

# Performance Evaluation in Supply Chain using Balanced Scorecard

P.Mathiyalagan, K.Tamil Mannan, and P.Parthiban

**Abstract**—Performance evaluation that compares actual performance with that planned in terms of both resource utilization and production. It measures inputs, outputs, and outcomes over time. In general, pre-post comparisons are used to assess change. It is used by management to redirect program efforts and resources and to redesign the program structure. The balanced scorecard, as it is today, is a Performance Management System that can be used by organisations of any size to align vision and mission with customer requirements and day-to-day work, manage and evaluate business strategy, monitor operational efficiency improvements, build organization capacity, and communicate progress to all employees. The scorecard allows us to measure financial and customer results, operations and organization capacity.

In this paper we have developed a model to arrive at a single score for the overall performance of the supply chain. As increasingly competitive environment calls for speedy, Cost efficient and reliable supply chain, Companies are focusing their attention in developing superior supply chain performance. Since what gets measured, gets managed the Companies have to develop metrics to measure performance of their supply chains.

**Keywords**— Balanced Scorecard, Effectiveness Score, Performance evaluation, Perspective.

## I. INTRODUCTION

COMPLETION has become so intense that managers do not have time to respond to market situation. Efficiency in operations and profitability are the key words driving organisations today. Newer technological developments and improvements in communication and the internet have made available a large quantum of data at the manager's disposal.

But does the modern manager have all the leisure to go through these mountains of data before developing a strategy? Can he wait till the release of the Annual Report to measure his performance? The answer is a definite NO. Organizations, to be successful, need to perform continuous evaluation of all their activities to be sure that they are on the path to success.

Performance measurement systems succeed when the organization's strategy and performance measures are in alignment and when senior managers convey the organization's

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mission, vision, values and strategic direction to employees and external stakeholders. The performance measures give life to the mission, vision, and strategy by providing a focus that lets each employee know how they contribute to the success of the company and its stakeholders' measurable expectations.

## II. REVIEW OF LITERATURE

Since Kaplan and Norton introduced the Balanced Scorecard (BSC) in the early 1990s, it has become widely adopted by companies and divisions within companies. The BSC was conceived as way to operationalize a company's vision and strategy. In this regard, it is a management system, or as the originators note, a tool for change within the firm or unit. When Kaplan and Norton introduced the Balanced Scorecard in 1992 [8], companies were already searching for new measurement systems to replace the age-old accounting measurements used for budgetary control. The BSC is an apparent antidote to the limitations of using lag measurements that are historically based and cannot be used to help the manager moving forward (e.g., financial ratios). In addition, the BSC attempted to bring objective value to non-financial measures such as customer satisfaction and operational processes.

Not surprisingly, the swift adoption and creation of BSCs has led to a number of different applications and variations of the tool. When implemented well, it appears that BSC is consistent with the principles of good management in that it promotes strategic planning, better definition of accountabilities, and more effective feedback by Epstein, Mark J. and Jean-Francois Manzoni(1997) [3].

Although companies or business units are encouraged to identify and customize their own areas of measurement, four broad perspectives are associated with BSC—customer perspective, internal processes perspective, innovation and learning perspective, and financial perspective. Specifically, the measures that are chosen by the unit tend to fall under one of these categories. For example, under the learning growth category, there may be a measure for number of training hours employees receive (see Albright, Davis, & Hibbets 2001) [18]. This outcome measure could then be linked to employee knowledge and skill in an area (e.g., sales) that then translates into successful referrals or cross-sells, leading to customer satisfaction-retention leading to some bottom line financial number. In this way, a training manager or specialist could see how her activity linked to the larger business goals.

Although not conceived as metrics system by the originators, BSC has become closely aligned with performance

measurement and compensation systems. As an example, a CEO for a credit union who implemented a BSC for his firm is quoted as saying, "All the bonuses, from mine on down to the most entry-level employee's, are tied to the scorecard" (Hanson and Towle, 2000) [5].

In fact, McKenzie and Shilling (1998) [12] talk about balanced scorecards in terms of performance measurement systems that are tied to incentive or compensation plans—and all the problems this can create. Employees as well often think of the Scorecard in terms of performance evaluation or meeting the prescribed numbers (Albright, Davis, & Hibbets, 2001) [18].

