

# Formulation and Implementation of a Performance Measurement System

Y K Chan, K Y Leung, L C Koo and F K C Tao

**Abstract:** The MTR Corporation Ltd (MTR), a metro railway company in Hong Kong has formulated and implemented a fit-for-purpose Total Management System (TMS). One of the important issues of the TMS is to determine a performance measurement method to drive overall performance improvement of the organisation. The paper reviews various performance measurement systems and explains why the Balanced Scorecard (BSC) approach is adopted. Details on how the BSC is established and how the action learning spiral is employed for the BSC implementation are discussed. The paper also describes the design and review of the Balanced Scorecard for further application.

**Keyword:** BSC, Action Learning, Performance Management

## 1. Review of Performance Measurement Systems

Performance measurement has been defined as the systematic assignment of numbers to entities (Zairi, 1994). A performance measurement system can also be defined as the set of metrics used to quantify both the efficiency and effectiveness of actions (Neely et al., 2000). The literature on performance measurement systems has demonstrated many examples of identifying, selecting and implementing appropriate performance measures (Neely et al., 1995). Appropriate performance measures are those which enable organisations to direct their actions towards achieving their strategic objectives (Dixon et al., 1990). Traditional performance measures developed from costing and accounting systems are liable to criticisms for being short-term measures (Banks and Wheelwright, 1979, Hayes and Gavin, 1982), lacking strategic focus (Kaplan and Norton, 1996), encouraging minimisation of variance rather than continuous improvement (Lynch and Cross,

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1991) and not being externally focused (Kaplan and Norton, 1992). Zairi (1992a) distinguishes between traditional measures of performance such as cost and improvement measures. He considers the traditional measures of performance are generally harmful and incompatible with improvement measures. They can be of use in describing past performance but are of little use in day-to-day control of operations, or improving those operations.

The MBNQA, the Deming Award and the EFQM provide a set of performance measures, which can be used to measure the potential long-term performance of the organisation. However, these models only provide a self-assessment protocol without detailing how these measures are formulated and implemented. Several researchers have developed a broad-based set of performance measurement systems which provide a more balanced view of internal and external focuses (Keegan, et al., 1989). Cross and Lynch (1988-89)'s Performance Pyramid, as an early attempt, describes how corporate strategy can be linked to operational measures between levels in the organisation. Fitzgerald et al. (1991)'s Determinants and Research Framework designed for service industry should therefore be more relevant to the MTR. This Framework predicts that the different aspects of quality service, flexibility, resource utilisation and innovation will determine the financial results and competitiveness of the organisation. The measures used to track such determinants, in authors' opinion, do not extend far enough along the core business process of the MTR's railway operations and they do not provide clear links between corporate strategy and operational measures.

Eccles and Pyburn (1995) present a Business Model that describes how an organisation's strategy can consist of a series of assumptions about cause and effect relations. The concept of translating corporate strategic objectives into performance measures is further developed by Meeking (1995) using a Visible Indicator Tree. Both methods do not address "internal process" and "learning and growth" performance. Hence they are less comprehensive as compared with the Balanced Scorecard (BSC) performance measurement method proposed by Kaplan and Norton (1992). The BSC is conceived as a management tool to enable an organisation's strategy to be translated into operational terms (Gryna, 2001). The objectives and measures of the BSC, derived from the organisation's vision and strategy, view the performance of an organisation from four perspectives: finance, customer, internal process and learning and growth (Kaplan and Norton, 1992). According to Kaplan and Norton (1996), the BSC is described as being "balanced" because the measures employed are:

1. Balanced between external measures for shareholders and customers, and internal measures of critical business processes, innovation and learning and growth;
2. Balanced between measures of outcome (the results of past actions), and the measures

that predict the future performance; and

3. Balanced between objective, easily quantified outcome measures and subjective, more judgmental performance drivers of the outcome measures.

There are three other features of the BSC which, taken together, make it distinctive from other performance methods. These features are the relationships between causes and effects; the mix of outcomes and performance drivers; and the linkage to financial measures (Kaplan and Norton, 1993). The BSC articulates corporation strategy by a sequence of “if-then” statements (Kaplan and Norton, 1996). A BSC will typically use a selection of generic outcome measures (i.e. lagging indicators), irrespective of the strategy of the organisation or its industry environment. These generic outcome measures consist of profitability, market share, customer satisfaction, and employee skills (Kaplan and Norton, 2001). The specificity of a scorecard to a particular business unit hinges on the choice of performance drivers (i.e. leading indicators). Taken together, the lagging and leading indicators provide an overview of a business unit’s strategy and they are both needed for optimal effect (Kaplan and Norton, 2001). The following paragraph further explains why BSC is being selected from a more practical standpoint.

