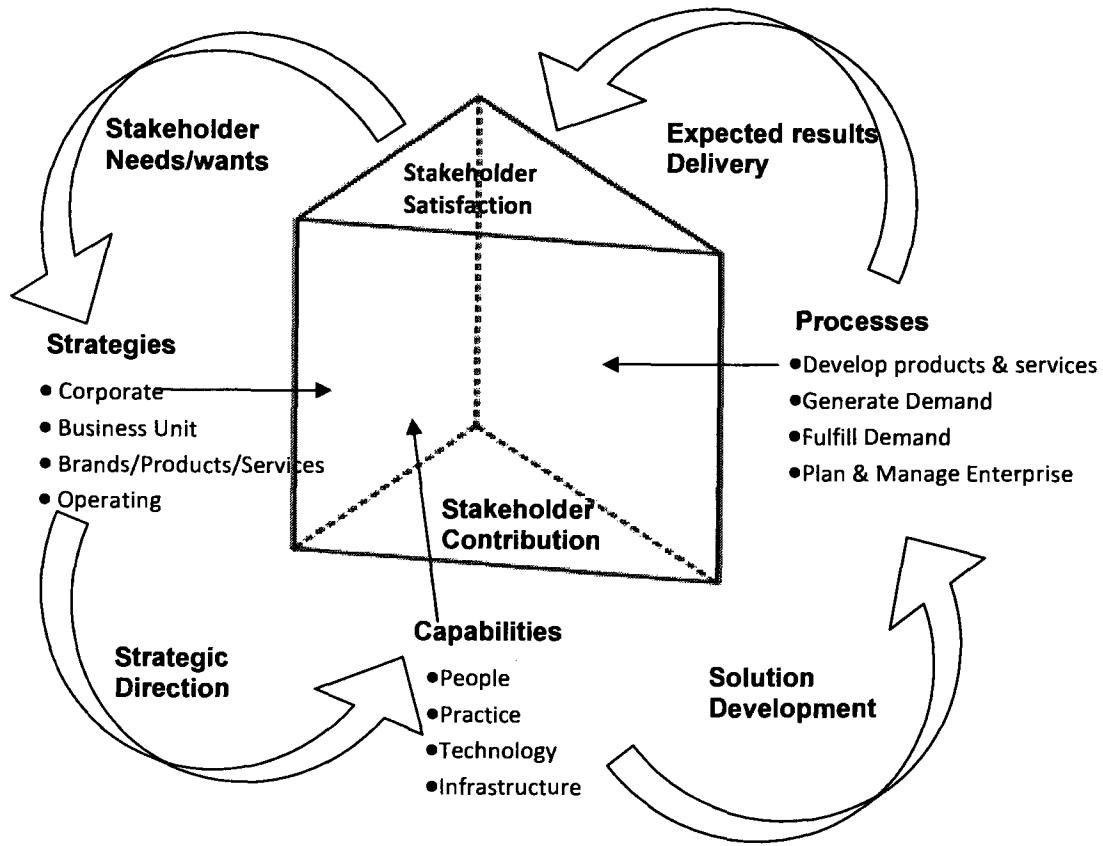


Figure 6 – Performance Prism

How well does Prism address Otley's questions? By addressing stakeholders' needs and wants and developing key strategies to achieve those requirements, Prism answers Otley's questions on defining key objectives and developing strategies to achieve these key objectives. Prism does not discuss techniques on setting targets for objectives. However, the framework paves the way for managers to set expected performance levels to satisfy stakeholders. By defining the wants and needs of the stakeholders, the expectations are set. Once the expectations are defined, managers can work with the affected parties to set targets. Prism does not discuss rewards for achieving the objectives. Although the framework does not directly discuss a feedback loop, Prism provides feedback information through stakeholder satisfaction. If the stakeholders are not

satisfied with the results, the organization is expected to revisit its strategy and processes. Figure 6 explains the work flow of Prism and the feedback loop is clearly articulated as the activities go in a circle to attain stakeholder satisfaction.

Viewed from the effective performance management framework criteria perspective, Prism does not provide a mechanism for understanding cause-and-effect relationships between measures. It does not provide a methodology to quantify relationships between measures as well. There is no consideration given to external environment perspective in the Prism.

2.4.3 Balanced Scorecard

The Balanced Scorecard performance management framework was introduced by Kaplan and Norton [Kaplan and Norton, 1996a]. This framework helps to translate mission and strategic objectives into a set of performance measures. The purpose of the Balanced Scorecard is to help communicate and implement organizations strategies. It contains sets of financial and non-financial measures to help an organization achieve its strategic vision. The Balanced scorecard reports key performance indicators from four different perspectives: Financial, customer, internal business and innovation and learning perspectives. The financial and customer perspectives are measured as outcomes of a business. Internal business and innovation and learning perspectives are the drivers for the financial and customer objectives. According to Kaplan and Norton, the major strength of the Balanced Scorecard is the emphasis that it places on linking performance measures with business strategies [Kaplan and Norton, 1996a]. Kaplan and Norton later added strategy maps to their framework in order to link the scorecard with the

management of strategies. A strategy map defines the relationships between strategies, objectives and key performance indicators. Figure 7 shows each of the perspective of the framework and the key question each perspective is trying to address.

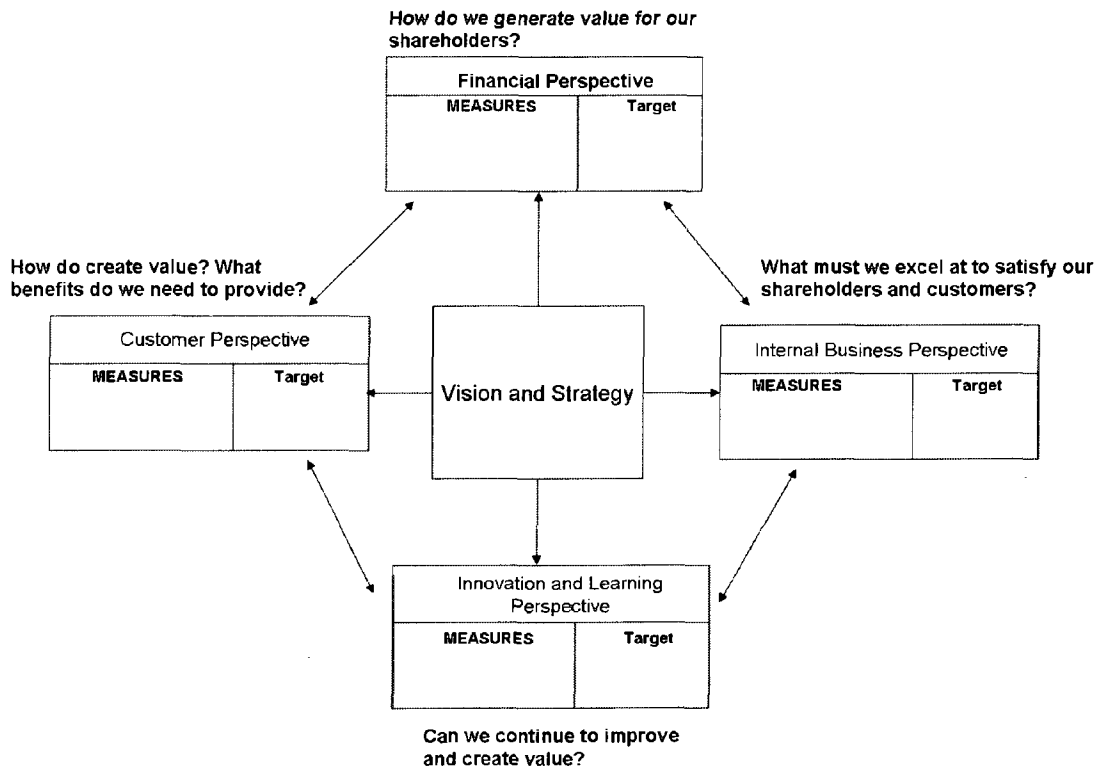


Figure 7 – Sample Balanced Scorecard

Figure 8 below shows the main steps of the framework in creating, monitoring and reporting using a Balanced Scorecard. Market requirements, stakeholder and external environmental needs drive the way an organization needs to operate. Self assessment for an organization is conducted based on these requirements. This helps to identify how mission, vision, core values and business strategies need to be formulated. Subsequently business strategies are translated into objectives and categorized into the four Balanced Scorecard perspectives. Objectives from each of these perspectives are linked to one another using a strategy map. From the strategy map, key performance indicators for each of the four perspectives are developed and reported on the Balanced

Scorecard. Based on the KPIs result, new initiatives are taken to improve performance if the expected targets are not met.

It is important to highlight that although the external environment is considered during the initial business strategy formulation; the Balanced Scorecard does not track the external environment perspective as part of its routing monitoring or reporting.

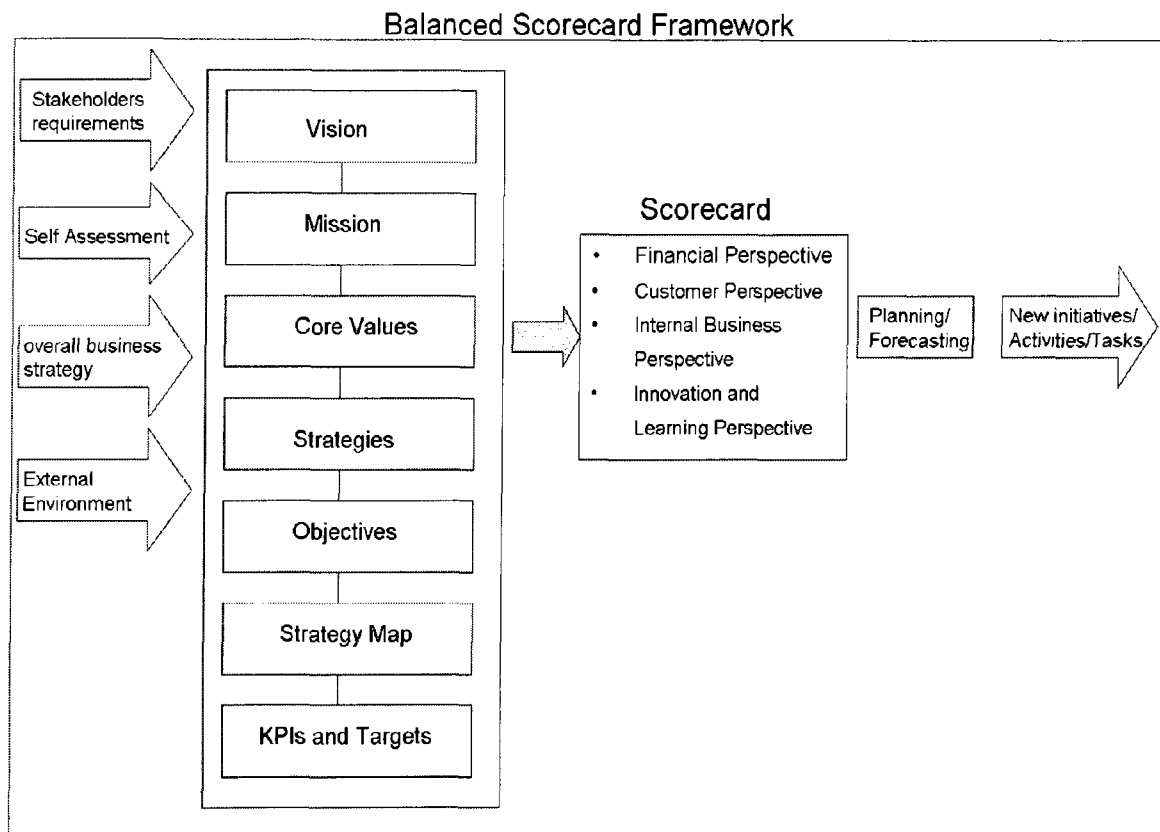


Figure 8 – Balanced Scorecard Framework

2.4.3.1 Self Assessment

Before creating a Balanced Scorecard, an organization needs to go through various steps to gather requirements for a Balanced Scorecard. The first step in formulating a performance management framework is to conduct a self assessment of the

organization for strategy formulation [Rohm and Halbach, 2005]. Various methods are available for the self assessment. This can be achieved by having discussions and meetings with management and coming up with what is important to an organization and its stakeholders. Management can conduct strength, weaknesses, opportunities and threats (SWOT) analysis and complete the self assessment. This self assessment will help the organization to define its mission, vision and overall strategy for the business.

2.4.3.2 Overall Business Strategy formulation

After completing the self assessment, an organization would be able to create an overall business strategy. Examples of common strategic themes include:

- build the business
- improve operational efficiency
- increase return on capital
- develop new products

After developing an overall business strategy, an organization will be able to define the mission, vision, core values and strategies [Kaplan and Norton, 1996b].

2.4.3.3 Strategy Map

Once strategies are formulated, they need to be translated into objectives. “The strategy map provides a powerful tool for visualizing the strategy as a chain of cause-and-effect relationships among strategic objectives and KPIs.” [Kaplan and Norton, 2008] Objectives from each perspective are linked to one another. This will allow managers to see how the strategies, objectives and KPIs are linked from the financial perspective to

learning and growth prospective [Kaplan and Norton, 2000c]. A strategy map is normally drawn on a single page. An organization needs to strike a balance on what level of objectives are placed in the strategy map [Kaplan and Norton, 2008]. If operational level details are added to the map, it would clutter the map and make it ineffective. Figure 9 below shows an example of a strategy map which shows how the objectives are linked to strategies [Rohm and Halbach, 2005]. It illustrates how developing new employee skills can improve productivity and lead to higher quality new products. This can lead to higher customer satisfaction which has direct impact to sales and return on investment.

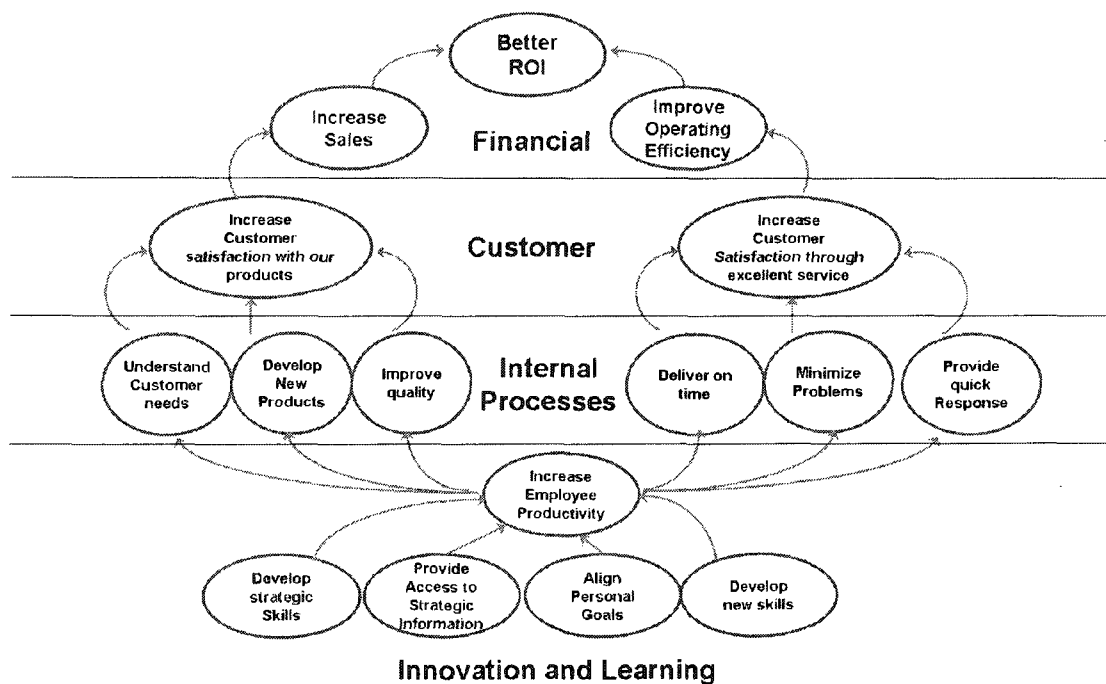


Figure 9 – Strategy Map

2.4.3.4 Key Performance Indicators

Once the objectives are identified, performance measures need to be developed to measure and monitor performance. These performance measures are Key Performance Indicators for the business. Organization should identify these KPIs and expected level of performance (goals, targets) for these measures [Dolence and Norris, 1994]. Selecting KPIs is an art. One cannot rush to list all the measures as KPIs. Only those measures which are critical to measuring strategy should be listed here. Strategy map lists out the strategies and objectives. From the strategy map, one should be able to identify the KPIs which are linked to strategies. Figure 10 below shows how KPIs are derived from various areas of a business and how the selection process makes KPIs effective and balanced. This diagram is based on the article "Developing and Using Balanced Scorecard Performance Systems" from Rohm and Halbach [Rohm and Halbach, 2005].

