

Implementation Of A Computerized Balanced Scorecard (BSC) System In A Manufacturing Organisation In Zimbabwe

N. Gwangwava, S. Mhlanga and W. Goriwondo

Abstract— This modern era's high technological improvements present manufacturers and other organizations with a plethora of Management Information Systems (MISs) which makes them face challenges when choosing a corporate information system. High initial investment in setting up the information systems make it very difficult for companies to adopt new systems as they come into market before realizing a reasonable return from the previous system. In line with these concerns, a methodology for building a Balanced Scorecard module as a strategic management platform that can be integrated smoothly into already existing information system such as MRP/ERP is presented. The paper uses a case study of a manufacturing company based in Zimbabwe. Various manufacturing based metrics are reviewed with the main intent of showing how these can be tracked in a computerized platform. Sample data extracted from the production system is used to test the built system. The paper shows a methodology for software design, setting up and adopting a BSC system. The proposed approach is used to design a computerized BSC system for the case study company, which incorporates a BSC dashboard for the four main perspectives derived from various operational metrics.

Index Terms— Balanced Scorecard (BSC), Metrics, MRP/ERP, Management Information System (MIS).

I. INTRODUCTION

Transition from a small shop to a manufacturing company requires competitive ability. To compete effectively, an organization needs accurate cost, inventory, production capabilities and customer information. If you cannot describe something in business numerically, you are not doing your job properly. It will be difficult to communicate success, failure or the gaps that need to be closed. Confronted with these challenges, it has been deemed necessary to develop a computerized balanced scorecard and measurement system for small-medium sized manufacturing organizations.

While this describes a case of one manufacturing company, the design follows a systematic methodology to enable easy adoption by similar organizations [1]. Manufacturers need to pursue high quality standards in all their processes and be able to deliver quality products to a continuously growing customer base. This push is as a result of globalization and availability of competing products in the local market. In order to clearly assess its performance, an organization needs feedback from its customers and will need to analyze the information so as to get a quantitative feedback on its quality

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delivery. Performance measures such as delivery, machinery, quality control and material control performance measures are very crucial in conducting business in a modern approach.

The paper presents a summary on designing a balanced scorecard for a foundry based manufacturing organization. The metrics of the system are derived from the production, sales and distribution, maintenance and purchasing departments as these were evaluated as the key factors contributing to the mission and vision of the company. The system captures daily work activities in the mentioned departments to enable routine performance evaluation. The evaluation of performance will be based on the targets preset on the selected metric or performance measures. The software package will consist of a centralized aggregate database built on MySQL Server 5.0 where every user will access relevant information according to their account profiles. In order to present the end user with a friendly environment, an object oriented development software, VB2005 Edition, will be used so as to build an easy to manipulate interface.

II. THE BALANCED SCORECARD CONCEPT

The concept of the **Balanced Scorecard (BSC)** is defined as a strategic management **tool** that measures how well the business activities are aligned with the organization's strategic vision [2]. It balances financial results with non-financial performance metrics [3]. It is also a management system – not just a measurement tool – in that it helps to clarify vision and to translate strategy into activity. The novelty of the Balanced Scorecard is the addition of non-financial metrics. Without a balanced scorecard, a business tends to be judged only by short-term financial results. These may hide serious problems. It is rare to have more than 20 metrics in a BSC and only about a quarter should be financial.

The BSC should answer four questions:

- How do shareholders (owners of small firms; stakeholders in not-for-profit organizations) perceive the organization?
- How do customers perceive the organization?
- How excellent are our internal processes?
- How well are we innovating, learning and improving?

The four questions above are technically called the four perspectives of the balanced scorecard [3] and they are summarized diagrammatically in Figure 1 below.

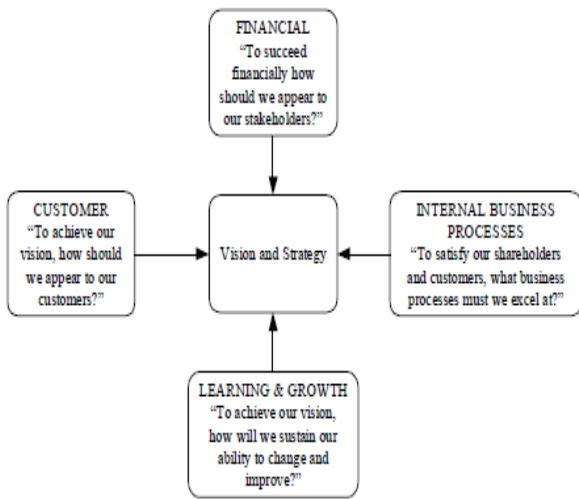


Figure 1: Four Perspectives of the Balanced Scorecard [3]

A. Financial perspective

Financial measures summarize the readily measurable economic consequences of actions already taken. They answer the question: Is the organization’s strategy, deployment, and implementation contributing to bottom-line improvement? Examples of financial indicators include:

- Economic value added (EVA).
- Generation of cash flow.
- Operating income.
- Rapid sales growth.
- Return on capital employed.
- Return on net assets (RONA).