## 2. Why a Balanced Scorecard?

The Institute of Management Accountants (IMA), through its Cost Management Group, has conducted an annual survey of its 1,300 members on performance measurement (PM) systems, practices and trends (Frigo, 2001). In the year 2001, the survey grouped the performance measurement systems into four categories; (1) traditional PM (that is predominantly financial), (2) the Balanced Scorecard, (3) value-based management PM system, or (4) hybrids. When respondents were broken down into Balanced Scorecard (BSC) users and non-users, distinct differences emerged in the ratings. A much higher percentage of BSC users rated their PM systems as “very good” to “excellent” in supporting management’s objectives (BSC 52% vs non-BSC 5%), communicating strategy to employees (BSC 48% vs non-BSC 3%), and supporting innovation (BSC 22% vs non-BSC 2%).

The results of this survey are in line with the same survey conducted in the previous year. The results of the 2000 survey indicate that the BSC framework has been gaining support at many companies. Approximately 40% of the respondents are currently using a BSC or plan to do so within the next year and 12% of the companies have been using the BSC for more than two years (Frigo, 2001). In the IMA’s 2000 survey, approximately 83% of the respondents said that BSC was worth implementing or “not yet, but will be” and the other 17% said “Too early to tell”.

When asked to describe the benefits of the BSC approach, the respondents focused on the following themes (Frigo, 2001):

1. Linking performance measures to shareholder value;
2. Use of leading indicators and non-financial measures;
3. Focus on the “vital few” performance measures; and
4. A change management tool.

The IMA survey reports (Frigo, 2000 and 2001) conclude that the trend in performance measurement reflects an increased usage of non-financial measures and that the use of BSC has been well received by industries. This conclusion is supported by the survey conducted by Bain & Company (Rigby, 1999), which also indicates a similar result: 55% of surveyed companies in the USA and 45% in Europe are using the BSC. The Gartner Group estimated in February 1999 that by the year 2000, at least 40% of the Fortune 1000 companies would have implemented a BSC (Gartner Group Study, 1999). The results of these surveys have indicated that the BSC is a popular and practical performance measurement method.

In view of the many benefits brought about by the balanced scorecard approach in performance measurement as revealed in IMA’s reports and of various research results, the BSC has been selected for implementation in the MTR.

### **3. Establishing a Balanced Scorecard**

Kaplan and Norton (1992) quoted “What you measure is what you get” when they initiated the Balanced Scorecard (BSC) in 1992. The BSC gives the management a snapshot but comprehensive view of the business and makes the corporate strategies operational by translating them into a coherent set of performance measures (Kaplan and Norton, 1993 and 1996). This Section describes the case of developing a BSC in the Operation Engineering Department (OED) as a critical component of the closed-loop strategic management system in TMS for achieving the intended business results.

The BSC is commonly recognised as a mission-driven, quantitative, cause-and-effect feedback monitoring system (Kaplan, 1997; Gartner Group Study, 1999). In adopting the BSC for implementing TMS in the OED, the authors considers, in order to meet the Railway’s mission statement: “... *providing a safe, reliable and efficient railway service...*” the four usual perspectives, namely financial, customer, business processes, and learning and growth, are not adequate for railway management where safety is of paramount importance and cannot possibly survive without a good safety record. To this end, the authors added safety as the fifth perspective

for the OED's BSC.

Various researchers when designing and implementing performance measurement system have developed a number of framework and processes. These studies include Neely's (1996) management process, Dixon et al. (1990) performance measurement questionnaire, Eccles and Pyburn's (1992) facilitated process, Wisner and Fawcett's (1991) nine-step process and Kaplan and Norton's (1993) eight-step process. Among these processes, Kaplan and Norton's method was selected because the Balanced Scorecard performance measurement method has been selected to be implemented in the OED, and hence it is logical to adopt their implementation process. Furthermore, the MTR requires a well-proven implementation method in order to ensure a successful implementation of this new initiative in the large, multi-disciplinary engineering department and this eight-step process has been used by many organisations (Kaplan and Norton, 1993, 1996 and 2001). The eight-step BSC implementation process fits very well with the action learning spiral.