After implementation, McCunn (1998) [13] makes it a commandment that the implementing firms not underestimate the significant administrative cost in time and money for gathering information from the scorecard.

Michel Porter(1985) [17] has suggested the Five force model . In this models he lays great emphasis on all the relevant factors that an organization should consider. He says that for an organization to succeed it needs to take into account the firm, its competitors, its suppliers, its customers and also its substitutes. All these if not monitored properly can cause havoc to the performance of an organization. Punniyamoorthy M.(2003) [15], Strategic Decision Model for the Justification of Technology Selection has been used here for the conversion of different units into a single unit.

Ho and McKay (2002) [6] compare two companies—one that abandoned its use of BSC and one that is succeeding. Among the critical differences cited was that the failed example emphasized individual performance measures. In fact, the use of the scorecard as an evaluation tool may compromise one of the supposed benefits of the program—focus on long-term instead of short-term results. In the firm where BSC was abandoned, the management system focused more on individual performance and tied compensation directly to the scorecard measures. Perhaps the most important feature of a successful BSC program is the use of timely feedback.

In Ho and McKay's (2002) [6] comparison, the firm successful with the BSC was able to tie the measures to pertinent feedback structures. Furthermore, it was focused to teams rather than individuals. The literature in general extols the ability of BSC to provide lead indicators as a way to assist managers.

For example, McCunn (1998) [13] cites a plastics manufacturer that identified one of its scorecard measures as machine availability. Simply measuring this as a percentage and reporting it to the 15 business units (placed in a context so they were not competing against each other), allowed the units to move from 90% availability to over 98%. Although McCunn credited the scorecard with this boost—"without the scorecard, machine availability would not have been given such high priority . . ."—the effective use of feedback (and tactical controls) was the critical factor.

### III. WHAT IS BALANCE SCORE CARD

A balanced scorecard is a framework drawn up by a company to help them implement complex and intricate corporate strategies and monitor them. The balanced scorecard is a way of measuring the effectiveness of organisational, SBU or departmental strategies adopted by an organisation. The different measures of success are broadly divided into four main categories as mentioned below. Financial Perspective, Internal business process, perspective Learning and Growth perspective and Customer perspective

Indicators are selected according to the organization's strategic objectives. Targets are set that need to be achieved in a specific period of time. Targets are very specific, realistic, and measurable and time bound. They are set so as to take the company to its strategic objective.

The balanced scorecard can thus give a true picture of reality. The balanced score card can thus enable the organisation to better itself in all spheres both internally and externally.

- 1) Translates vision and strategy
- 2) Defines the strategic linkages to integrate performance across organizations.
- 3) Communicates objectives and measures to a business unit, joint venture, or shared service.
- 4) Aligns strategic initiatives
- 5) Aligns everyone within an organization so that all employees understand how what they do supports the strategy

### IV. PROBLEM DEFINITION

The Balanced Scorecard in its present form eliminates uncertainty to a great extent compared to the traditional financial factors based performance measurement systems. But there is still scope for improvement in the Balanced Scorecard. Normally when we set out to measure the actual performance against the targeted performance, not all the criteria are met. For some factors actual performance is greater than the targeted performance, for some it is less than the targeted performance. This does not help the decision maker. There is some kind of confusion regarding the direction in which the organization is going. Effort has been made to overcome the above shortcomings. This ambiguity is accounted for and reduced using the Balanced Score Model for a Balanced Scorecard.

The Single Score of Balanced Scorecard tries to arrive at a single value for comparing the target performance and the actual performance of the organization. Balanced Scores of two different time periods can also be compared to evaluate the performance of the organization over the two time periods. In short it is a measure, which incorporates under achievement as well as over achievement.

If you were to ask most anyone how they would measure company performance, they might give you a funny look and say, "How much money the company makes, of course! Isn't that obvious?" To a certain extent, they are right. Profitability, gross revenues, return on capital, etc. are the critical, "bottom

line" kind of results that companies must deliver to survive. Unfortunately, if senior management only focuses on the financial health of the organization, several unfortunate consequences arise. One of these is that financial measures are "lagging indicators" of success. This means that how high or low these numbers go depends on a wide variety of events (talked about later) that may have happened months or years before and that you have no immediate control of in the present.