B. Customer perspective

Through the customer perspective, business unit managers identify their competing customer and market segments. They then select performance measures for these targeted segments. Examples of core customer measures are:

- Customer satisfaction.
- Customer retention.
- New customer acquisition.
- Customer profitability.
- Market and account share for the targeted segments.

C. Internal business process perspective

The internal business process perspective answers the question: What are the critical internal business processes in which the organization must excel? Internal business process measurements enable the business unit to:

- Deliver value propositions that attracts and retain customers in the target market segments.
- Satisfy shareholder expectations of superior financial returns.

D. Learning and growth perspective

The learning and growth perspective identifies the infrastructure the organization must build to create long-term growth and improvement. The three principal sources of organizational growth and learning are people, systems, and organizational procedures. The company identifies gaps between existing capabilities of people, systems, and procedures and the actions required to achieve breakthrough performance. To close gaps, the organization must invest in re-skilling employees, improving information technology

and other support systems, and aligning organizational procedures and routines.

III. INTEGRATION OF BSC WITH ERP/MRP

The Balanced Scorecard can be integrated with the organization’s Enterprise Resources Planning (ERP) or its Manufacturing Resources Planning (MRP II) system. If properly used, the BSC stand to benefit companies with measurable effects in a big way. The BSC idea assumes that an abstract vision of company development can be changed into multilevel action strategy and into measurement of its application effectiveness with various measures.

A combination of current and forecasting ratios set on a base of four perspectives (customers, financial, processes and development) will enable personnel to know not only information about current company situation but also instantly evaluate whether the company is heading in the desired direction [4]. BSC-ERP/MRP integration is indispensable because strategic management module must be fed with real data from ERP/MRP systems. An integrated model of BSC has been used for implementing world class manufacturing (WCM) strategies and eliminating deficiencies related to the classical architecture of BSC and strategic management approach as well [5].

A. Factors Required for a Successful Performance Measurement System

One technical report postulated that if a performance measurement system is to work successfully in an organization, the following contingent factors must be understood [6];

- It must be integrated with the overall strategy of the business. All approaches to performance measurement emphasize the alignment of objectives, measures, strategic decision making and rewards. This is crucial, as it is not possible to measure performance unless it’s clear what an organization is trying to achieve.
- There must be a system of feedback and review
- The performance measurement system must be comprehensive
- The system must be owned and supported throughout the organization
- Measures need to be fair and achievable
- The system needs to be simple, clear and understandable

IV. BALANCED SCORECARD FOR MANUFACTURING ORGANISATIONS

Four strategic capabilities in manufacturing operations are outlined in [7]: production capability (a) with lower cost, (b) high quality, (c) reliable delivery, (d) flexibility in assembly and quantity supplied. The elements, strategy, role and production capability are further describe as follows [7]: "From the viewpoint of production management, strategic capability plays an important role in the success of a company, meaning that the power of a factory is based on keeping its strategy and supporting its market development. Producing, developing, and transferring of strategic capabilities are important functions of production strategy."

How balanced scorecard can be linked to corporate strategies is articulated in [8]. Figure 2 provides an overview of the approach they proposed. The methodology shows that there ought to be a systematic link between a company’s strategy, its goals, and the measures used to determine if the goals are being met.