To go through the eight-step process, Kaplan and Norton's method requires typically, eight months to complete (Kaplan and Norton, 1993). The formulation and implementation of the BSC for the OED only took three months as the MTR had already implemented an Executive Information System (EIS). An enormous amount of information available in the MTR had been distilled and much of the most useful has been incorporated into the Executive Information System (EIS). The adoption of the Balanced Scorecard approach has tackled the pressing need for an overall structure to link the unconnected indicators to the key objectives of the OED.

#### **4. Construction of the OED Balanced Scorecard**

The MTR developed an Executive Information System (EIS), which served as the core reporting system for business performance monitoring at the Corporation level. The OED, when implementing a TMS, considered that adopting a balanced scorecard approach to measure its performance would lead the organisation on a par with the world-class organisation. The proven success of the BSC would facilitate the OED to translate the Corporation's vision and mission to departmental strategies which in term would be further cascaded to the operational level through formulating appropriate sectional objectives and initiatives to meet the Corporation's goals. The Balanced Scorecard becomes a core element of the Total Management System (TMS) to support the achievement of the business goals and the Customer Service Standards (CCS). These together with the system audit and management review form the core elements of the OED's performance management system. Taking advantage of being a facilitator and also an implementer

of the BSC in the OED, the authors adopts a simplified version of the Kaplan and Norton’s (1993) eight-step process to develop and implement the OED’s BSC. The action learning spiral in four stages is described in the following sections.

**4.1. Identification of the OED Objectives (Reflect)**

Objectives for each of the perspectives of the BSC, tabulated in Table 1, are derived from the identified OED vision, mission and strategies documented in the OED Policy Manual.

<i>Perspectives</i>	<b>OED Objectives</b>
Safety	Maintain safety awareness among the OED staff Continuous reduction in accidents and reportable events
Financial	Provide cost-effective asset management Provide value-for-money engineering services
Customer	Provide safe and reliable railway service to customers
Business Process	Provide effective & efficient asset maintenance Apply appropriate technology Involve in planning and implementation of new extensions
Efficiency and Effectiveness	Learn and grow Retain critical skills

*Table 1 OED Objectives for the Five Perspectives of BSC*

**4.2 Formulation of Measures for the Five Perspectives of the OED BSC (Plan)**

Appropriate quantifiable measures are determined for each of the five perspectives of the OED BSC with the ultimate goal of fulfilling the established strategy, mission and vision of the OED. During the formulation process, the identified measures were mapped out showing the cause-and-effect relationships between them. This mapping facilitates managers in the identification of any omitted measures or missing issues that are vital for the fulfilment of the defined objectives. The selected measures for the OED BSC, approved by the OED Senior Management Group, are summarised in Table 2.

<i>Perspectives</i>	<b>OED Measures</b>
Safety	1. Lost time injury rate (for the OED staff) 2. Reportable accident frequency rate (for contractors) 3. Operating railway risk index
Financial	4. Capital works achieved relative to total depreciation charge 5. OED maintenance costs per passenger journey at '90 price 6. OED maintenance costs per revenue car-km at '90 price
Customer	7. Gate and ticket machine reliability 8. Escalator availability 9. Number of train service delays due to equipment failure 10. Sum of initial delay (minutes) due to equipment failure 11. Electric Multiple Unit (EMU) performance 12. EMU availability
Business Process	13. Response to failure 14. Average OED percentage coverage of scheduled PM jobs 15. Capital works achievement
Efficiency and Effectiveness	16. Training hour ratio 17. Internal promotion plus transfer

*Table 2 Measures for the OED Balanced Scorecard*

In the Safety Perspective, the first two measures (i.e. measures 1 and 2), Lost Time Injury Rate (for the OED staff) and Reportable Accident Frequency Rate (for contractors) are the internationally recognised measures, which MTR has been using for many years for the international benchmarking. The third measure (3), Operating Railway Risk Index, is a leading indicator, which aims to reduce risks, hence preventing incidents from happening. Two of the three financial measures (5 and 6), the OED Maintenance Costs per Passenger Journey at 1990 Price and the OED Maintenance Costs per Revenue Car-km at 1990 price, are coming from the previous Executive Information System (EIS), which have been considered to be effective measures by the Corporation and they have been used for many years. The first financial measure (4), Capital Works Achieved Relative to Total Depreciation Charge, under the Financial Perspective attempts to provide a leading indicator on how the Corporation is upkeeping its assets.