Another of the consequences of just focusing on financial measures is that they have nothing to do directly with the customers who use your organization's product or service. Decisions may be made that help your organization financially, but hurt the long-term relationships with one's customers, who may eventually reduce the purchases or leave you altogether. We all may have been in the spot of paying for car repairs that we need, but we know that we are paying too much and will never go back to that service station again.

Instead of such a short-sighted, after-the-fact view of company performance, we need a more comprehensive view with an equal emphasis on outcome measures (the financial measures or lagging indicators), measures that will tell us how well the company is doing now (current indicators) and measures of how it might do in the future (leading indicators).

V.METHODOLOGY

Let us now see the development of Single Score for Balanced Scorecard. In a Balanced Scorecard we have four perspectives. The perspectives, the measures under each perspectives, the target and actual values of each measure are analysed in a framework.

There are four Levels in the Single Score for Balanced Scorecard Model.

A.Level 1Criteria:

The first level is the goal of the model i.e., Balanced Score for Balanced Scorecard. The frame work to arrive at the *Single Score for Balanced Scorecard* for the industry concerned.

B.Level 2 Criteria:

In this model four perspectives are considered. They are:

- 1) Financial Perspective
- 2) Customer Perspective
- 3) Internal Business Process Perspective
- 4) Learning and Growth Perspective

Weightage for each perspective are arrived by preference table. In this case of perspectives, <sup>4</sup>C<sub>2</sub> pairs are considered for pair wise comparison using preference theory. The possible pair wise combinations are

- 1) Finance and Customer Perspective
- 2) Finance and internal process Perspective
- 3) Finance and Learning Perspective
- 4) Customer and Internal Perspective
- 5) Customer and Learning Perspective
- 6) Internal and Learning Perspective

After thorough consultation with the top management the relative Weightage for each factor is arrived at by pair wise comparison using the preference theory. These perspectives are compared pair wise and 0 or 1 is assigned based on the importance of one perspective over another. In each level the perspective's relative Weightage is established by pair wise comparison. In the process of comparison if the first perspective is more important than the second perspective, 1 for the first and 0 for the second, otherwise 0 for the first perspective and 1 for the second perspective are assigned. If both perspectives are valued equally, 1 is assigned for both perspectives. When the values are assigned, it is to be seen that results of the comparison decision are transitive. i.e., if the perspective 1 is more important than perspective 2 and perspective 2 is more important than perspective 3, then the perspective 1 is more important than perspective 3. The weightage thus calculated are used to attach importance for the respective perspectives in the preference table and the relative weightage are shown in (Table I).

TABLE I  
WEIGHTAGE

Factor	F&C	F&I	F&L	C&I	C&L	I&L	Weight age	
Financ e	1	1	1				3	0.5000 =a <sub>1</sub>
Custo mer	0			1	0		1	0.1667 =a <sub>2</sub>
Internal		0		0	1	0	1	0.1667 =a <sub>3</sub>
Learnin g			0		0	1	1	0.1667 =a <sub>4</sub>
							7	

C.Level 3 criteria:

Each perspective will have sub criteria for measuring organizational performance. To measure each criteria or sub criteria measures are identified

1. Financial Perspective

We do not disregard the traditional need for Financial data. Timely and accurate funding data will always be a priority, and the managers will do whatever necessary to provide it. In fact there is often more than enough handling and processing of financial data. The current emphasis on financials leads to the "unbalanced" situation with regard to other perspectives.

There is perhaps a need to include additional financial-related data, such as risk assessment and cost-benefit data in this category.

Having a clear idea of what data to be collected for financial perspective with the above mentioned factors, the sub factors for the industry concerned are:

- 1) Market share
- 2) Sales growth by year or quarter
- 3) Net profit margin
- 4) Reduction in manufacturing cost
- 5) Reduction in distribution cost
- 6) Reduction in Inventory and warehouse cost



Now we are ready to frame a general expression, considering the entire factors. The expression is framed in such a manner that the factors are converted into consistent, dimensionless indices. The sum of each index is equal to 1. This is the newly developed factor evaluation expression. This is used to evaluate the factors in order to assist to arrive at the relative weightage at the lowest level.