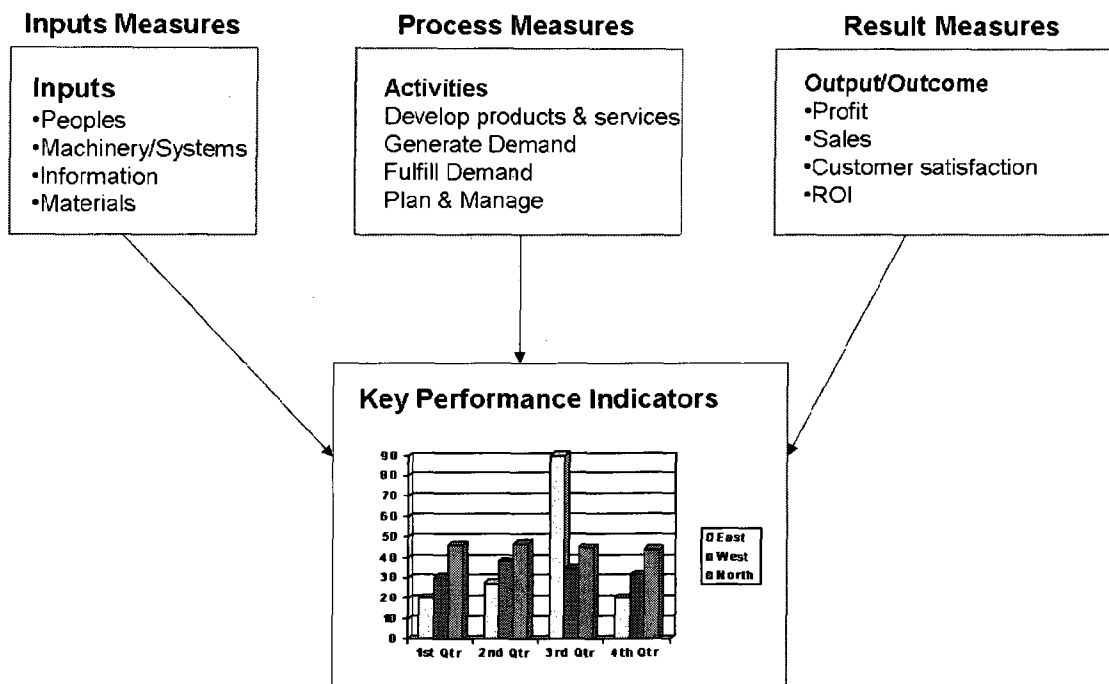


Figure 10 - Key Performance Indicators

How effective is the Balanced Scorecard in addressing Otley's questions? The Balanced Scorecard defines measures in four generic performance areas. According to Kaplan and Norton, each company is required to develop its own performance measures and scorecard as suited for its success and improvement [Kaplan and Norton, 1993]. The process of creating Balanced Scorecards takes a journey from defining strategies, translating them into objectives, defining key performance measures, linking them in a strategy map to setting targets. The Balanced Scorecard approach has multiple key performance objectives which are driven by the organization's overall business strategy [Wonggrassamee et al., 2003]. Otley's second question on defining strategies, plan and objectives to achieve overall business strategy is accomplished by the strategy map which maps the strategy to objectives and key performance indicators in each of the four perspectives. There is no guideline provided in the framework on target setting. As the Balanced Scorecard is a non-prescriptive framework, goal and target setting responsibilities are left with the managers. Kaplan and Norton suggested there should be a link between Balanced Scorecard measures and incentive compensation [Kaplan and Norton, 1996b]. They also argue setting rewards to attain targets may limit management objectives to short term goals and over look the long term goals [Kaplan and Norton, 1996a]. They highlight that the better approach to incentive compensation is to "establish minimum threshold levels for a critical subset of the strategic measures. Individuals would earn no incentive compensation if performance in a given period fell short of any threshold. This requirement should motivate people to achieve a more balanced performance across short and long-term objectives." [Kaplan and Norton, 1996b] The

feedback process takes effect when the results are reported in the Balanced Scorecard and compared to targets. If the expected results are not achieved then corrective actions will be taken.

From the effective performance management framework criteria point of view, which is discussed in Chapter 3, the Balanced Scorecard provides a mechanism for understanding cause-and-effect relationships between strategies, objectives and key performance indicators through strategy map. However, there is no provision in the framework to link the key performance indicators to driver measures. Driver measures, operational in nature, are the ones which shape key performance indicators. One needs to know what activities or measures drive a KPI to make an effective decision. Another aspect that the Balanced Scorecard missing is, it does not provide a methodology to quantify relationships between measures. It also does not take into account measures related to external factors.

2.5 Enterprise Data Architecture

Enterprise data architecture defines how the data is modeled, stored, managed and utilized in a system. Enterprise data architecture establishes common processes and guidelines for data operations and reporting. It contains modeling, reporting and storing technologies for both operational and analytical data structures. This enables an organization to speak one version of the truth at each level of the organization and be able to control, model and predict using the data in its system. Some of the technologies used for modeling, storing, managing and reporting data are discussed in the below section.

2.5.1 Operational Data Store

An operational data store (ODS) contains transactional data. An ODS is built utilizing enterprise resource planning (ERP), customer relationship management (CRM) or in-house built transaction systems. Daily detail level transactions are stored in ODS databases. This data is used for online transaction processing (OLTP) purposes. Database queries can be run to extract data for operational reporting. These queries can take a long time to execute as the volume of transactional level data stored in the ODS is high. These reports provide very little analytical value to decision makers. However, the importance of an ODS should not be overlooked as operational data stores are the main data sources for data warehouses which are built for analytical purposes.

2.5.2 Data Warehousing

A data warehouse is a physically structured environment which is developed to house non volatile data for decision making and analytical purposes. Data is extracted from various sources, transformed and loaded into the warehouse periodically. Data stored in a data warehouse can be summarized according to dimensions such as time, products, regions and organizations using various reporting technologies for analytical purposes. The physical structure is extensible as need arises to include more data from existing and new sources [Jarke et al., 2000].

A data warehouse should allow an organization to speak to one version of truth as the data is conformed and centrally stored within an organization. This provides a foundation for consistent reporting and decision making across an organization. “To facilitate complex analyses and visualization, the data in a warehouse is typically

modeled multi-dimensionally. For example, in a sales data warehouse, time of sale, sales district, salesperson, and product might be some of the dimensions of interest. Often, these dimensions are hierarchical; time of sale may be organized as a day-month-quarter-year hierarchy, product as a product-category-industry hierarchy” [Chaudhuri and Dayal, 1997]. Figure 11 below based on [Chaudhuri and Dayal, 1997] shows a typical data warehousing architecture. It shows how the data flow from operational data sources to reporting analysis tools.

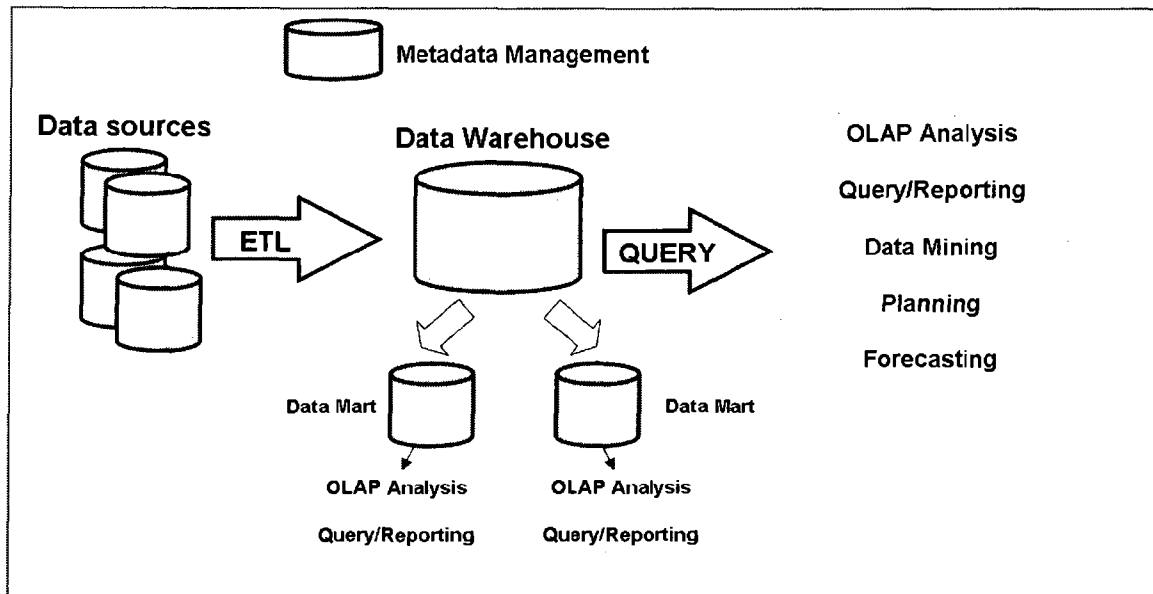


Figure 11 - Data Warehousing Architecture

2.5.3 Online analytical processing

Online analytical processing (OLAP) is a technique which allows decision makers to perform complex and detailed analysis over information stored in an enterprise data warehouse. It provided a vehicle to generate decision support and analytical reporting

[Chaudhuri and Dayal, 1997]. Data warehousing and OLAP complement each other. Data warehouse provides summarized, accurate, timely and consistent data to OLAP. OLAP in turn focuses on decision makers analytical and reporting needs. [Inmon et al., 1997]

2.5.4 Business Intelligence

According to Dayal et al., “Business Intelligence (BI) is a collection of data warehousing, data mining, analytics, reporting and visualization technologies, tools, and practices to collect, integrate, cleanse, and mine enterprise information for decision making” [Dayal et al., 2009]. Business intelligence can be classified as the portion of enterprise data architecture which is utilized for analytical and decision making purposes.

3 Driver Measures Enhanced Framework for KPIs

3.1 Overview

We propose a Driver Measures Enhanced Framework (DMEF) as a key contribution of the thesis. It addresses four key criteria which are partially effective or completely omitted from other performance management frameworks. The DMEF will address the following “gaps” in current performance management frameworks:

- Link operations to strategies
- Show cause-and-effect relationships between driver measures and KPIs
- Quantify measure relationships
- Support an external control process

In this framework, Driver Measure Models (DMM) will be a key concept. Driver measures, derived from operational level activities, influence, affect and drive KPIs. In doing so, driver measures links operations to strategies (KPIs).

The Driver Measures Enhanced Framework is built as an extension to the Balanced Scorecard. Executives have visibility to KPIs in a corporate Balanced Scorecard but do not have visibility to driver measures. For example, the Balanced Scorecard for ABC Company (used in the case study), reported that KPI “Total Sales Revenue” met only 57% of its target for this year. It was expected to make \$700 million but total sales accounted for merely \$400 million this year. By looking at the strategy map of the corporate Balanced Scorecard, executives can identify, from the internal

business and innovation and learning perspectives, the collection of objectives and KPIs related to the “Total Sales Revenue”. However, they are left with two key gaps. How do they link these KPIs to operational level measures which drive them? What techniques are available for them to analyze the issue? They need to understand what operational level tasks need to be taken to improve sales performance.

We will show how the Driver Measures Enhanced Framework, using Driver Measure Models, makes it possible for executives to drill down from a corporate Balanced Scorecard to see which drivers affect and influence the KPIs. Defining cause-and-effect relationships using Driver Measure Models and quantifying these relationships between driver measures and KPI using mathematical techniques, allow executives to plan actions and predict results while changing these drivers. This definitely helps an organization make strategic decisions with confidence.

Organizations that use existing performance management frameworks only consider the external environment while forming the initial vision, mission and business strategies. They don’t have a process for routine monitoring and reporting of external environment related factors. The Driver Measures Enhanced Framework provides an external control process for tracking KPIs related to external environment. It includes the external environment as the 5th perspective for reporting.

3.2 Effective Performance Management Framework Criteria

A Driver Measures Enhanced Framework (DMEF) should satisfy the below seven performance management criteria to be successful. These criteria were assembled based on the literature survey of existing performance management framework characteristics

discussed in Chapter 2, as well as a gap analysis of existing performance management frameworks based on our case study in Chapter 4. Following new criteria, “link operations to strategies”, “show cause-and-effect relationships” and “quantify measures relationships” were identified from the gap analysis.

We will use these criteria to evaluate DMEF and compare it with existing performance management frameworks.

3.2.1 Translate corporate strategy into KPIs

A performance management framework should have techniques in place to integrate its measures into corporate strategies [Kaplan and Norton, 2000c]. This necessitates a top-down approach for deriving measures. Techniques need to look at an organization’s mission and vision and formulate strategies to achieve its vision. Subsequently corporate strategies can be translated into objectives. Key performance indicators can be derived from these objectives. These derived KPIs emerge as the barometer for monitoring and reporting on corporate performance.

Obviously when monitoring and reporting KPIs, one needs to understand what the KPIs are being measured against. Organizations should be able to set goals and targets for these KPIs. This can inform executives if the goals are achieved or not. It is also important to define motivating factors for achieving these targets. Thus organizations need to be able define and set rewards for achieving the goals.

3.2.2 Show cause-and-effect relationships

Performance management frameworks should be able to show cause-and-effect relationships between operational and strategic objectives, processes and their respective measures. It is essential for an organization to identify cause-and-effect relationships between measures. This can help the organization identify where the issues are when targets are not. It also allows an organization to plan and forecast results when the cause-and-effect relationships of “who drive what” are defined.

3.2.3 Provide a balanced perspective

An organization is not able to manage its performance by monitoring and reporting only on financial related measures such as total revenues, net profit, cash flow, etc. That perspective alone cannot provide the complete picture of the business to executives. Organization needs a performance management framework which includes measures from multiple perspectives. In particular, for a typical organization, these perspectives need to be monitored and reported on.

- financial
- customer
- internal processes
- innovation and learning
- external environment

It is important to highlight that the external environmental perspective is important for strategic and tactical decision making, not just for initial business strategy

formulation. Thus external environment related measures need to be monitored as part of routine performance management. This presents the organization with the ability to quickly react to ever changing external factors. This allows an organization to make decisions by looking at the external factors as well the internal factors which affect the business. It also provides a more complete picture of the organization and its context to executives while making decisions.