All customer services measures under the Customer Perspective are derived from the customer surveys (the Corporation conducts nine different customer surveys per year). Being a self-service railway, trains and equipment at stations are the only interfaces between the passengers and the railway service under normal circumstances. Reliability and availability of trains and station equipment have become good indicators for a smooth travel within the railway system. Reliability of Gate and Ticket Machines (7), Availability of Escalators (8), Train Delays (9 and 10), EMU Reliability and Availability (11 and 12) have become customer service measures for the OED as the Department is responsible for maintaining them.

In the Business Process Perspective, three measures (13, 14 and 15), Response to Equipment Failure, Average OED Percentage Coverage of Schedule Preventive Maintenance, and Capital Works Achievement, are the results from the long debates among the members of the OED Senior Management Groups (SMG). These indicators try to measure the lead-time for service resumption in case of equipment failures and the progress of two major tasks, the accomplishment of the preventive maintenance and achievement of capital works. The two measures under the Efficiency and Effectiveness Perspective (16 and 17), Training Hour Ratio and Internal Promotion Plus Transfer, are selected by the SMG (System Management Group) Members as initial indicators for measuring the level of training provided and the competence of the staff. The latter measure, Internal Promotion and Transfer, has been subsequently replaced by two measures, Staff Efficiency Index and Passengers Carried per OD Staff, when the OED BSC extended to cover the whole railway operations.

### **4.3 Targets Setting and Monitoring (Act)**

Based on the confirmed measures for the five perspectives, an annual target (targets that have to be achieved and maintained in the year) as well as a 5-year rolling target were suggested for each of the measures based on past performance. They were discussed, debated, modified and finally approved by the OED Senior Management Group (SMG).

The monthly and the year-to-date performance results for the OED BSC are compiled. The SMG, together with the respective management teams will review the results and formulate appropriate actions to cater for any identified discrepancies. These follow-up actions are reported to the Operations Executive Management Committee (OEMC) meeting monthly. The progress and effectiveness of the follow-up actions are further reviewed quarterly by the OEMC. For long-term monitoring, an annual evaluation report is compiled to ascertain the achievements of departmental objectives and review the appropriateness of the defined 5-year rolling targets. Endorsement from the OED Senior Management Group needs to be obtained for any amendments to the defined requirements of the Balanced Scorecard.



## 4.4 Post Implementation Review (Observe)

### 1. Interviews

A Consultant was employed after the BSC had been implemented for six months to conduct a comprehensive review on the OED performance measurement system. The aim of the review is to ensure that the system is fulfilling its intended purpose and is able to drive overall performance improvement. Relevant company documents were studied to examine the alignment of the company's vision, mission, with the OED's organisation structure, management systems, strategies, initiatives and performance measures in use. The Sectional managers were selected for interview as an important source of information. These interviews focused on the following issues relating to the design and application of balanced scorecards:

- Methodology for identifying major initiatives in the business plan;
- Strategic issues identified by the OED and the major initiatives developed to neutralise the perceived threats or exploit the envisaged opportunities;
- Design of the Balanced Scorecards being used in the OED;
- Setting of stretch (5-year) targets for performance measures;
- Validation of the causal relationships between action plans and their expected outcome; and
- Analysis and presentation of measurement data.

Resulting from the interview, the following recommendations were made to enhance the efficacy of the scorecard:

- One or more measures relating to those end-to-end processes that are critical to satisfying customer needs are to be included.
- More leading indicators ought to be introduced into the scorecard, and they should be linked to the OED's strategic initiatives, such as implementation of the Total Management System (TMS) and development of a multi-skilled workforce.
- The appropriate measures for the Learning & Growth perspective such as employee satisfaction, employee loyalty and value added per employee should be added. Organisation specific measures in this perspective should be considered through those strategic initiatives that relate to manpower development, knowledge management, and organisational learning.

## 5. Balanced Scorecard for the Operations Railway

While there is room for improvement in OED's application of balanced scorecards, the Consultant's report revealed that executive managers and supervisory staff in the OED are enthusiastic about the initiative. M. Brown, Chief Engineer (Operations), who is in charge of the OED, finds the balanced scorecard *"to be an effective, holistic and well-balanced tool for the department to assess its performance, identify improvement opportunities, and initiate improvement actions on a continuous basis"* (Chan 1999). The implementation of the OED BSC has led to a general performance.