Here the actual and targeted values for each constituent of the Level 3 are substituted in the Equation 1 to arrive at the weightage for the targeted and Actual Performance values for the industry concerned. All the Weightage are shown in the table (Table VI). These weightage are multiplied and summed to arrive at the *Single Score for the Balanced Score Card*. The purpose of effectiveness can be found.

$$ES_1 = BM_1 ( 1/ \Sigma BM ) + [CM \Sigma(1/CM)]^{-1} + BT_1 ( 1/\Sigma BT_1 ) + [TM_1 \Sigma(1/TM_1)]^{-1} + NF_1 ( 1/\Sigma NF ) + [NFM_1 / \Sigma 1/NFM_1 ]^{-1}$$

- ES<sub>1</sub> = Effectiveness score for alternative 'I'
- BM<sub>1</sub> = Benefit in money for alternative 'I'
- BT<sub>1</sub> = Benefit in time for alternative 'I'
- CM<sub>1</sub> = Cost to be minimised for alternative 'I'
- TM<sub>1</sub> = Time to be minimised for alternative 'I'
- NF<sub>1</sub> = Non financial factors for alternative 'I' to be Maximised
- NFM<sub>1</sub> = Non financial factors for alternative 'I' to be Minimized

TABLE VI  
FINANCIAL PERSPECTIVE

Measure	Targeted	Actual	Target Weightage	Actual Weightage
Market share	25%	20%	0.5555	0.4445
Sales growth by year or quarter	5%	7%	0.4167	0.5833
Reduction in Manufacturing cost	5%	4%	0.5555	0.4445
Reduction in Distribution cost	3%	2%	0.6000	0.4000
Reduction in Inventory & Warehouse cost	5%	3%	0.6250	0.3750

CUSTOMER PERSPECTIVE

Measure	Targeted	Actual	Target Weightage	Actual Weightage
Lead time	5	6	0.4545	0.5455
No of defects per order	2%	1.5%	0.4286	0.5714
On-time delivery rate	95%	90%	0.5135	0.4865

INTERNAL PROCESS PERSPECTIVE

	Targeted	Actual	Target Weightage	Actual Weightage
Productivity	1.2	1.3	0.4800	0.5200
Customer order CT	15 days	20 days	0.5714	0.4286
Manufacturing CT	7 days	10 days	0.5882	0.4118
Inventory Replenishment CT	10 days	13 days	0.5653	0.4347
Cash to Cash CT	20 days	23 days	0.5349	0.4651
No of defects per order	3%	5%	0.6250	0.3750

LEARNING AND GROWTH PERSPECTIVE

Measure	Targeted	Actual	Target Weightage	Actual Weightage
% of sales from new product	10%	12%	0.4545	0.5455
On-time delivery	10%	5%	0.6667	0.3333
Cycle time	5%	3%	0.6250	0.3750
Defect rate	15%	10%	0.6000	0.4000

Calculations

**TP = 0.5072**

Balanced score for Balanced scorecard (Actual Performance)  
**AP** = a<sub>1</sub>( b<sub>1</sub>c<sub>2</sub> + b<sub>2</sub>c<sub>4</sub> + b<sub>3</sub>c<sub>6</sub> + b<sub>4</sub>c<sub>8</sub> + b<sub>5</sub>c<sub>10</sub> + b<sub>6</sub>c<sub>12</sub> ) + a<sub>2</sub>( b<sub>7</sub>c<sub>14</sub> + b<sub>8</sub>c<sub>16</sub> + b<sub>9</sub>c<sub>18</sub> + b<sub>10</sub>c<sub>20</sub> ) + a<sub>3</sub>( b<sub>11</sub>c<sub>22</sub> + b<sub>12</sub>c<sub>24</sub> + b<sub>13</sub>c<sub>26</sub> + b<sub>14</sub>c<sub>28</sub> + b<sub>15</sub>c<sub>30</sub> + b<sub>16</sub>c<sub>32</sub> ) + a<sub>4</sub>( b<sub>17</sub>c<sub>34</sub> + b<sub>18</sub>c<sub>36</sub> + b<sub>19</sub>c<sub>38</sub> + b<sub>20</sub>c<sub>40</sub> )  
**AP** = { **0.5** [(0.1875 x 0.4445) + (0.25 x 0.5833) + (0.125 x 0.4445) + (0.0625x0.4) + (0.0625x0.375) + (0.3125x0.4) ] + **0.1667** [(0.1429 x 0.5455) + (0.1429x0.4286)+ (0.4286 x 0.4865) + ( 0.2857 x 0.5715)] + **0.1667**[(0.3125 x 0.52) + (0.0625 x 0.5714) + (0.25 x 0.5882) + (0.0625x0.5653) + (0.125x0.5349) + (0.1875x0.625)] + **0.1667** [ (0.4286 x 0.5455) + (0.1429x0.3333)+ (0.2857 x 0.375) + ( 0.1429 x 0.4) ] }