3.2.4 Dynamic

A performance management framework needs to be dynamic to accommodate the constantly changing external and internal environment of an organization [Bititci et al., 2000; Lynch and Cross, 1991]. When the results from the lagging indicators show performance is below expectation, management is forced to make process, objectives or strategy changes. These changes need to be monitored by the performance management framework in the next cycle. Thus the agility of the framework is critical for the organization to monitor its initiatives successfully.

Feedback and feed-forward loops are discussed in Chapter 2 as one of the characteristics of the existing frameworks. These characteristics can be considered as being dynamic. However, the level of dynamism in the existing frameworks is very low, as the response to poor performance is often identified after the fact. It may take a few reporting cycles to correct the problems as the infrastructure (missing cause-and-effect relationships and measure quantifications) to identify corrective actions and predict results is poor.

3.2.5 Link operations to strategies

Performance management frameworks should be able to link operations to strategies. This is a critical gap identified in the existing frameworks. It is necessary for an organization to understand what operations drive a KPI which is linked to strategies. By linking driver measures to KPIs, the framework can in effect link driver measures to strategies which lead to proper strategic decision making. Monitoring and reporting KPIs on a performance management framework can highlight the problems. But the real question is what strategic decisions executives need to take to fix the problems. Strategic decisions are derived and executed using the operational activities. Thus a performance management framework requires methodologies which can link operations to strategies for effective decision making.

3.2.6 Quantify measure relationships

Performance management frameworks need to be able to quantify relationships between measures [Bititci et al., 2000]. Quantification of measure relationships through mathematical or scientific techniques allow an organization to put quantifiable figures on predicted results for planning activities and help them set targets. This paves the way for an organization to change its strategy or objective and be able to predict expected results. This helps them evaluate which leading indicators (driver measures) would potentially bring higher future value for their organization. Although these predictions may not become reality, it at least provides quantifiable techniques for predictions and forecasts rather than some arbitrary or qualitative statements on future performance.

3.2.7 Support an external control process

In today's global market place, businesses face various challenges from the external environment. These challenges directly or indirectly affect performance of an organization. Performance management frameworks should include measurement characteristics which can be associated to external environment. These measures can help to review, control and reprioritize the strategic and operational goals as the external environment changes. It is important for an organization to identify the external factors which affect the business and have a monitoring process to observe these variables as they change in the external environment. For an example, rising fuel prices and government incentives for smaller cars can directly affect the large size cars sales in the market place. Ignoring these external factors could seriously affect large car sales. Thus an organization which produces large cars may need to re-visits its strategy and sees how well it can tackle the rising fuel prices concerns. One of the options could be to change the strategy to produce small size cars to compete in the market place. However, overlooking external environment factors could turn out to be costly for an organization in the long term.

3.3 A Performance Management Framework based on Driver Measure Models

Our Driver Measures Enhanced Framework (DMEF) is defined as an extension to the Balanced Scorecard performance management framework. The DMEF is developed using Driver Measure Models which define cause-and-effect relationships between KPIs and driver measures and quantify these relationships using mathematical techniques.

Figure 12 below illustrates the DMEF. All the components which are the same as the Balanced Scorecard are shown with *italic labels* and dotted line boxes. All the components which are part of Balanced Scorecard but have significant changes due to the DMEF are shown in with regular labels and solid line rectangles. The items new to DMEF are shown with **bold labels** and thicker line rounded rectangles. Figure 12 shows how each of the components fit together.

Driver Measure Models introduce the external environment (society, government policies, market trend, competition) in order for decision makers to consider external factors which could affect and influence a KPI. This is very import for decision making. Executives should not make decisions in isolation of the external environment. For an example, rising fuel prices could potentially affect large car sales. So any strategy implementation related to large size car sales needs to include external factors such as oil price trends, market trend, etc. Due to the fact that the Driver Measure Models will track factors related to external environment, strategy map and KPIs are required to include external environment factors. This is shown as a 5th perspective for reporting in the Balanced Scorecard.

With Driver Measure Models, organizations are able to do formal planning and forecasting with higher degree of accuracy. It translates into new initiatives with an improved chance of achieving the set out goals.

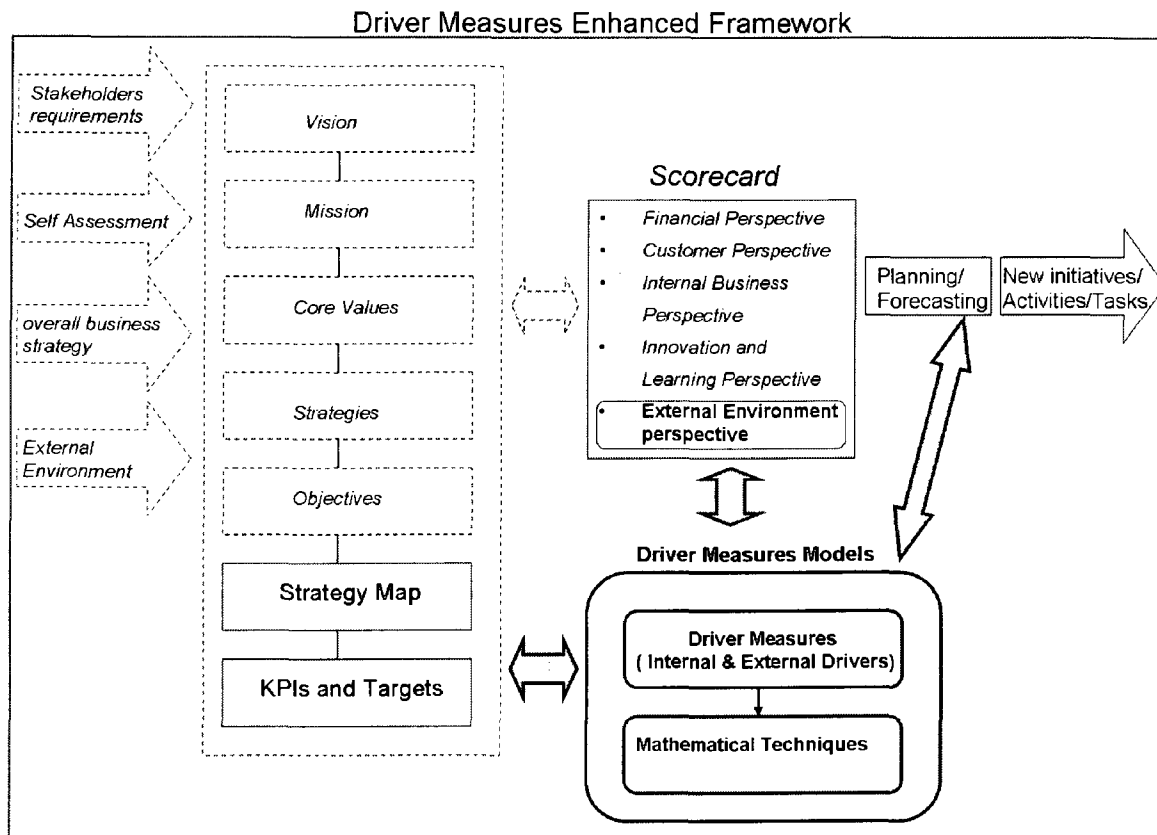


Figure 12 – Driver Measures Enhanced Framework

3.3.1 Driver Measures

Driver measures are the key component of the Driver Measure Models. Driver measures are measures associated to operational actions or tasks which drive the KPIs. Executives have accessibility to KPIs in the Balanced Scorecard. How do they link the KPIs on the Balanced Scorecard to operations? Business unit level managers and employees have access to operational level data and operational level Balanced Scorecards. They can interpret the numbers and measures at their level. However these

Balanced Scorecards are effective for line managers not for executives. If everything goes according to plan and targets are met then there will not be a need for executives to analyze further. But, this is not a practical scenario. It is almost certain that some targets are not going to be met. Hence there is apparent need for further analysis. Decision makers may need to change course or modify the existing strategies. This requires insight into what inputs (resources, people, systems, and information), processes and activities drive KPIs. Driver measures comprise of all these inputs, process and activities.

Figure 13 below describes the link between KPIs and driver measures. KPIs are part of the strategic side of an organization and driver measures are from the operational side. It is important to highlight that an organization may have many measures at different levels of their business and not all of them can be considered drivers of KPIs. Only measures that are highly correlated to KPIs are considered driver measures and rest of them are shown in the diagram below as regular measures. Strategic level cause-and-effect relationships between two KPIs are also shown in the diagram. These types of relationships can be obtained from a strategy map.

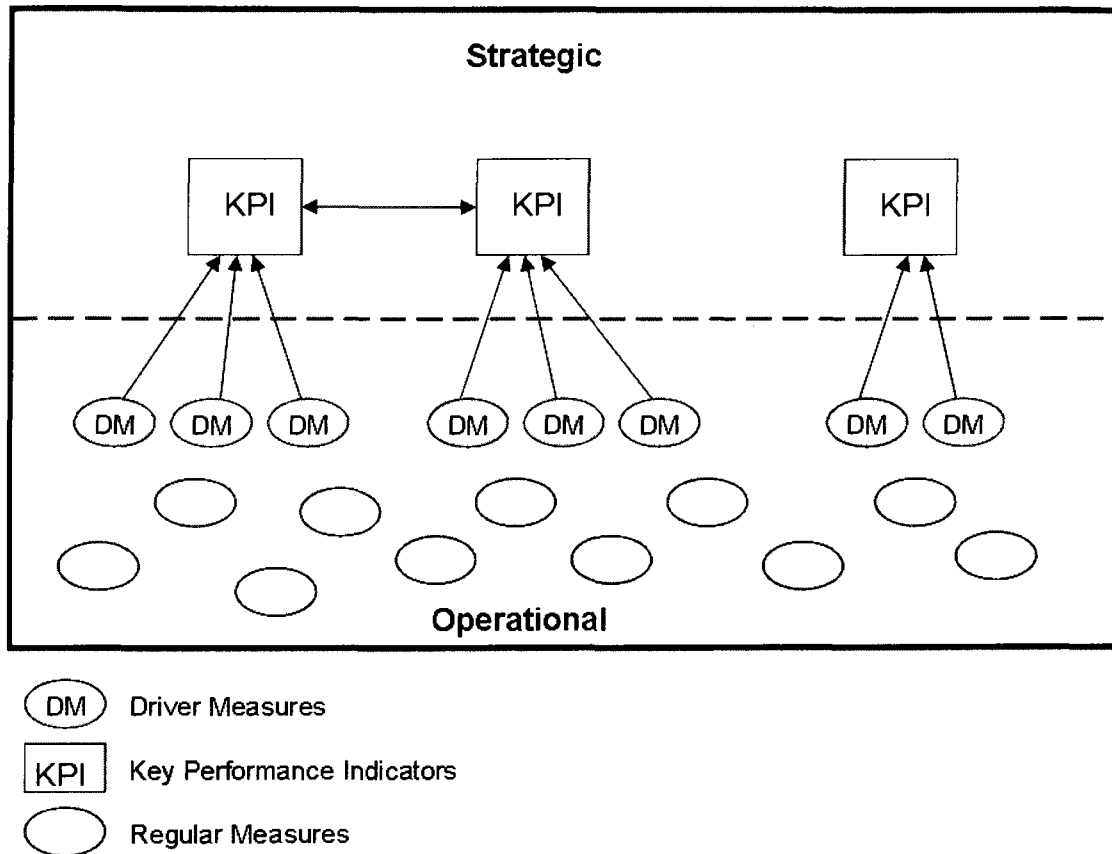


Figure 13 - Driver Measures

3.3.2 Mathematical Techniques

Mathematical techniques are used to build equations and models with driver measures which affect KPIs. This allows the DMEF to quantify the measure relationships between driver measures and KPIs. These equations can be very useful in predicting and forecasting results. However it's worth mentioning that these techniques cannot be solely relied upon for decision making. Mathematical techniques can only provide estimates. There are other factors, qualitative in nature, which are beyond the scope of mathematical modeling. For an example, from the case study, ABC Company will not be able to

quantify how much of buying power its potential customers would have this year which could influence the sales. This is dependent on many factors including health of the economy, consumer confidence, etc.

3.4 Driver Measure Models

3.4.1 Defining Cause-and-effect Relationships

Existing frameworks lack the ability to define cause-and-effect relationships between measures. Current frameworks treat each KPI as independent of other KPIs and they disregard the cause-and-effect relationships between them and between them and driver measures. It can be difficult to effectively and efficiently characterize what can be a very chaotic and unpredictable causality between measures. Nonetheless, measures rarely function independently and there definitely are cause-and-effect relationships between measures. This is certainly applicable to KPIs and driver measures.

Initially a managers' domain knowledge or brain storming sessions can be carried out to identify the cause-and-effect relationships between measures. However these relationships can be validated with formal processes such as business process modeling and statistical analysis using historical data. Cause-and-effect relationships give an organization the ability to plan and predict results based on certain drivers and take corrective decisions as necessary to improve performance. However it is important to point out that this predictability cannot guarantee success. It can only offer a higher probability for success. There are many qualitative and unforeseen factors beyond an organization's control which cannot be defined in cause-and-effect relationships.

Defining cause-and-effect relationships, allow the organization to work with its known variables for decision making as opposed to a “shooting in the dark” approach.

It is important to identify cause-and-effect relationships among the following areas to manage corporate performance effectively.

- 1) Between strategies and key performance indicators
- 2) Between key performance indicators and driver measures

The key benefit of defining these relationships is it shows how operations tie up and roll into corporate strategies making the framework very effective at the strategic level. A strategy map can link KPIs to strategies and Driver Measure Models can link KPIs to driver measures. In doing so, Driver Measure Models in effect link strategies to operations. Figure 14 below shows how driver measures are linked to strategies.

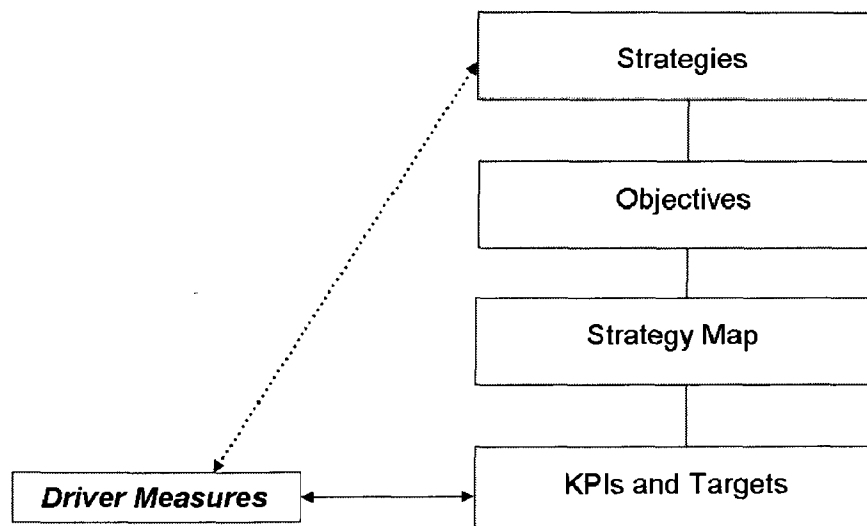


Figure 14 – Strategies and Driver Measures

There are various methods available to define cause-and-effect relationships between these measures. The following methods are common.

- business process modeling
- managers' domain knowledge
- activity based costing
- analytic hierarchy process
- statistical analysis

Some of these approaches are process oriented and some can be expressed as mathematical techniques. The following subsection discusses some of these methodologies for developing cause-and-effect relationship between KPIs and driver measures.