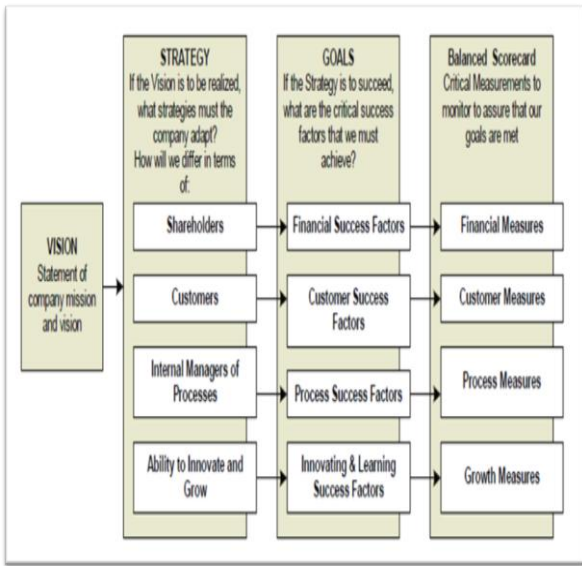


Figure 2: Linking Strategies to Balanced Scorecard Measures [8].

Process Mapping represents a major expansion of the Balanced Scorecard approach and is designed to make very explicit the relationship between a performance scorecard and the organization's strategy. A hierarchical model that suggests that some measures contribute to others and are summed up in shareholder value was introduced in [9]. Figure 3 summarizes the idea behind the Balanced Scorecard Strategy Maps. The four sets of Balanced Scorecard measures are now arranged in a hierarchical fashion, with Financial Measures at the top, driven by Customer Measures, which are, in turn, the result of Internal (Process) Measures, and are supported by Innovation and Learning Measures.

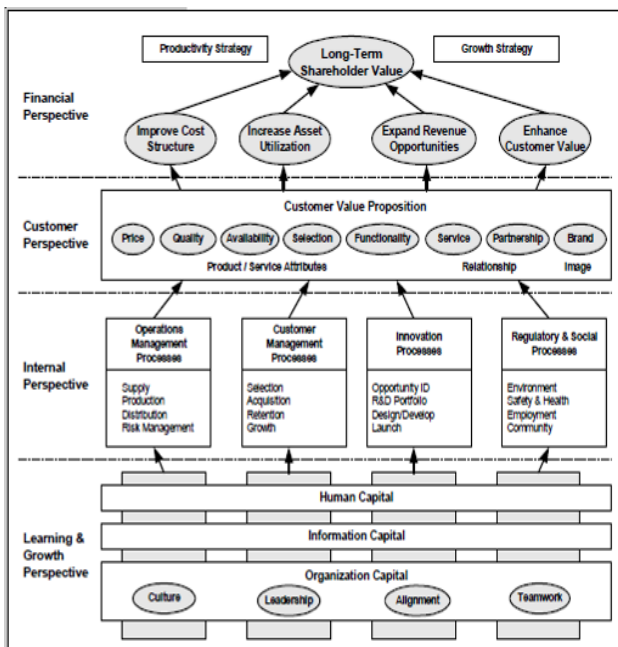


Figure 3: A Strategy Map Shows How the Organization Creates Value [8]

V. DESIGN OF THE BSC MODULE AT CASE STUDY COMPANY NFDC P/L

This section outlines the major steps taken to come up with BSC computer module. It starts with the company mission and cascades down to the individual level.

A. Translating a mission into desired outcomes

In a broader sense, the process begins with the mission for the organization. The steps for translating the mission into desired outcomes are as shown in Figure 4 below.



Figure 4: Translating the mission into desired outcomes.

B. Strategy Map

Figure 5 shows the strategy map developed for NFDC P/L. The map shows strategies to be adopted by the company at each perspective level. This leads to the actual performance measures to be tracked by the company. The strategy map provides a basis for the software model and the final software design. In order to allow efficient reporting of the performance trends, a scorecard template showing the desired performance level, actual performance, and variance, will be designed.