As part of its efforts to prepare for the tough challenges ahead, the Corporation is integrating its Operations and the OED functions to form a new Operations Division to look after the whole railway operations. The management decided, in view of its positive impact on the OED performance, to extend the balanced scorecards to cover eight departments of the Operations Division with the top-level scorecard modified to embrace the additional function. Based on the five perspectives of the balanced scorecard developed for the Operations Engineering Department, an enhanced set of the scorecards has been developed. Table 9 compares the new set of the OD BSC with the old OED BSC, which demonstrates more comprehensive coverage of the railway operations.

Perspectives	OD Measures	OED Measures
Safety	S 1 Passenger accident rate (12-m average)	2. Reportable accident frequency rate (for contractor)
	S 2 Staff lost time injury frequency rate (12-m average)	1. Lost time injury rate (for the OED staff)
	S 3 Risk control performance index	3: Operating railway risk index
Finance	F 1 Divisional costs per passenger at out-turn prices	5. OED maintenance cost per passenger journey at 1990 price
	F 2: Divisional costs per revenue car-km at out-turn prices	6. Maintenance costs per revenue car-km at 1990 price
	F 3: Reinvestment ratio (Capital work expenditure / depreciation charge) (12-m average, exclude LAR depreciation)	4. Capital works achieved relative to total depreciation charge
	F 4: Non-fare revenue per passenger trip	
Customer	C 1: Customer Service Pledges score	8. Escalator availability
	C 2: Passengers affected ratio (Delays ≥ 5 min)	10. Sum of initial delay (minutes) due to equipment failure
	C 3: Train service reliability (Revenue car-km per incident ≥ 2 min)	11. EMU performance
	C 4: Total train delay min (Train trip delay ≥ 2 min)	9. Number of train delay due to equipment failure
	C 5: Octopus card reliability	7. Gate and ticket machine reliability
	C 6: Customer per complaints on operational issues (Million passenger per complaint)	12. EMU availability
Process	P 1: % coverage of scheduled PM	14. Average OED % coverage of scheduled PM jobs
	P 2: Response to failure (% of recovery meeting SPS relating to train services)	13. Response to failure
	P 3. Capital works achievement against plan	15. Capital works achievement
Efficiency	E 1: Staff efficiency index (Car km per staff & contractor hour comparing with last year's)	17. Internal promotion plus transfer
	E 2 Passenger carried per Operations staff	
	E 2 Training hours ratio (%)	16. Training hours ratio

Table 9 The Balanced Scorecard for the Operations Division

## 6. Conclusion

Various studies (e.g. Neely et al., 1995; Zairi, 1992a and b; Zairi et al., 1994; Keengan, et al. 1989, and Frigo, 2000, 2001) highlight the importance of measuring financial and non-financial performance. Various measurement methodologies have been proposed by various researchers including the well received balanced scorecard (BSC) proposed by Kaplan and Norton (1992). According to the large scale survey conducted by IMA in 1999 and 2000, among the four types of performance measurement methods, namely, traditional performance measures, the balanced scorecard, value-based management performance measures and hybrids, the BSC approach has been gaining support at many companies. The survey results have indicated that the performance measure in four perspectives proposed by Kaplan and Norton (1992) provides a balanced view on external, internal financial and non-financial performance that has been well received in practice. Hence, Kaplan and Norton's balanced scorecard (BSC) approach has been adopted as a performance measurement method for the OED. In addition to the four perspectives, namely, finance, customer, internal process, and learning and growth, safety has been added as the fifth perspective as safety is of paramount importance to railway operations. The OED BSC has been successfully established and implemented by using an action learning spiral (reflect, plan, act and observe). A critical review upon implementation of the BSC in the OED has been conducted. Results of the review have proved to be very useful inputs in designing the BSC for the whole railway operations.

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**【摘要】** 香港地鐵有限公司經已設計完成了一套以企業目標為基準的全面管理系統（TMS），這套管理系統最重要的一個環節是確立了一套績效測量法旨意推動企業全面績效的提昇，本文探討各類的績效測量系統並解釋最終確立採用平衡計分卡（BSC）方法的理據，詳細討論如何設計平衡計分卡系統及如何圍繞系統進行實踐學習，本文同時亦描述和探討了平衡計分卡方案在將來的應用前景。

**【關鍵詞】** 平衡計分卡、實踐學習、績效管理

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