3.4.1.1 Business Process Modeling

Lin et al., define a business process as “a series of activities, often involving several organizational units and operated by actors (humans or machines) that are aiming to create value for customers” [Lin et al., 2002]. Business process modeling and managers' domain knowledge are the two key techniques used to demonstrate cause-and-effect relationships between key performance indicators and driver measures in the thesis. By listing out all the business process related to a KPI, an organization can identify “what, how and where” to measure KPIs. For an example, consider “Average Total Order Processing Time” as one of the KPIs for an organization which produces larger size cars, by identifying all the relevant business processes (driver measures) related to order

processing (e.g. order placed, payment history check, inventory availability, shipping), we can link all the relevant driver measures for this KPI. Figure 15 below explains this. Figure 15 shows that the KPI, “Average Total Order Processing Time” is driven by the following driver measures: “Order completion time”, “Credit check time” and “Production cycle time”.

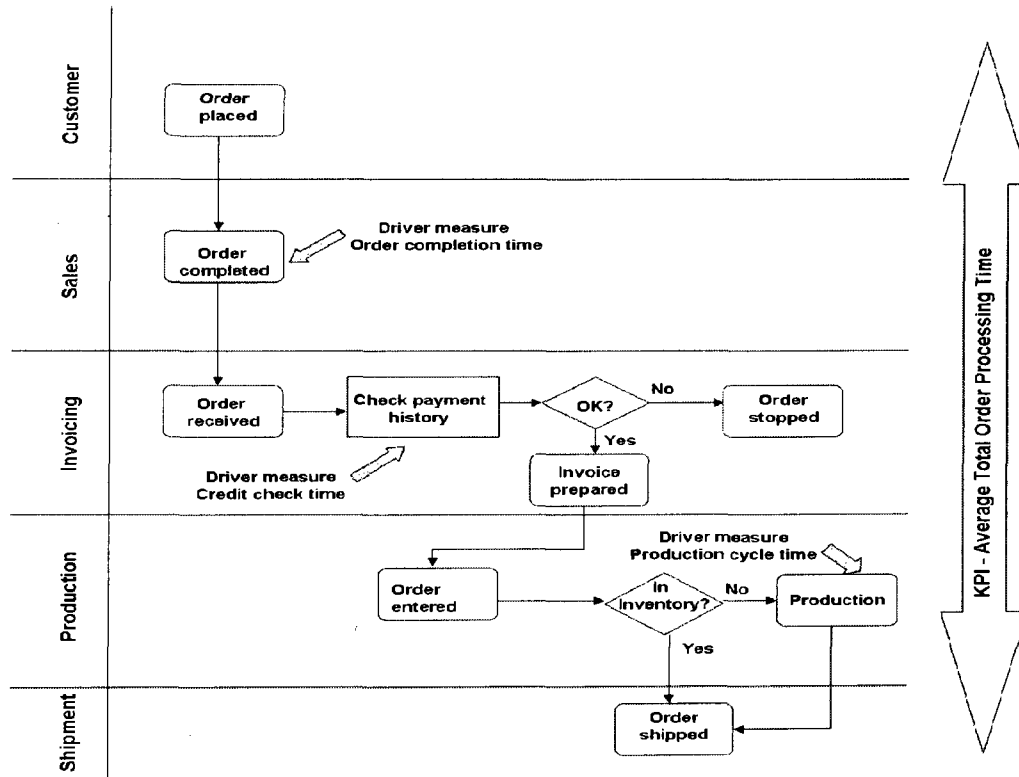


Figure 15 - Business Process Modeling

3.4.1.2 Managers' Domain Knowledge

Another way to define the cause-and-effect relationship between two measures or activities is a managers' domain knowledge. Managers are heavily involved in day to day business operations and will have learned the typical pattern of relationships between measures from their day to day experience. They can easily map out the drivers for a key

performance indicator quickly. Further statistical analysis might be required to understand the correlation sensitivities between a KPI and its respective drivers. However managers' domain knowledge can be the foundation for this analysis.

3.4.1.3 Activity Based Costing

Activity based costing is a methodology that uses “cost drivers that are related to unit-level, batch-level and product-level characteristics. Examples of batch-level bases include set-up hours and number of set-ups. Examples of product-level bases include number of parts, number of times ordered and number of engineering charge orders.” [No and Kleiner, 1997] Activity based costing can be utilized to generate cause-and-effect relationship between measures. Using activity based costing; an organization can identify all the drivers of a cost or revenue related measure. For an example, for key performance indicator called “Average Labor Cost”, activity based costing can be used to derive and list out all the drivers for it.

3.4.1.4 Analytic Hierarchy Process (AHP)

Analytic hierarchy process can be used for multiple criteria decision making to achieve a goal. If a key performance indicator is considered the goal to be archived and a collection of driver measures are the criteria, then most appropriate driver measures can be identified using AHP. Pan has demonstrated in article “Identifying Key Performance Indicators of Balanced Scorecard by Analytic Hierarchy Process” [Pan, 2004] on how AHP can be used to derive the most pertinent key performance indicators for Balanced Scorecard. A similar approach can be used to list out the best suitable driver measures for a key performance indicator once the relevant set of driver measures for the KPI are identified.

3.4.1.5 Statistical Analysis

Statistical analysis from the historical data can be used to identify highly correlated driver measures from a collection of driver measures which are chosen either through the business process modeling or managers' domain knowledge. This analysis can help to build the most relevant cause-and-effect relationships between KPIs and driver measures for effective decision making.

3.4.1.6 Cause-and-effect relationships example

The following example demonstrates “defining cause-and-effect relationships” concept. If Company ABC’s strategy is to increase sales revenue by producing large sized, technologically advanced cars. How can ABC define the relationships between “Total Sales Revenue” KPI and the driver measures for that KPI? Initially, using a strategy map, ABC identifies its KPIs from internal business, external and innovation and learning perspectives which drive “Total Sales Revenue”. ABC also identifies financial, customer and external environment related KPIs which can influence “Total Sales Revenue”. Figure 16 below shows all the relevant KPIs to “Total Sales Revenue”.

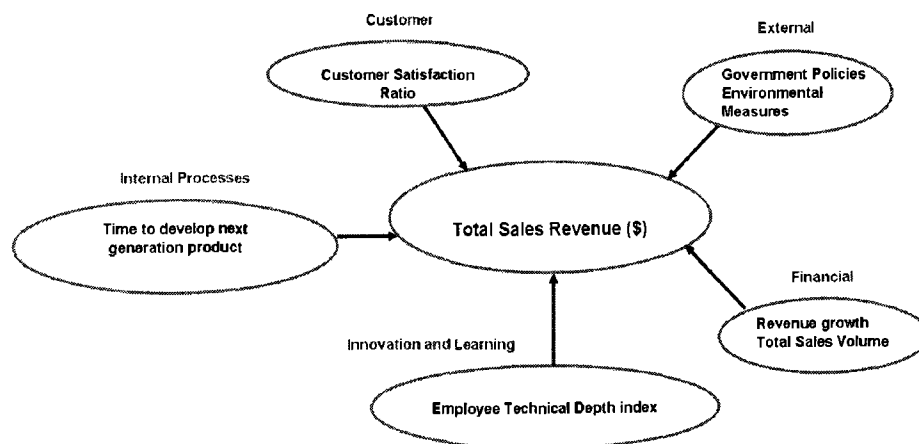


Figure 16 - Total Sales Revenue and other related KPIs

Subsequently business process modeling and management domain knowledge are utilized to identify all the driver measures relevant to KPI “Total Sales Revenue”. Figure 17 below shows all the pertinent driver measures to “Total Sales Revenue”.

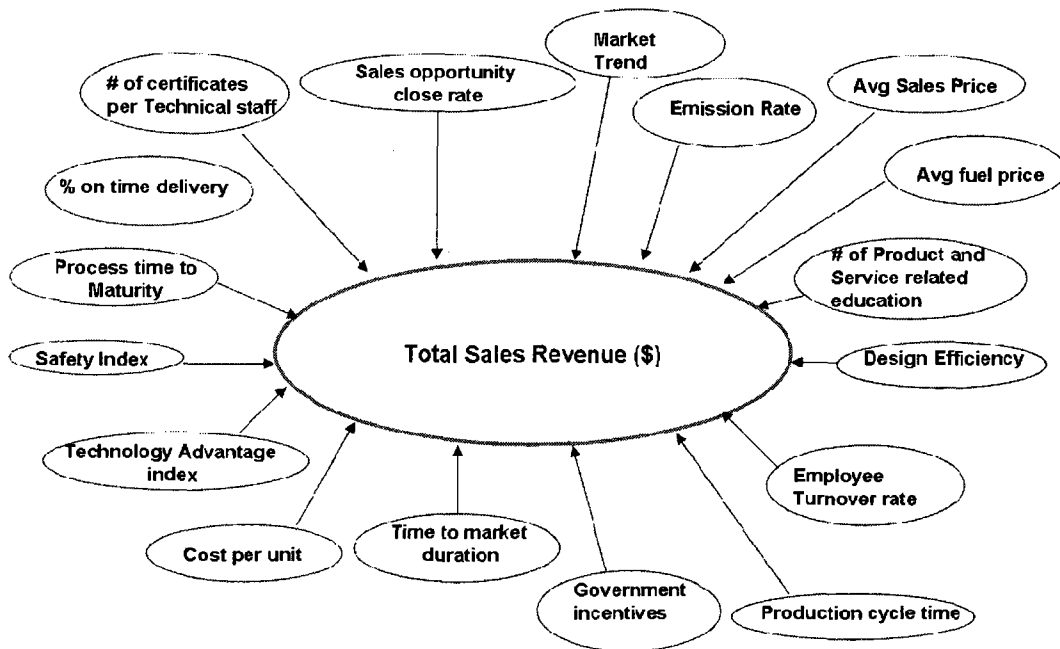


Figure 17 - Total Sales Revenue and its Driver Measures

3.4.2 Quantifying measure relationships between driver measures and KPIs

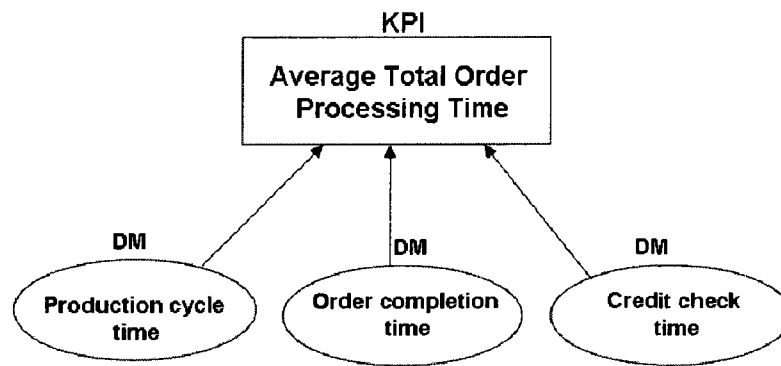
Once the cause-and-effect relationships between KPIs and all driver measures are defined, statistical analysis or analytic hierarchy process can be used to derive the highly correlated driver measures to KPIs. Objective function can be used to maximize sales or minimize cost using these highly correlated driver measures and their respective coefficients. Objective functions can be used to come up with an optimal solution to a problem by applying a collection of strategic actions. Level of inputs required from

highly correlated driver measures can be attained through sensitivity analysis. Sensitivity analysis can be carried out on mathematical techniques to assess the impact on a KPI to the range of variation of an input from a driver measure. Analysis typically involves calculating the output for a few values of a driver measure input that represent the possible range of the input [Salehi et al., 2000]. It is important to emphasize that sensitivity analysis can also help to distinguish the most important driver measure inputs and identify inputs that require further data collection or research [Cukier et al., 1978].

Quantification of measure relationships using mathematical techniques let an organization put cause-and-effect relationship between measures into perspective. For an example, if you are a design engineer who is asked to improve fuel efficiency of large size cars, your first question would be to find out the performance rate i.e. # of km/liter. You would then be interested in finding out what drives the fuel usage (cause-and-effect relationships). Once you identify them, you would want to quantify them so that you can get an optimal design to maximize fuel efficiency. This analogy can be used to explain why it is critical to quantify measure relationships. Quantification of measure relationships allows an organization to plan, predict and forecast optimal solution to improve performance. It allows decision makers to troubleshoot the issue by looking at the relevant drivers and decide on best cause of actions to solve the issue with conviction.

Figure 18 shows a simple example of mathematical techniques which are used to quantify the relationships between KPIs and its driver measures. This example is on “Average Total Order Processing Time” KPI. Its driver measures are derived using business process modeling as shown in figure 15. Figure 15 illustrates that the KPI

“Average Total Order Processing Time” is driven by “Production cycle time”, “Order completion time” and “Credit check time”. An objective function is developed to minimize the KPI’s value. The function takes a set of strategic action plans (a=1, A) to minimize the “Average Total Order Processing Time”.



Objective Function

Minimize Average Total Order Processing Time

$$\sum_{a=1}^A U_p P + U_p O + U_p C$$

A = Strategic Action Plan

Subject to constraints

Production Capacity < 15000
 Production labour hours < 200000 hours
 Order completion labour hours < 10000 hours
 Credit check labour hours < 1000 hours
 Total labour cost < \$X

U_p = Unit processed
 P = Production time/unit
 O = Order completion time/unit
 C = Credit check time/unit

Figure 18 – Mathematical Equation for Average Total Order Processing Time KPI

3.5 Systematic Problem Solving

The first question which comes to mind when we are trying to solve an issue is “where is the issue? If an executive is not satisfied with a KPI’s performance, then the executive can look at the strategy map and identify where issue is at the strategic level. Once the executive identifies where the issue is, the second question would be “How do I solve the issue?”. This question leads to driver measures. One needs to understand all the related drivers of a KPI and how these drivers affect one another before coming up with an action plan to solve the issue. Once the executive identifies the drivers, he or she would then be able to do sensitivity analysis using mathematical technique on the drivers to find the action plan which will lead to an optimal solution. Sensitivity analysis allows executives to tweak the level of input required from each of the affected driver measures to the KPI in the mathematical model and come up with the best possible solution based on costs and benefits. Once these steps are completed, executive will be able to make a decision to tackle the issue with high confidence. The Driver Measures Enhanced Framework (DMEF) provides decision makers methodologies necessary for a systematic approach to decision making and problem solving. This approach offers executives higher degree of repetitive success than the exiting frameworks.

Figure 19 below shows the work flow for troubleshooting an issue systematically using DMEF. When an executive identifies a problem with a KPI, an executive can take a look at the strategy map and see how this KPI is linked to objectives and strategies. Subsequently, the executive can look into Driver Measure Models to see the relevant

driver measures and understand what kind of decisions need to be made to improve the KPI. Mathematical techniques can be used to predict and forecast results by changing the driver measures which are directly linked to operational activities. Based on the outcome of this analysis, appropriate decisions can be made to achieve an optimal solution. This is a systematic way to resolve the problem.