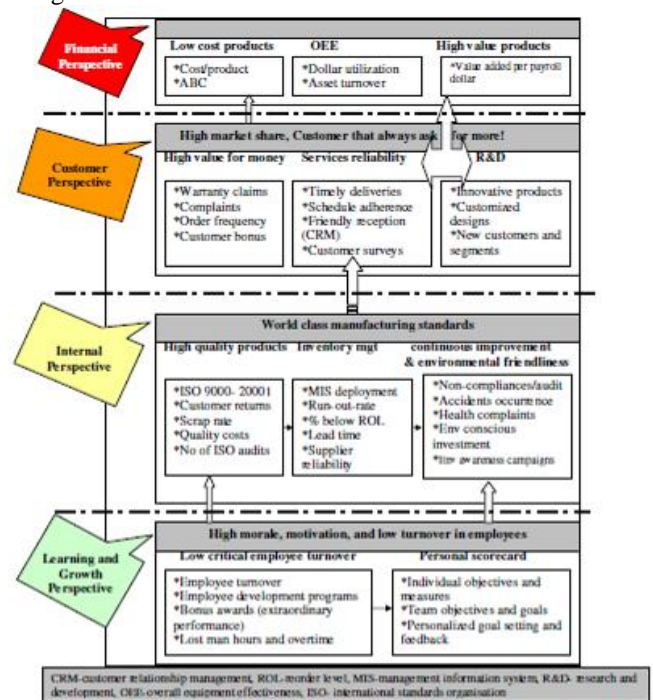


Figure 5: Strategy Map for NFDC P/L

C. Setting Performance Measures

Key performance areas have been identified that should be reported at a companywide level. The metrics have been categorized into four aspects addressed by the balanced scorecard and each category has gauges representing Key Performance Indicators. Gauges have been selected depending on whether low values (Product Returns) or high values (Share Price) are being reported as shown in Table 1 below. The sensitivity of trend reporting is set by the company.

Table 1: Company-wide metrics

Strategic Objective	Strategic Measure	Target	Actual
Low critical employee turnover	*Key employee turnover *Employee development training sessions *Bonuses awards for extraordinary performance *Lost man hours *Overtime		*% of total empl *% of sessions & Ave pass rate * Freq & No of Empl awarded * % of productive hours * % of total productive time
Personal and Team scorecard setting	*Personal goal setting & feedback *Team initiated scorecard		*Sessions per employee *Sessions per team
High quality	*Scrap rate/department *ISO audit deviations/dept *ISO audits prior to recertification		*% of production *% deviation *No prior to cert
Continuous improvement and Env. friendliness	*New system procedures *Recurring non-compliances *Accidents *Health & Env awareness		*No of new proc. *No recurring *No/period *No of sessions & Ave pass rate
Efficient Inventory management	*Integrated management systems(MIS) *Run out rate *% below ROL *Supplier Lead Time adherence *Reliable suppliers *WIP turns *Lead Time ratio		*No of stand alone syst. *Ave % run out *% below ROL * deviation * % of suppliers * WIP turns * MTC
High value for customer's money & CRM	*Customer returns *Customer complaints *Warranty claims *Returning customers *New customers *Customer surveys		*% of total sales volume * No *% of total sales value *% of total customers *% of total available * No per period
Service Reliability	*Timely deliveries *Schedule adherence		*% of total * Linearity index (L)
R&D	*New products *Customer involvement & initiation *Time to incorporate Eng changes *Cost reduction per product *Value added per payroll dollar (VAP) *Head count productivity (HCP)		* No of new products * No of projects * Time period *% reduction in cost * VAP * HCP
Low cost Products			*Performance efficiency *Rate of quality *ROTA
High Equipment Utilization	*OEE *Return on Total Assets (ROTA) *Asset Turnover (AT)		*Asset turnover (AT)

VI. BSC- GRAPHICAL USER INTERFACE

The computer module of BSC is built on a MySQL database platform which is accessed through a Visual basic application because of its ability to build friendly graphical interfaces. Microsoft Excel is used to provide graphical reporting.

A. BSC Dashboard Interface

The interface used to manipulate the module is shown in Figure 6. The interface shows a pictorial view of the Balanced Scorecard approach in order to assist the user when defining metrics.

B. Supplier Evaluation

Figure 7 shows the interface that enables the tracking of quality standards from the supplier throughout the production system.