**AP = 0.4928**

Thus arrived single measure enables the top management to assess the overall performance

VI. RESULT AND DISCUSSION

On the whole the company's targeted performance is on the higher side (0.5072). This would mean that the overall performance of the company is less than the specified target. This leads us to discuss the reason(s) for the poor performance of the company and what it should do to improve.

From the financial perspective, the company's actual performance score (0.2291) is less than the target score (0.2709). It is evident that the organization falls short in terms of financial performance. The reason for this under performance is inadequate employee training. Shortage of training results in lower skill levels of the employees, which in turn affect the employee output. The result is stretched budgets and hence lower realization.

Regarding the customer perspective the actual performance (0.08518) more than the target performance (0.08153) reflecting a need for the organization to maintain its consumer satisfaction scores.

Internal perspective shows the actual performance (0.0941) to be less than the target performance (0.0726)

Learning and growth perspective also shows that the actual performance (0.0743) is less than the target performance (0.0924). Inadequate training like this can possibly result in increased rework constituting a major problem.

If all performance is good then we have to check the specified target. So that the performance will be as per our strategic goals. This analysis helps the organization to set realistic target scores and to achieve performance levels equal to or higher than the set target(s).

## VII. CONCLUSION

Indian companies are yet to leverage the supply chain for competitive advantage and as such there are no Initiatives to measure the performance of their existing supply chain systems. However, multi-nationals companies are fully exploiting the benefits and are also moving towards web-enabled supply chains. In view of globalization and liberalization of the economy, Indian companies are being forced to change their ways of doing business to meet the competitive pressure. In the recent past, many progressive companies are re engineering their business processes and exploiting the use of Information Technology to challenge the ever-increasing competitive pressures in the market place. In this context, Supply Chain Management initiatives could be a competitive tool and measuring the performance against industry standards would go a long way in achieving international standards.

The Balanced Scorecard enabled organizations to eliminate all the drawbacks and strategies were developed taking into account the concerns of all involved and the organisation came out with one united strategy for all its activities which was made clear to all. This enabled the widespread and successful implementation of the balanced scorecard across the industry, cutting across regional, departmental, nature of business and other barriers. It has been successfully adopted by many companies across the world today.

Improvements flow from detailed analysis, innovation and specific actions. And finally, cross-functional workers and the organization culture play a critical role. In other words, the key to scoring is balancing your resources with your priorities.

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TABLE II  
FINANCIAL PERSPECTIVE

Factor	12	13	14	15	16	23	24	25	26	34	35	36	45	46	56	Weightage		
1 Market share Sales growth by year or quarter	0	1	1	1	0											3	0.1875	=b <sub>1</sub>
2 Reduction in Manufacturing cost	1					1	1	1	0							4	0.2500	=b <sub>2</sub>
3 Reduction in Distribution cost		0				0				1	1	0		0		2	0.1250	=b <sub>3</sub>
4 Reduction in Inventory & Warehouse cost			0				0			0			1			1	0.0625	=b <sub>4</sub>
5 Net profit margin				0				0			0		1		0	1	0.0625	=b <sub>5</sub>
6					1				1			1		1	1	5	0.3125	=b <sub>6</sub>
															16			

TABLE IV  
INTERNAL PROCESS PERSPECTIVE

Factor	12	13	14	15	16	23	24	25	26	34	35	36	45	46	56	Weightage		
1 Productivity	1	1	1	1	1											5	0.3125	=b <sub>11</sub>
2 Customer order CT	0					0	1	0	0							1	0.0625	=b <sub>12</sub>
3 Manufacturing CT		0				1				1	1	1				4	0.2500	=b <sub>13</sub>
4 Inventory Replenishment CT			0				1			0			0	0		1	0.0625	=b <sub>14</sub>
5 Cash to Cash CT				0				1			0		1		0	2	0.1250	=b <sub>15</sub>
6 No of defects per order					0				1			0		1	1	3	0.1875	=b <sub>16</sub>
															16			