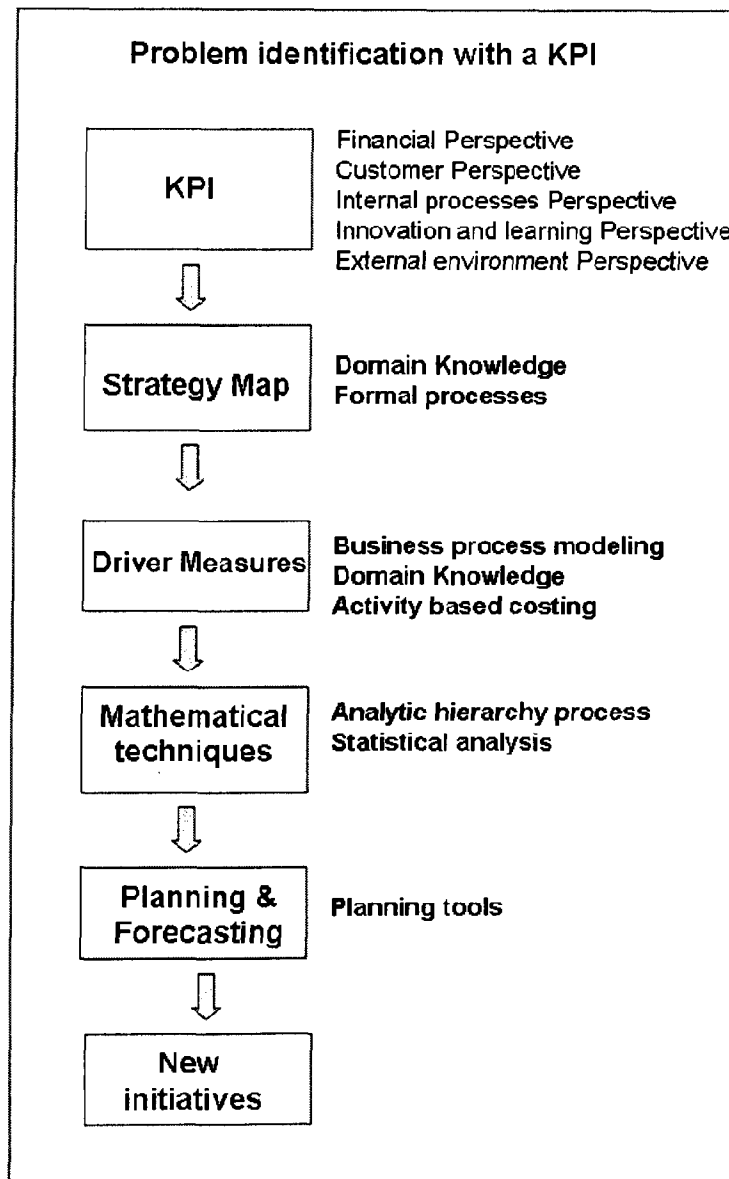


Figure 19 – Systematic Problem Solving

4 Case Study

4.1 Case Study Approach

A case study was conducted to demonstrate how the Driver Measures Enhanced Framework and its Driver Measure Models is able to address gaps in current performance management systems. A full evaluation and comparison of DMEF with other performance management frameworks is given in Chapter 5.

The case study takes a top down approach to show all the related concepts and components of performance management for ABC Company, which is an imaginary company, although the numbers and analysis done is representative of current practice in industry. ABC Company and its numbers are an example situation which was constructed based on my years of experience working in industry with similar data. It would have taken several years to collect data from physical implementation of a Driver Measures Enhanced Framework. This is not a practical approach to the thesis. Thus representative sample data was used for the study. ABC Company's shareholders wants and needs are highlighted and overall business strategy is formulated to achieve these requirements. Steps on how to translate the business strategy into objectives and KPIs are discussed.

The focus of the case study is on sales performance measures. Organization ABC seems to have concerns with its sales performance. It has not been able to achieve its sales revenue and volume targets for the last few years. Driver Measure Models are introduced to analyze where the issues are with sales performance. We also use the case study to show how other frameworks would have approached the problem. Use of these

frameworks was based on my experience with them in industry as well as following the format outlined in the thesis references for them.

In section 4.2, we introduce the problem which needs to be analyzed. In section 4.3, we discuss how other frameworks would approach the problem. In section 4.4 we show, in detail, how Driver Measures Enhanced Framework approaches the problem. The effectiveness of these approaches is evaluated and summarized in chapter 5.

4.2 Case Study - Problem

ABC Company which has been producing large size cars is seeing its sales revenue and volume dropping over the last few years. It has only met 57% of its sales revenue and 50% of its sales volume targets globally for 2009. Executives are struggling to understand the cause for its poor sales performance.

The corporate vision of ABC Company is to be the industry leader in the market for large cars by 2015. Table 1 below shows the 2009 sales data. However it has been losing market share to other car manufacturers in the industry. Its mission is to provide very comfortable cars through state of the art technology to achieve customer satisfaction.

Vision: Be the industry leader in the market for large cars by 2015.

Mission: Provide very comfortable cars through state of the art technology to achieve customer value and satisfaction.

Core Values: Improve annual sales by 10% through customer focus and satisfaction.

Year 2009		
	Actual	Target
Sales Volume (units)	10,000	20,000
Sales Revenue (\$)	\$400,000,000	\$700,000,000

Table 1 – ABC Company's 2009 Sales Results

4.3 Approaches - Other Frameworks

In this section, we discuss how EFQM, Performance Prism and Balanced Scorecard can be used to approach the problem based on my experience with these frameworks in industry as well as following the format outlined in the thesis references for them.

4.3.1 EFQM Excellence Model™

Assuming ABC Company is using EFQM Excellence Model as its corporate performance measurement system; thesis shows what would be the recommended way to find out where the issues are with sales performance. Table 2 below shows an example of the current self assessment results which would have been conducted on ABC Company using EFQM Excellence Model™. Self assessment on the nine EFQM criteria can be conducted using workshop, discussions, surveys, questionnaires and check list with top management, employees and sample customer base. [Porter et al., 1998; Camisón, 1996; Yang et al., 2001]

EFQM Criteria	Company ABC Score	Industry Score
Leadership	55%	68%
People Management	75%	65%
Policy & Strategy	58%	75%
Resources	61%	70%
Business Processes	68%	73%
People Satisfaction	80%	72%
Customer satisfaction	58%	71%
Impact on Society	58%	73%
Business results	50%	65%

Table 2 – ABC Company’s EFQM self assessment results

Using the above results from the self assessment, we can see that the business scores do not produce the expected results. This is evident from the self assessment score as well as the sales revenue numbers for this year - highlighted in table 1 containing 2009 sales results. What are the next steps top executives need to take? They may need to trace back to the lowest level of details on how the scores are calculated and identify where the scores are low. This is not a straightforward task. Going back to the surveys, minutes of the meetings, questionnaires, discussions and check list can give insight into what needs to be improved and what policies and strategies need to be modified. This is not a flexible approach. This process takes a long time to complete. Even if it is completed, it will take another cycle to realize the results of the changes made as there is limited ability to plan, predict and forecast with the framework.

4.3.2 Performance Prism

Assuming ABC Company is using Performance Prism as its corporate performance measurement system; this shows what would be the recommended way

for executives to find out where the issues are with the sales performance. Table 3 below shows an example of how the Performance Prism framework would be set up based on the stakeholder wants and needs. It lists out key questions on all five prism components (stakeholder satisfaction, strategies, processes, capabilities and stakeholder contribution) which need to be answered to address respective stakeholders' requirements [Neely et al., 2001]. Sample key performance indicators are listed for stakeholder satisfaction and strategies components to demonstrate the approach.

Now that we have shown the process of setting up the Performance Prism framework, we can look at the specifics of how executives would be able to analyze the sales performance results using Performance Prism. Table 4 depicts sample relevant measures and their results for 2008 and 2009. ABC Company does not meet its sales volume and revenue targets. Its revenue and market share are on the decline. How would the executive get to the bottom of the issues? They can go through all the relevant measures and identify where the issues are. However, this framework does not show relevant relationships between sales and driver measures in the framework. Further analysis would be required to understand the poor performance. This may lead to some clues as to what needs to be changed. Executives have to draw conclusions using their own experiences. There is no scientific evidence available to show executives where exactly the problem is. The problem could be with its internal factors such as strategies, capabilities or processes. Alternately, the problem could be due to external factors such as rising gas prices and environmental and emission concerns with large cars. And it could also be related to incentives governments are introducing to encourage people to buy

smaller eco-friendly cars. However this framework does not do a good job in linking external variables to its internal key performance indicators.

Stakeholders	Management	Shareholders	Customers	Employees	Society
Stakeholder satisfaction	Are we going to deliver on our targets for this year? Measures: Total Sales Revenue Total Sales Volume	Is the company going to be profitable this year? Measures: Net Revenue Net Profit Share Price Earning per Share Cash flow	How satisfied our customers are? Measures: Customer Satisfaction Ratio	Do we have high employee satisfaction? Measures: Employee Satisfaction Ratio Turn over rate	Are we able to meet the society and government agencies demands? Measures: Safety Rating Emission Rating
Strategies	Are all our strategies are working to achieve our targets? Do our strategies line up with our vision/mission to be the industry leader for large size cars by 2015? Measures: Market share Revenue growth	Are the strategies management defined working to achieve profit and business growth? Measures: Market share Share price growth Dividend paid out	Are revenue growth and quality strategies working? Measures: % on time delivery Customer Retention count Customer referral count % of sales from new customers % of sales from new products	Are our people management strategies working? Measures: Training cost per headcount Succession planning rate Promotion rate # of training courses offered Compensation Ratio	Are our society related strategies working? Measures: # of safety complains # of emission related complains # of re-design due to government policy changes
Processes	Do we have right processes in place to achieve our targets?	Can the processes company enabled deliver profits and growth?	Do we have the processes in place to achieve sales growth and quality?	Do we have right processes in place to deliver on people strategy?	De we have processes in place to deliver on society's requirements and demands?
Capabilities	Do we have the technology to deliver state of the art cars?	Do the company has the right capabilities to deliver profits and growth?	Do we have the capabilities to deliver quality state of the art technology made cars to customers?	Do we have the capabilities to support the people strategy?	Do we have the capabilities to deliver on society's demands?
Stakeholder contribution	Are the management executing proper strategy to achieve company's vision/mission?	Are the shareholders providing support and feedback on company's performance?	Are the customers loyal and paying on time? Are they providing proper feedback on products?	Are the employees delivering to company's success?	Are the government agencies providing enough support to company's growth?

Table 3 - Performance Prism Grid

Measures	Actual 2008	Actual 2009	Target 2009
Total Sales Revenue (\$)	\$450,000,000	\$400,000,000	\$700,000,000
Total Sales Volume	12000	10000	20000
Market share	55%	50%	60%
Revenue growth	-5%	-8%	10%
Avg Unit price	\$38,000	\$40,000	\$37,000
Customer Satisfaction Ratio	65%	58%	70%
Fuel Consumption (L/100 km)	City:13/Highway: 8.2	City:13.5/Highway: 8.9	City:11/Highway: 7
% on time delivery	80%	70%	90%
Customer referral count	3000	2000	4000
% of sales from new products	60%	40%	70%
Safety Rating	4 Stars	4 Stars	5 Stars
# of safety complaint	1200	1000	200
Production cycle time	50 days	55 days	50 days
Delivery cycle time	10 days	12 days	10 days
Unit cost per car	\$20,000	\$22,000	\$18,000
Design Efficiency (out of 100)	90	80	90
Technology Advantage index (out of 100)	80	82	90
Time to develop next generation product	100 days	110 days	90 days
Process time to maturity	2 years	2 years	1 year
Time to market duration	130 days	135 days	100 days
Employee Satisfaction Ratio	85%	80%	90%
Turn over rate	10%	15%	10%
Training cost per headcount	\$2,000	\$2,500	\$2,000
Employee Technical Depth index (out of 100)	90	85	90

Table 4 – ABC Company's performance results using Prism

4.3.3 Balanced Scorecard

Assuming ABC Company is using the Balanced Scorecard as its corporate performance measurement system; we show how executives would be able to find out where the issues are with sales performance. The company's business strategy is to improve annual sales by 10% each year by focusing on quality, innovation and customer needs. By adopting this business strategy, ABC Company is planning to reach its vision of being the market leader by 2015. Figure 20 below shows ABC Company's corporate strategy map which translates the strategies into objectives. Strategies are defined based

on the company's vision and mission. Key performance indicators which need to be reported on the Balanced Scorecard are developed from the strategy map and these key performance indicators are aligned with company's strategies, vision and mission.

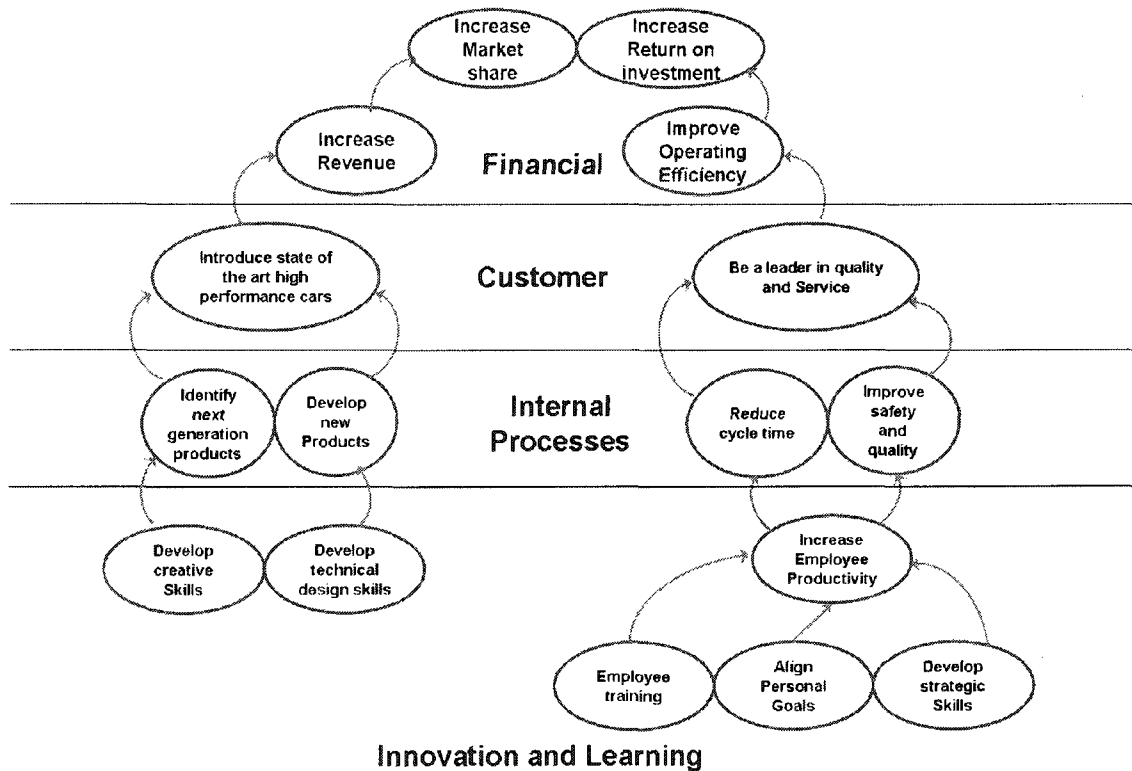


Figure 20 - ABC Company's corporate strategy map

Figure 21 below shows what ABC Company's Balanced Scorecard would look like. Key performance indicators, its results and respective targets are listed in the Balanced Scorecard. As shown in the Balanced Scorecard, sales performance does not meet the expectations. Executives would be able to trace back through the strategy map and try to identify the issues.