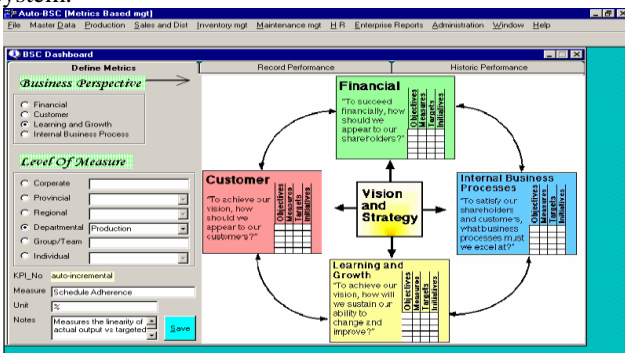


Figure 6: BSC Dashboard Interface

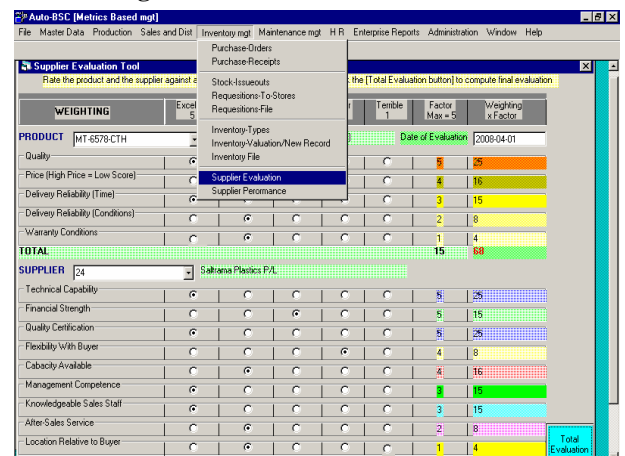


Figure 7: Supplier Evaluation Interface

C. Pivotal Report Template

Figure 8 shows an Excel based template used to generate performance reports. The user enjoys greater flexibility in formatting the final reports in a familiar Ms-Excel environment. Various options for reporting are available, i.e. report by business perspective, level of measure (Corporate, Departmental, Group, Regional, Provincial, and Individual), and Level- Description e.g. Specific Department, or Individual's name. Graphical views are also generated instantaneously, without strenuous effort. Even novice users can achieve maximum results from the system.

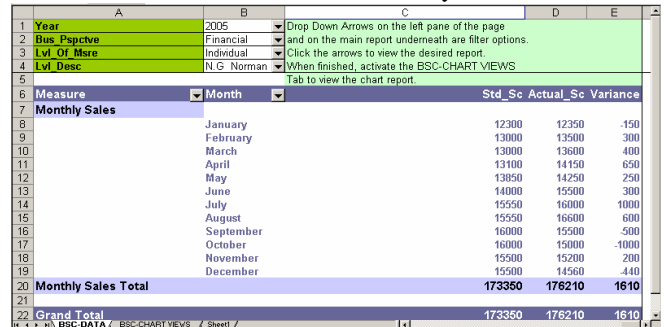


Figure 8: BSC Dashboard Pivotal Report Template

VII. CONCLUSION

The paper presented a methodology that can be adopted by an SME manufacturing company towards the design of a suitable BSC module which is integrated with an ERP/MRP system. A wide set of BSC strategic indicators has been outlined to give readers a broad range of choice when implementing the solution tool kit. In SMEs such as the case study company, a greater proportion of the value of Balanced Scorecard comes from two elements: the description of strategic destination and associated strategic objectives and priorities in a way that builds consensus; and impetus given to the development and application of more effective strategic management processes. Successful Balanced Scorecard implementation in any organization requires sustained management commitment to using it making sure it drives the necessary behavioral changes within the organization, starting with the managers themselves.

REFERENCES

- [1] K. J. Fernandes, V. Raja and A. Whalley, Lessons from Implementing the balances scorecard in a small and medium size manufacturing organisation, *Technovation*, 26, 2006, pp 623-634
- [2] L. Garvin, A. Henrik and C. Ian, Balanced scorecard implementation in SMEs: reflection in literature and practice. 2GC working paper, 2006, 2GC Limited.
- [3] R. S. Kaplan and D. P. Norton, *Translating strategy into action: the balanced scorecard*, Harvard Business School press, 2000.
- [4] M. Torbacka and W. Torbacki, BSC methodology for determining strategy of manufacturing enterprises of SME sector, *Journal of Achievements in Materials and Manufacturing Engineering*, Vol 23 Issue 2, 2007, pp 99-102.
- [5] M. S. Seyedhosseini and A. Soloukdar, Modelling for World Class Manufacturing at Iran Khodro Company: A dynamic system approach, *American Journal of Scientific Research*, Issue 26 (2011), pp.48-58.-available: <http://www.eurojournals.com/ajsr.htm>
- [6] CIM A Technical Briefing, *Developing and Promoting Strategy*, 2002, CIM A Publishing.
- [7] A. Grobler, An Exploratory System Dynamics model of strategic capabilities in Manufacturing, *Journal of Manufacturing Technology Management*, 21(6): 2010, pp 651-669.
- [8] P R. Niven, *Balanced Scorecard Step-By-Step: Maximizing Performance and Maintaining Results*, Second Edition, 2006, Wiley.
- [9] R. S. Kaplan, and D. P. Norton, *Strategy Maps: Converting Intangible Assets into Tangible Outcomes*. Harvard Business School Press, 2004.



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