Company ABC Balanced Scorecard				
Vision				
Be the industry leader in the market for large cars by 2015.				
Mission				
Provide very comfortable cars through state of the art technology to achieve customer value and satisfaction.				
Core Values				
Improve annual sales by 10% through customer focus and satisfaction.				
Business Strategy				
Improve annual sales by 10% each year by focusing on quality, innovation and customer needs.				
Objective 1 - Financial Perspective				
Increase Sales and market share				
Measures	Actual 2008	Actual 2009	Target 2009	Initiatives
Total Sales Revenue (\$)	\$450,000,000	\$400,000,000	\$700,000,000	New marketing campaign
Total Sales Volume	12000	10000	20000	New marketing campaign
Market share	55%	50%	60%	Reduce price
Revenue growth	-5%	-8%	10%	New technology introduction
Avg Unit price	\$38,000	\$40,000	\$37,000	
Objective 2 - Customer Perspective				
Be a leader in quality and Service and introduce state of the art high performance cars				
Measures	Actual 2008	Actual 2009	Target 2009	Initiatives
Customer Satisfaction Ratio	65%	58%	70%	
% of sales from new products	60%	40%	70%	
Objective 3 - internal processes				
Identify next generation products and Develop new Products				
Measures	Actual 2008	Actual 2009	Target 2009	Initiatives
Design Efficiency (out of 100)	\$90	\$80	\$90	
Technology Advantage index (out of 100)	80	82	90	
Time to develop next generation product	100 days	110 days	90 days	
Process time to maturity	2 years	2 years	1 year	
Time to market duration	130 days	135 days	100 days	
Objective 4 - internal processes				
Reduce cycle time and improve safety and quality				
Measures	Actual 2008	Actual 2009	Target 2009	Initiatives
Production cycle time	50 days	55 days	50 days	
Delivery cycle time	10 days	12 days	10 days	
% on time delivery	80%	70%	90%	
Unit cost per car	\$20,000	\$22,000	\$18,000	
Safety Rating	4 Stars	4 Stars	5 Stars	
# of safety complaint	1200	1000	200	
Objective 5 - innovation and learning Perspective				
Develop technical design skills and increase employee productivity				
Measures	Actual 2008	Actual 2009	Target 2009	Initiatives
Training cost per headcount	\$2,000	\$2,500	\$2,000	
Employee Technical Depth index (out of 100)	90	85	90	
Employee Satisfaction Ratio	85%	80%	90%	
Turn over rate	10%	15%	10%	

Figure 21 - ABC Company's corporate Balanced Scorecard

Alternatively, executives can go through cascading business unit level Balanced Scorecards to see where the issues are. This is a tedious procedure. There could potentially be many business unit Balanced Scorecards to go through. Even if executives can go through all of the lower level (tier 2) Balanced Scorecards and identify issues with respective business units, how would they be able to link these business unit problems to the corporate performance (tier 1)? Executives can draw upon their experience and knowledge to make some conclusions and decisions. However, they don't have a systematic way of analyzing the problem. Executives don't have clear visibility into operational level variables which affect sales directly or indirectly. Figure 22 below shows how the executives would have tried to evaluate the issue based on the data available to them at the corporate and the business unit levels. It would have been an exercise where they would use their domain knowledge to draw conclusions. It is evident that there is no systemic way to analyze the problem.

Objective 1

Increase Sales and market share

Tier 1 – Corporate Scorecard Objectives

Measures	Actual 2008	Actual 2009	Target 2009	Initiatives
Total Sales Revenue (\$)	\$450M	\$400M	\$700M	New marketing campaign
Total Sales Volume	12000	10000	20000	New marketing campaign
Market share	55%	50%	60%	Reduce price
Revenue growth	-5%	-8%	10%	New technology introduction

Tier 2 – Business Unit Scorecard Objectives

Could this have caused the poor sales performance?

Measures	Actual 2008	Actual 2009	Target 2009	Initiatives
Turn over rate	30%	35%	10%	

Sales Business Unit

Could this have caused the poor sales performance?

Measures	Actual 2008	Actual 2009	Target 2009	Initiatives
Employee Technical Depth	85	80	90	

R&D Business Unit

Figure 22 - Cascading Scorecards

4.4 Driver Measures Enhanced Framework

In our Driver Measures Enhanced Framework (DMEF) implementation, we extended and revised the work described in 4.3.3 for Balanced Scorecard. ABC Company has a clear vision to be the industry leader for large cars by 2015. Its mission is to provide very comfortable cars through state of the art technology to achieve customer value and satisfaction. Its business strategy is to improve annual sales by 10% each year by focusing on quality, innovation, efficiency and customer needs. Although all the relevant key performance indicators related to ABC Company are listed, we now focus

on two key performance indicators to demonstrate the value of DMEF. We will analyze the following key performance indicators in details.

- Total Sales Revenue
- Market Share

4.4.1 Identify KPIs needed on the Driver Measures Enhanced Framework

Understanding the vision and mission of ABC Company is critical for business strategy formulation. Objectives are defined from the business strategy. Once the objectives are defined, key performance indicators which need to be identified on the Driver Measures Enhanced Framework are developed. ABC Company's performance is measured using these key performance indicators and their respective targets. Table 5 below shows a sample of key performance indicators from the five perspectives; financial, customer, internal processes, innovation and learning, external environment. It is important to highlight again that Driver Measures Enhanced Framework has a fifth perspective (external environment) which Balanced Scorecard does not possess. For example, KPIs "Fuel Price" and "Market Trend" are additions to DMEF which are not part of Balanced Scorecard framework.

Key Performance Indicators
Total Sales Revenue (\$)
Total Sales Volume
Market share
Revenue growth
Avg Unit price
Customer Satisfaction Ratio
% of sales from new products
Delivery cycle time
Design Efficiency (out of 100)
Technology Advantage index (out of 100)
Time to develop next generation product
Employee Satisfaction Ratio
Turn over rate
Training cost per headcount
Employee Technical Depth index (out of 100)
Market Trend
Fuel Price

Table 5 - ABC Company's Sample KPIs list

4.4.2 Cause-and-effect Relationships between Sales Performance KPIs and Driver Measures

One of the key features of the Driver Measure Model is its ability to link KPIs to driver measures. A strategy map which links strategies to objectives is used as the starting point for the process. From the objectives, key performance indicators can be developed. Figure 23 below shows ABC Company's sample strategy map which is pertinent to the case study. It shows the relationships between relevant sales strategies, objectives and key performance indicators.

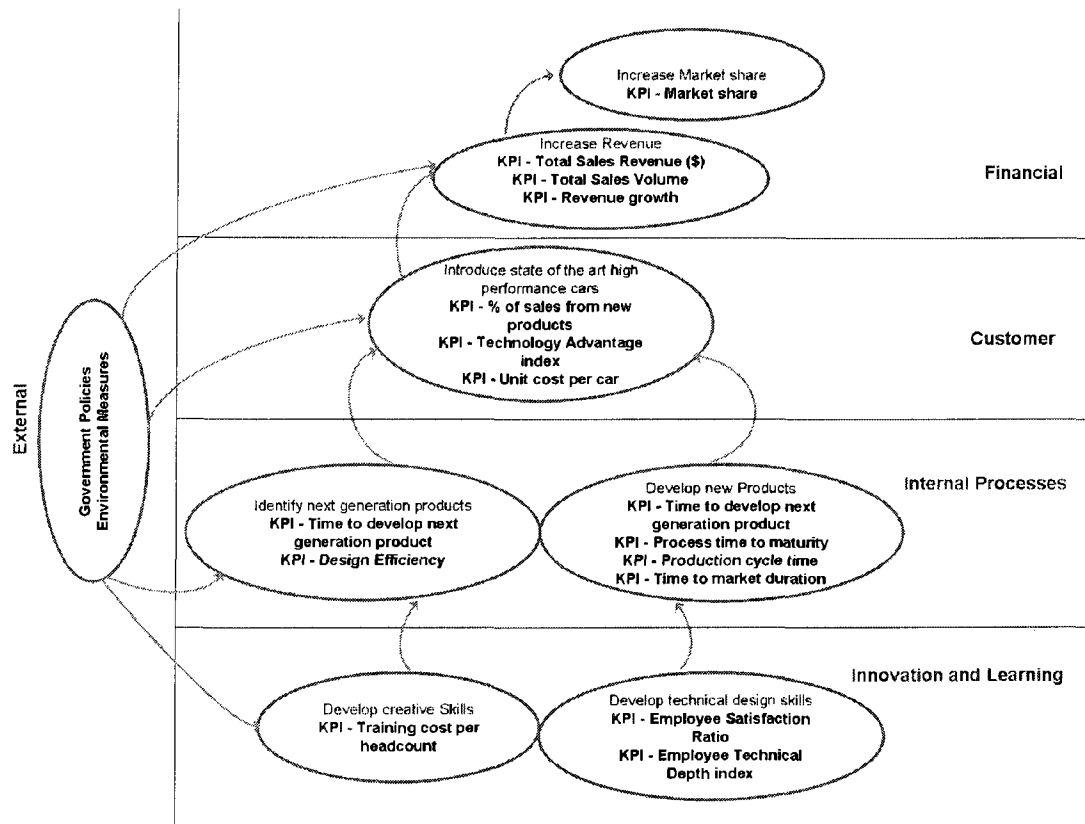


Figure 23 –Strategy Map of ABC Company's Sales objectives and KPIs

The case study demonstrates cause-and-effect relationships between measures using two key performance indicators, “Total Sales Revenue”, “Market Share” which are critical for evaluating sales performance. What drives the sales revenue and market share for ABC Company is illustrated using a cause-and-effect diagram.

Figure 24 below shows how sales are affected directly or indirectly by other measures which help to derive driver measures. It is important to highlight that cause-and-effect relationships between KPIs from the strategy map can help to derive driver measures. For an example, you can see that sales revenue is driven by customer satisfaction which has its own driver measures. Indirectly these driver measures affect the

“Total Sales Revenue” KPI. Figure 24 below shows all the KPIs and driver measures which are pertinent to “Total Sales Revenue”. Some of these measures are highly correlated to the “Total Sales Revenue” and some are weakly correlated. External perspective, one aspect not discussed in the Balanced Scorecard, is shown in the diagram as well. As discussed in Chapter 3, this is an important aspect to consider when creating a Driver Measure Model.

Domain experience and business process modeling methodologies were used to derive these cause-and-effect relationships.

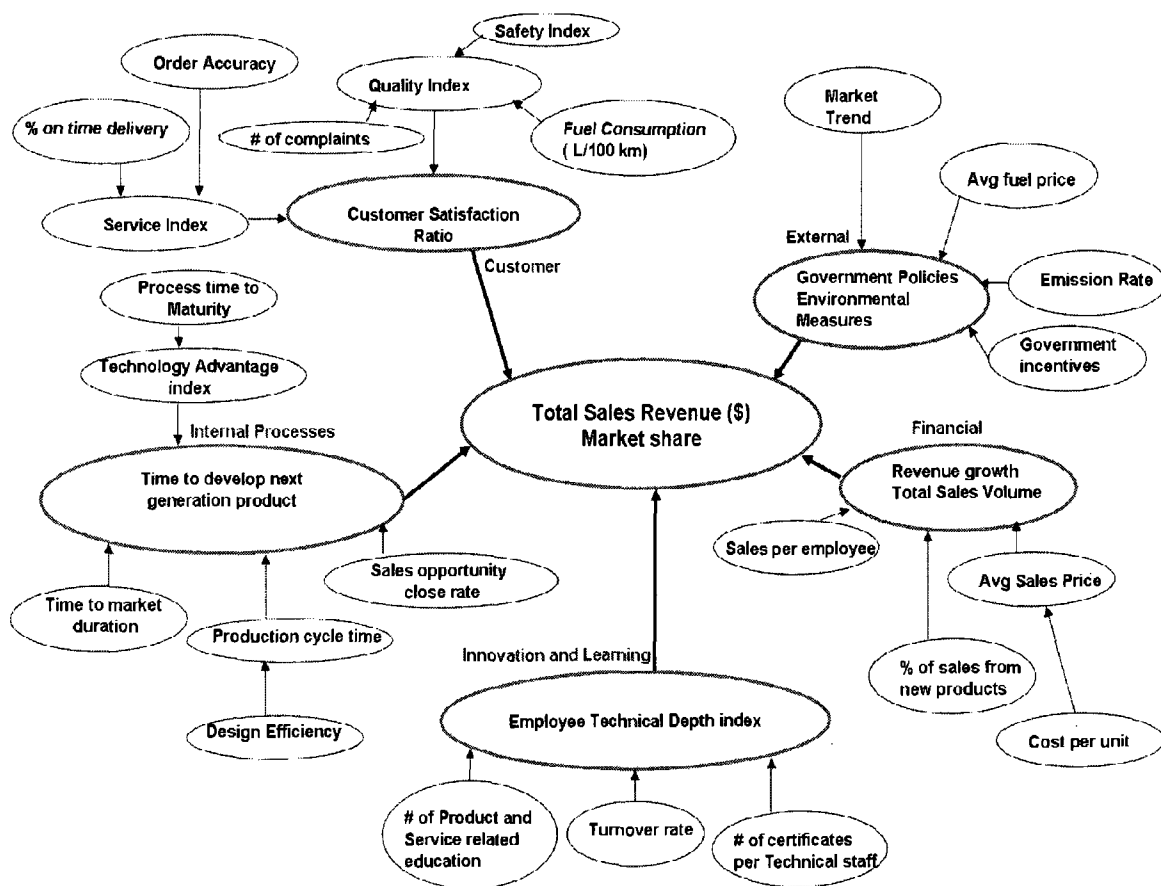


Figure 24 - Cause-and-effect relationships between KPIs and Driver Measures

In addition the Driver Measure Model further highlights key performance indicators-driver measures relationships by organizing them into a measure hierarchy. There are many ways to graphically illustrate and analyze the cause-and-effect relationships between KPIs and driver measures and following describes one of the many ways. For an example, a hierarchy of measures for “Total Sales Revenue” is built where “Total Sales Revenue” is at the root followed by “employee technical depth index”, “customer satisfaction ratio” and “time to develop next generation product” KPIs as level one and “production cycle time” and “service index”, etc. as level 2. Hierarchical organization of measures can allow an organization to choose appropriate level of details when analyzing issues with performance. Figure 25 below illustrates a hierarchical view of the most relevant and highly correlated driver measures to “Total Sales Revenue” and “Market Share” KPIs. There many ways to graphically illustrate the cause-and-effect relationships between KPIs and driver measures.

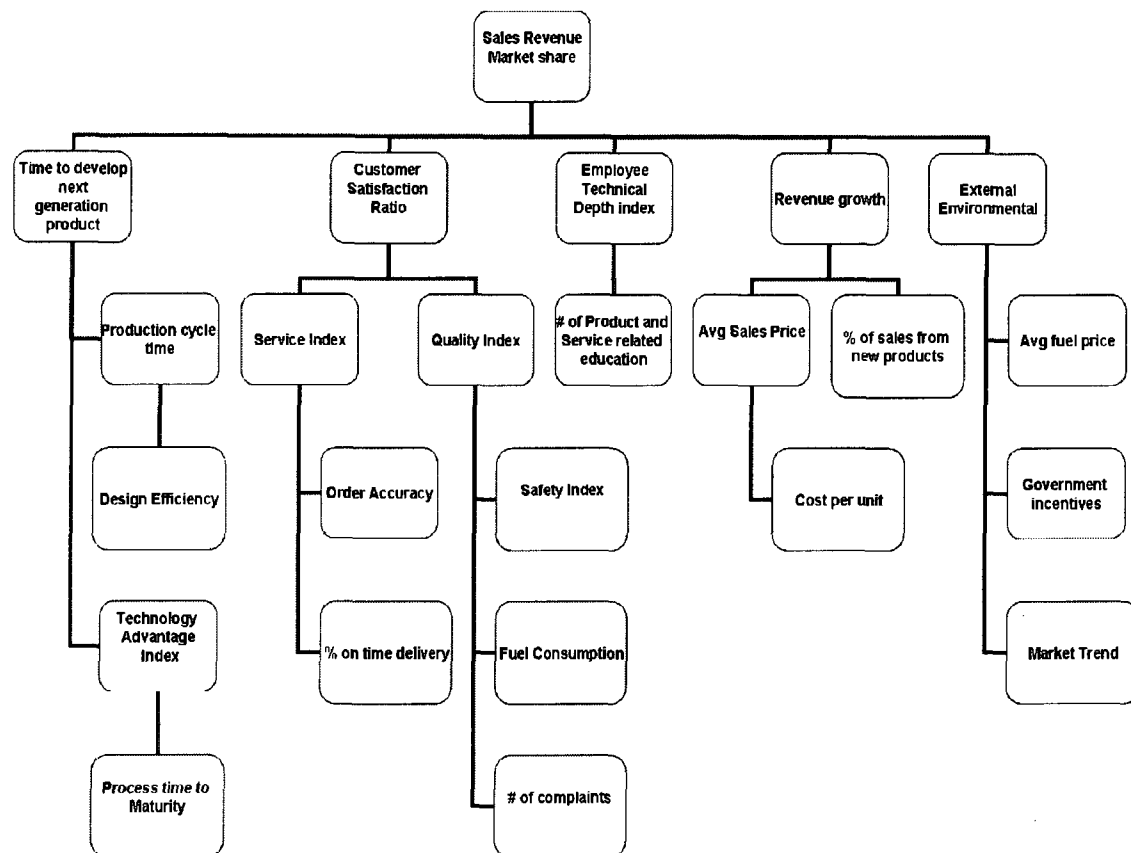


Figure 25 - Cause-and-effect relationships in a hierarchical view

As discussed earlier, sales performance for 2009 is far below expectation. Now let's ask the same question again to see if we have enough information to answer the question with the driver measure approach. How would the executives get to the bottom of the issues with sales performance? Having mapped out all the pertinent cause-and-effect relationships between two sales performance KPIs and driver measures in question, we now have a vehicle to troubleshoot the issue. We are able to identify the chain of driver measures which affect and influence the KPIs. We discuss how to quantify these relationships in the next section.

4.4.3 Quantify the relationships

In the previous section we illustrated how to link the KPIs to driver measures. Creating a map of relevant measures allows us to identify where the issues are. However we need to be able to quantify these relationships in order to plan, predict and forecast KPI's outcome while changing some of its driver measures. Quantification of measure relationships leads to mathematical techniques. For this case study, we developed a simple mathematical technique using an objective function to maximize the sales revenue. It is important to highlight that the thesis hardly scratched the surface of mathematical techniques. Real data is not available to go into detail mathematical and statistical analysis in the thesis. Thesis attempts to show an example of a mathematical objective function which can be used as a technique to derive an optimal solution for a problem in performance management. The sensitivity of the results with respect to the driver measures (parameters) used need to be analyzed in further studies. Advanced statistical methods are required to understand the correlation between KPI and each of the driver measures. Equation below (Figure 26) shows a sample objective function which tries to maximize "Total Sales Revenue". The coefficients in the objective function are assigned arbitrarily. However they could be derived using statistical analysis in further studies. Objective function in Figure 26 describes how "Total Sales Revenue" can be maximized by tweaking its affected driver measures. Objective function is subject to certain constraints and the constraints are listed in the below objective function. Equation shows that there is base revenue ($U_a M_a$) and quality (Q_a), service (S_a), safety (H_a) and technology (T_a) improvements can affect the sales positively. Whereas the capital cost

(C_a), labor cost (L_a), R&D cost (I_a) and government incentives for fuel efficient cars (G_a) can affect the sales negatively.

Objective Function

Maximize Sales Revenue Z

$$\sum_{a=1}^A (U_a M_a + 0.01 U_a Q_a M_a + 0.01 U_a S_a M_a + 0.15 U_a T_a M_a + 0.05 U_a H_a M_a - 0.01 U_a G_a M_a - L_a W_a - K_a C_a - I_a X_a)$$

Subject to constraints

Total production cost $\rightarrow K_a C_a + L_a W_a + I_a X_a \leq \X

Production output dependent on Labor, Capital and Innovation units $\rightarrow F^a(W_a, K_a, X_a) = P_a$

Production Capacity $\rightarrow P_a \leq 15000$

Fuel Efficiency dependent on Design Efficiency and Technical Depth $\rightarrow Y^a(D_a, E_a) = F_a$

Emission Rate dependent on Fuel Efficiency and Fuel Price $\rightarrow R^a(F_a, F_p) = N_a$

Government incentives are dependent on Emission Rate and Fuel Price $\rightarrow V^a(N_a, F_p) = G_a$

A = Strategic Action Plan

U_a = Base Unit Sold

M_a = Avg Sales Price

P_a = Unit Produced

L_a = Labor Unit Cost

W_a = Labor input

C_a = Capital Unit Cost

K_a = Capital input

I_a = Innovation and Learning Unit Cost

X_a = Innovation and Learning unit

Q_a = Quality Index

S_a = Service Index

T_a = Technology Advantage index

H_a = Safety Index

G_a = Government incentives for fuel efficient cars

D_a = Design Efficiency

E_a = Employee Technical Depth index

F_p = Avg fuel price

F_a = Fuel Consumption Per Unit

N_a = Emission Rate

Figure 26 – Sales Revenue Objective Function

4.4.4 Creating a Driver Measures Enhanced Framework

Before showing how Driver Measures Enhanced Framework helps to identify the issues with sales performance in the case study, we would like to explain how the Driver Measures Enhanced Framework would have been organized for effective monitoring, reporting and analysis. Once the business strategy is formulated, ABC Company creates a strategy map to link business strategies to objectives. Subsequently, it develops KPIs for monitoring and reporting using the strategy map and managers' domain knowledge. Related KPIs from external environment are also included in the above process. In addition to KPIs, ABC also generates cause-and-effect relationships between relevant driver measures and KPIs. Using these driver measures and the historical data available in its data warehouse, it performs statistical analysis to identify highly correlated driver measures and its coefficients to "Total Sales Revenue". All of these can be made available to executives to make effective decisions while analyzing a problem.

Below describes my analysis of the recommend way for executives to evaluate the problem with ABC's "Total Sales Revenue" using Driver Measure Models. Executives need to look at the strategy map and see what the relevant KPIs are to "Total Sales Revenue". This would give them a qualitative approach to envisioning the problem. They also have to look at the cause-and-effect relationships between "Total Sales Revenue" and its driver measures to understand all the drivers. Subsequently, executives need to look at mathematical techniques to understand the sensitivities of each of these driver measures. After going through this systematic process, although they are producing technologically advanced quality large size cars, executives would find the problem is with its external factors. Rising fuel prices, growing green environmental campaigns and

government rebates for fuel efficient cars are driving the large car sales down. They would be able to identify the issue through a systematic approach rather than a “hit and miss” process and be in a position to make some strategic changes to improve performance. Would they find a way to improve fuel efficiency or change the business model to produce small fuel efficient cars? This would be entirely up to the executives of ABC to decide. However they would have been given the right framework to make effective decisions. Not only DMEF provides methodologies to identify the problem, it also provides mechanisms to plan and forecast corrective actions.

5 Evaluation

The results of the case study on company ABC are used to evaluate the thesis contributions based on the seven effective performance management criteria discussed in Chapter 3. It is essential to emphasize that the case study was conducted on an imaginary company with some representative sample data which was created based on my industry experience working with similar data. Case study showed, based on the research conducted on these frameworks and my industry experience, how each of the performance management frameworks would have handled the problem. Evaluations of these frameworks follow the same approach. In section 5.1, using the outlined evaluation criteria, we compare Driver Measures Enhanced Framework (DMEF) with the three existing performance management frameworks, EFQM Excellence ModelTM, Prism and Balanced Scorecard (BSC), discussed in Chapter 2. In section 5.2, we summarize differences between the frameworks and provide a pictorial view to visualize the effectiveness of each of the four frameworks. In section 5.3, we evaluate the resources and efforts required to implement a Driver Measures Enhanced Framework.

5.1 Comparison of Frameworks

Table 6 below summarizes how well the frameworks do against each of the seven criteria outlined for effective performance management. Detail evaluation of each of the criteria is discussed in the following section.

Criteria	Frameworks			
	EFQM	Prism	BSC	DMEF
Translate corporate strategy into KPIs	✓	✓	✓	✓
Show cause-and-effect relationships	X	X	Partial	✓
Provide a balanced perspective	Partial	Partial	Partial	✓
Dynamic	Partial	Partial	Partial	✓
Link operations to strategies	X	X	X	✓
Quantify measure relationships	X	X	X	✓
Support an external control process	X	X	X	✓

Table 6 - Comparison of Frameworks

5.1.1 Translate corporate strategy into KPIs

The EFQM Excellence Model™ is used for an organization's self-assessment. Evaluated results can be compared to the industry benchmark, European Quality Award. On-going self assessment is evaluated using the nine set of criteria (leadership, people management, policy, resource management, process management, people management, customer satisfaction, impact on society). These criteria are from multiple objectives which are associated to strategies. Thus deriving KPIs from these nine criteria allows the organization to translate the strategies into KPIs.

Performance Prism has five interrelated components; stakeholder contribution, strategies, processes, capabilities and stakeholder contribution. Developing KPIs from these components allows an organization to translate strategies into measures.

Balanced Scorecard and Driver Measures Enhanced Framework use strategy map to map strategies to objectives and key performance indicators. Thus Balanced Scorecard

and Driver Measures Enhanced Framework provide a methodology to translate strategies into KPIs.

5.1.2 Show cause-and-effect relationships

The key difference between Balanced Scorecard, Driver Measures Enhanced Framework, EFQM and Prism is that both Balanced Scorecard and Driver Measures Enhanced Framework have a methodology to define cause-and-effect relationship between strategies and KPIs. Looking at the strategy map, a decision maker can understand how the strategies and KPIs are linked and how one KPI affects another. Although EFQM and Prism have the ability to translate strategies into KPIs using the 9 criteria or 5 components respectively, they don't have a way to show the relationships between strategies and KPIs. These KPIs are derived as a collection of measures from each of the criteria or components and set to stand as independent entities.

If we look at the Balanced Scorecard and Driver Measures Enhanced Framework closely, Driver Measures Enhanced Framework takes one vital step further in defining the cause-and-effect relationship concept. It has additional provisions to create-and-effect relationship between KPIs and driver measures. This is an important functionality of Driver Measures Enhanced Framework which clearly put Driver Measures Enhanced Framework at the top in satisfying this criterion. Defining the cause-and-effect relationships between driver measures and KPIs allow organizations to take new operational initiative or decisions to improve KPIs. When a KPI does not meet its target, executives now have a systematic process to answer the question of "how do we improve the KPI". This is evident from the case study.

5.1.3 Provide a balanced perspective

EFQM and Prism derive measures from nine criteria and five components respectively. Balanced Scorecard reports measure from four perspectives. All three of these frameworks report measures from the perspective of financial, customer, internal processes, innovation and learning processes which can be considered almost a balanced perspective. However, one aspect these frameworks constantly overlook in their regular monitoring and reporting processes is external environment (society, government policies, market trend, and competition). During self assessment and strategy formulation, all organizations look at external factors regardless of the performance management framework they use. However they don't include them in their standard monitoring and reporting process or cause-and-effect analysis. The Driver Measures Enhanced Framework addresses this important aspect. It is critical to include external factors during cause-and-effect analysis between measures. For example, forecasting sales performance of large SUVs without looking at the fuel price trend (external) may not lead to a good sales prediction for SUVs.

5.1.4 Dynamic

A performance management framework should be able to assist an organization to react swiftly to ever changing stakeholder requirements and external environment. Framework should be able to adapt to changes in the internal and external environment by changing its strategies, objectives, measures, monitoring and reporting processes as quickly as possible when needed.

EFQM assessment provides the current status of an organization. Based on this assessment, an organization can take necessary actions to improve performance. This makes EFQM somewhat dynamic as it helps to identify changes required and allow monitoring process to track the progress towards these changes. However on the scale of 1 to 10, where 1 being very low and 10 being very high, EFQM ranks around 3 in terms of being dynamic. The organization has to wait for the feedback from the next cycle to realize the results of the changes made as it does not have methodology to plan and forecast.

Prism is very similar to EFQM. It allows changes to be made depending on the results from the lagging indicators and wait for the subsequent cycle to get the feedback.

The Balanced Scorecard has the concept of linking KPIs through strategy map. Thus it allows a higher degree of dynamism as the organization can plan, predict and forecast results by changing strategies related to KPIs. However how much prediction can the organization carry out using all the KPIs at the strategic level? Without knowing what drive these KPIs, the predictability analysis conducted has limited usage. Although the Balanced Scorecard is more dynamic than the EFQM and Prism, it is not as dynamic as the Driver Measures Enhanced Framework.

The Driver Measures Enhanced Framework includes cause-and-effect relationships between driver measures and KPIs. Additionally, it provides mathematical techniques to strengthen the planning and forecasting activities. It is very dynamic as it considers KPIs and driver measures from internal and external factors for analysis. Planning and forecasting techniques allow the organization to predict results, while

making the necessary changes, instead of waiting for the lagging indicators results from the next cycle.

5.1.5 Link operations to strategies

EFQM and Prism do not provide methodologies to link operations to strategies. They provide organizations with techniques to derive strategies. However, very little is discussed at the strategic or operational level in terms of defining objectives and measures to achieve strategic goals.

The Balanced Scorecard link KPIs to strategies using strategy maps but it does not link KPIs to driver measures. It is necessary for an organization to identify what operations or actions drive a KPI. This is the best way for executives to plan, predict and arrive at corrective actions to improve KPIs.

The Driver Measures Enhanced Framework contributes greatly to performance management by linking operations to strategies through causal relationships between KPIs and driver measures and quantification of these relationships. In addition, driver measures enable an organization to understand which operational decisions will most greatly influence strategic objectives. This contribution is clearly articulated in the case study.

5.1.6 Quantify measure relationships

The Driver Measures Enhanced Framework presents methodologies to develop mathematical techniques to quantify measure relationships. This is vital for planning, predicting and forecasting outcomes while changing strategies. Quantification of measure

relationships using mathematical techniques allows an organization to understand the sensitivities of the cause-and-effect relationship between driver measures and a KPI. This helps executives to make better decision by selecting the most influential drivers to improve upon.

EFQM, Prism and the Balanced Scorecard do not discuss this concept in their frameworks. This can be considered as a major drawback of these frameworks.

5.1.7 Provide an external control process

It is important for an organization to identify the external factors which affect the business. It is also important to set up a monitoring system to watch these variables as they change in the external environment. EFQM, Prism and the Balanced Scorecard include external environmental factors during their overall business strategy formulation stage. However, they do not monitor and report them as part of their routine performance management. When the lagging indicators do not meet the targets, organizations go through another round of management discussions and analysis and that is when these environmental factors are re-visited.

The Driver Measures Enhanced Framework includes measures from external factors such as competition, market trend, government policies and raw material price trends as part of their routine monitoring and reporting. This allows a Driver Measures Enhanced Framework possessing organization to react quicker to external factors as opposed to the other frameworks which take a few reporting cycles to realize the problem.

For example, ABC Company continues to manage and report its performance on large size cars without looking at the market trend, rising fuel prices and government incentives for low emission cars; sales for its large cars gradually start to slip even though it is successful in achieving its mission of producing technologically advanced quality cars; it will take a while for the decision makers to realize the problem is with its external factors. If ABC used Driver Measures Enhanced Framework, it would have detected the problem much quicker. This example demonstrates how valuable Driver Measures Enhanced Framework is for effective performance management.

5.2 Comparison Summary

Table 6 in section 5.1 summarizes the comparison results for of the seven criteria outlined for effective performance management. All of the frameworks discussed in the thesis have methodologies to translate corporate strategy into KPIs. These are all non-prescriptive frameworks which provide methodologies to formulate strategies and develop KPIs. Terminology on cause-and-effect relationships is not defined in EFQM or Prism. The Balanced Scorecard is rated partial on “cause-and-effect” criterion as strategy map only generates cause-and-effect relationships between strategies and KPIs but not between KPIs and driver measures. The Driver Measures Enhanced Framework possesses effective techniques to define cause-and-effect relationships between KPIs and driver measures.

All the frameworks except the Driver Measures Enhanced Framework rank partial on “balanced perspective” as they do not include external environment in their standard

performance monitoring and reporting. “Link operations to strategies”, “quantify measure relationships” and “possess an external control system” criteria are not met by any of the three frameworks, EFQM, Prism and Balanced Scorecard. The only framework which meets these three criteria is Driver Measures Enhanced Framework.

Figure 27 below illustrates a pictorial view to visualize the effectiveness of each of the four frameworks. The key question to ask when you hit a problem is “how to solve it”. Figure 27 demonstrates how Driver Measures Enhanced Framework provides the decision makers with a methodical way to troubleshoot the issue. It provides all the necessary tools to address the “what, how, and where” to solve a problem where as the other frameworks leave decision makers with more questions than answers.

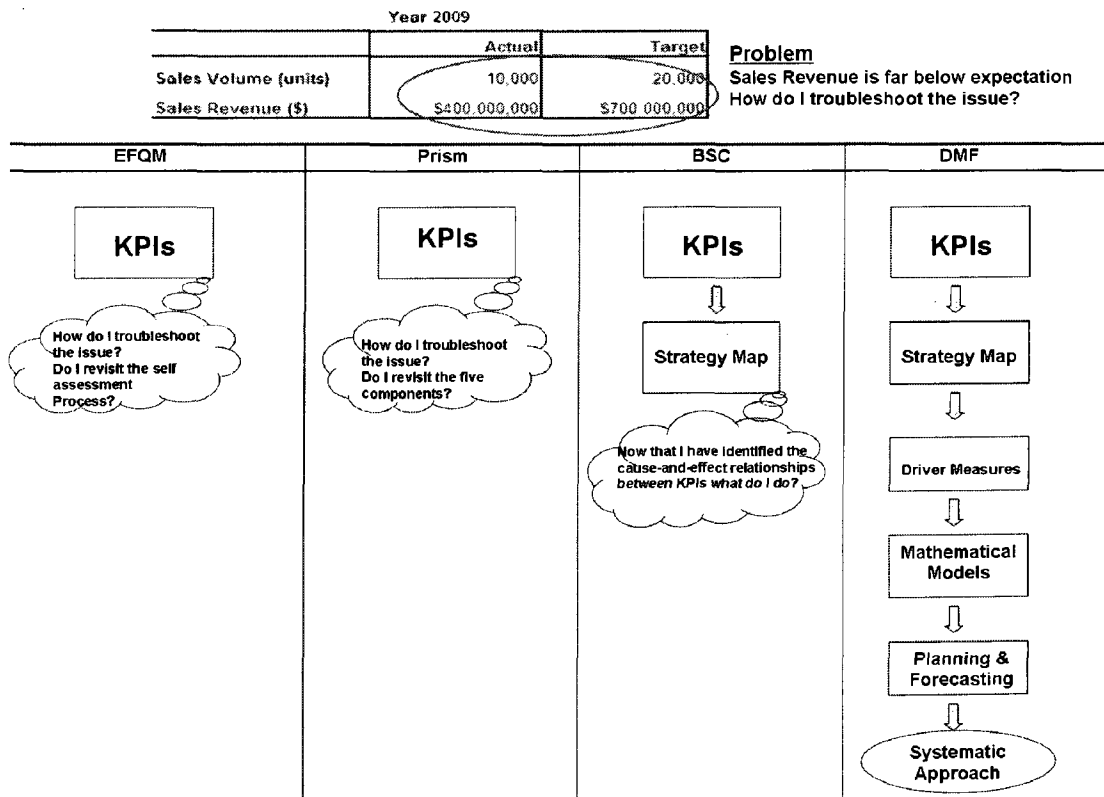


Figure 27 – Troubleshooting Approach

5.3 Development Effort

The Driver Measures Enhanced Framework portrays itself to be the ideal framework solution for effective performance management. It sounds too good to be true. Can this be implemented in an enterprise? The answer to this question is “yes”. However this requires extensive effort and competent resources and commitment.

Development effort	Frameworks			
	EFQM	Prism	BSC	DMEF
Enterprise data architecture and IT infrastructure effort	Low	Low	Medium	High
Statistical and mathematical techniques applications effort	n/a	n/a	n/a	High
Formal planning and forecasting effort	n/a	n/a	n/a	High
Implementation and maintenance effort	Low	Low	Medium	High

Table 7 - Development Effort Comparison

Table 7 summarizes the development effort required to implement each of the frameworks. Additional development effort is required in the areas of cause-and-effect relationships identification between driver measures and KPIs, statistical and mathematical technique applications and formal planning and forecasting processes for the Driver Measures Enhanced Framework.

The Enterprise data architecture and IT infrastructure effort level to put together the Driver Measures Enhanced Framework will be higher than the existing frameworks. Total cost of ownership of DMEF will be higher as well. Although the total cost of ownership is higher, it can be argued that the benefits of this framework far outweigh the

cost. This can be evaluated through future studies by physically implementing the framework at an organization.

The presentation layer of the Driver Measures Enhanced Framework should have the ability to drill down to driver measures from KPIs, from strategy map to driver measures and from driver measures to mathematical techniques. Executives are used to seeing KPIs presented in a dashboard and having the ability to drill down to analyze the issues. This functionally needs to be made available for the Driver Measures Enhanced Framework as well. The path from KPI-strategy map-driver measures-mathematical technique to formal planning should be connected and have the ability to drill from to one another. Additional software development effort is needed to accommodate these requirements.

Effort level is high in the area of statistical analysis, mathematical techniques and formal planning and forecasting. DMEF has statistical and mathematical methodologies which can be used for measures relationships quantification and planning and forecasting. Existing frameworks do not have these methodologies as such there is no effort required to build them. However DMEF has demonstrated the values which can be gained from quantification and formal planning. These can persuade an organization who uses DMEF to allocate effort to build statistical, mathematical techniques and formal planning and forecasting processes.

Driver Measures Enhanced Framework needs to be implemented properly using good database, business process modeling, business intelligence, and statistical analysis and GUI tools. It also needs to be maintained as requirements and needs change and the

data stored grow. As the above require sound enterprise data architecture and IT infrastructure, naturally the implementation and maintenance efforts are going to be higher than the existing frameworks.

The following resources and commitments are necessary for a successful implementation of a Driver Measures Enhanced Framework in an organization.

- Sound enterprise data architecture and IT infrastructure
- Competent resource pool who can understand the strategies, objectives business needs and drivers
- Excellent management domain knowledge of the business
- Commitment from top management down to line employees

Every organization requires sound enterprise data architecture to plan, forecast, monitor and report on its performance. The Driver Measures Enhanced Framework is no exception to this. If the required data for planning, analyzing, monitoring and reporting is not available, then the organization will not be able to properly report on performance and be able to do proper statistical analysis on driver measures. This will weaken the planning, forecasting and decision making activities. Organization needs to properly identify what data it needs to track, model and store for performance. Of course if the IT infrastructure is not secure and fast, even though the enterprise data architecture is sound, it will not be prolific as the potential for critical data loss and slowness in data retrieval is high.

The Driver Measures Enhanced Framework provides non-prescriptive guidelines to set up an effective performance management system. However, strategy formulation, right choice of KPIs and its relevant driver measures, strategy map creation, cause-and-effect relationship definitions and measures relationship quantifications need to be developed by the organization. The organization requires competent resources who understand and have domain knowledge about the shareholders' needs, business requirements and measures its need to track. Organization also requires capable resources who can set up a sound enterprise data architecture and IT infrastructure. Resources need to be knowledgeable in data warehousing, business intelligence, statistical analysis, mathematical technique building and planning tools.

The Driver Measures Enhanced Framework requires commitment from all levels of an organization. Management and employees need to buy into the framework concepts. They need to trust the data and the reports which come out of the system. Two factors which contributes to the trust and commitment. Data in the framework needs to be reliable and trustworthy. An organization need to make sure the data has a high level of integrity. Second factor is the scalability and performance. One would not wait for 2 hours to run an analytical report. Thus the framework needs to be built keeping efficiency in mind. Once the management and employees realize how critical, reliable and fast the data stored in the framework is, there will be commitment from management and employees. Actions derived as the outcome of the analysis conducted in the framework need to be carried out at the operational level. The results of these actions will be reflected in subsequent reporting. If employees are hesitant to implement the strategies and actions planned out by management then the process will not work. Only way this

framework is going to work from start to finish is by getting the acceptance and commitment from all levels of the organization.

6 Conclusions

6.1 Summary of Contributions

In section 1.3, key contributions of the thesis research were presented. Following is the list of key thesis contributions.

- 1) Identification of criteria that a performance management needs to provide to be effective based on research and a gap analysis of existing frameworks perspective.
- 2) Creation of Driver Measure Models to define cause-and-effect relationships between KPIs and driver measures for effective decision making and strategic alignment.
- 3) Establishment of Mathematical techniques to quantify measure relationships between KPIs and driver measures. This is essential for planning, predicting and forecasting outcomes while changing strategies.
- 4) Development of Driver Measures Enhanced Framework for effective performance management with support for tracking and managing external factors.

The impact of these contributions are discussed in the below section in details.

Contribution 1: Identification of criteria that an effective performance management framework needs to provide based on research and a gap analysis of existing frameworks. Following new criteria are identified.

- Show cause-and-effect relationships
- Link operations to strategies
- Quantify measure relationships
- Provide an external control process

Above listed criteria are very vital for effective performance management. Organizations need to know what to execute when KPIs don't meet the targets. This necessitates a systematic approach to decision making and problem solving which requires understanding of the relationships between KPIs and driver measures. This objective is attained by the cause-and-effect relationships definitions. Linking KPIs to driver measures indirectly ties driver measures to strategies. Thus it provides congruency between strategic and tactical thinking and decision making. In order to predict and forecasts the best cause of actions to improve performance, management require quantification of relationships between measures.

External environmental factors need to be considered not only during strategy formulation but also during standard performance management and decision making. If an organization neglects its relevant external environment while making strategic decisions or planning new initiatives, it could turn out to be costly for the organization. For an example, if ABC decides to make changes to improve its sales by only looking at its internal factors it would not have been successful. The current issue with ABC's sales performance is mainly due to its external environmental factors such as rising fuel prices, government incentive for fuel efficient cars and market appetite eco friendly small cars. We have demonstrated in the thesis that the external factors need to be monitored as part

of the performance management and they need to be considered while making business decisions.

Contribution 2: Establishment of Driver Measure Models to performance management.

Introduction of Driver Measure Models contributed in three ways to performance management

- Linked strategies to operations
- Provided a methodology to understand KPIs and its drivers using cause-and-effect relationships
- Presented the ability to predict and forecast results for new initiatives

Existing performance management frameworks show the relationships between strategies and KPIs. They don't demonstrate the linkage between KPIs and its drivers. Decision makers are not able to understand which operational processes drive these KPIs. How can the executives make strategic decisions when they are not sure what initiatives need to be taken to improve KPIs? Initiatives come from the operational levels. Our approach has demonstrated that the cause-and-effect relationships between KPIs and driver measures using methodologies such as business process modeling, managers' domain knowledge, analytic hierarchy process and statistical process. These cause-and-effect relationships allow decision makers to assemble effective decisions. Cause-and-effect relationships also provide the ability to predict and forecast results based on the new initiatives. By linking driver measures to KPIs which are linked to strategies, thesis has demonstrated the process to link operations to strategies. It has also made the

performance management more dynamic by providing the abilities to identify all the external and internal drivers of KPIs, plan new initiatives and predict results.

Contribution 3: Introduction of mathematical techniques to optimize business results

Introduction of mathematical techniques to understand and evaluate the cause-and-effect relationships between KPIs and driver measures has added a vital dimension to an organization's performance management. This is essential for planning, predicting and forecasting outcomes while changing strategies. Impact of choosing different strategies and initiatives can be evaluated using mathematical techniques such as objective function and liner programming. If a KPI can be modeled as an objective function and its drivers can be modeled as the variables which affect the KPI, then the decision makers can conduct sensitivity analysis by choosing different strategies to achieve an objective. Consequently they can execute the necessary strategies to attain the optimal solution. Mathematical techniques also allow a performance management framework to be dynamic as they provide the ability to predict and forecasts results before executing them. This feed-forward process permit decision makers to test their hypothesis before implementing them.

Contribution 4: Development of a Driver Measures Enhanced Framework for effective performance management.

Some organizations take bottom up approach to performance management. They build data marts and analytical applications to monitor and report on performance without having of a clear vision how these signify to the overall organizations' strategies. For

example, sales organization builds a performance management system to manage its sales performance. Human resources organization builds another performance management system to manage its own performance without having any linkage to sales performance organization. These two organizations report that sales revenue dropped by 10% and employee turnover rate is 20% respectively. What does this mean to strategic decision makers? How do they assess the impact of these with respect to their business strategies?

Our thesis approach takes a top down approach to performance management. It looks at shareholders needs and external environmental factors of a business, based on these requirements, vision, mission and business strategies are defined. From the strategies, objectives, KPIs and driver measures are derived. This approach shows how the KPIs and driver measures link to organization's overall objectives. Thesis approach shows how all the vital performance management components (vision, mission, business strategies, KPIs, driver measures, planning and forecasting and new initiatives) fit together. This approach not only helps decision makers to visualize how all the necessary components perform together but also allows them to consider, analyze, and evaluate all aspects of the business before making decisions.

6.2 Future Work

6.2.1 Data Mining

The Driver Measures Enhanced Framework in the thesis introduced managers' domain knowledge and business process modeling concepts as the methodologies to identify cause-and-effect relationships between KPIs and driver measures. Research into data mining algorithms and neural networks would be useful as a basis for developing

additional methodologies to derive cause-and-effect relationships between KPIs and driver measures. This can shed light into hidden data patterns which could identify driver measures which otherwise could not be identified.

6.2.2 Mathematical Techniques

Our thesis barely scratched the surface of mathematical techniques by using objective functions and linear programming to find an optimal solution for a problem. We have demonstrated how driver measures can be modeled to find the appropriate new initiatives which can improve a KPI. Research should be conducted to identify formal ways to analyze historical data on KPIs and driver measures which can then be used to reinforce the business process modeling and managers' domain knowledge identified cause-and-effect relationships. This will help to build effective mathematical techniques with proper coefficients which can be used for planning and forecasting.

However, it is important to point out that building these mathematical techniques or equations are not easy. This area is very complex and it requires mathematical expertise to understand statistical and mathematical models. Also the accuracy of these models is hard to evaluate. Although most of the measures can be quantified, there are some qualitative factors involved in decision making. For an example, we can use all the internal and external factors and derive a set of action to improve Total Sales Revenue. What would happen if the economy suddenly goes into a recession which no one has predicted? There are unforeseen events which are beyond anyone's control (e.g. natural disaster) and these factors are very hard to quantify. It shows how chaotic this space can be

and there is no perfect remedy of decisions which can be made to improve performance. We can only evaluate the best cause of actions with the known and quantifiable variables.

6.2.3 Driver Measures Enhanced Framework Development

Our thesis illustrated a theoretical model for a Driver Measures Enhanced Framework. On site case studies and physical implementation of Driver Measures Enhanced Framework need to be carried out to demonstrate its high value proposition. Also physical implementation of Driver Measures Enhanced Framework can help to evaluate the total cost of ownership and benefits from the framework. Physical implementation can also help to assess how effective the framework can be at different levels of management (middle management, executive level) for decision making. We can also evaluate how information from this framework can be fed to other technologies such as digital dashboards for analytical purposes and graphical representation.

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