Chapter 7

Sustainability Performance Measurement in Supply Chains

The previous chapter proposes a framework and a methodology for flexibility performance measurement of Supply Chains (SCs). The framework identifies flexibility objectives and its contributing attributes at four levels of the SC and suggests taxonomy of flexibility performance measures. This Chapter provides a brief of the sustainability measurement practices as applied to SC. A comparative analysis of some most widely cited Performance Measurement Systems (PMS) for Green SC is carried out in this Chapter and it indicates that the modified Balanced Score Card (BSC) as a suitable framework for Green SC PMS. This chapter demonstrates integration of Analytic Hierarchy Process (AHP) with modified BSC to facilitate effective Green SCPMS.

7.0 INTRODUCTION

Environmental management is becoming a key strategic issue for SC performance. Organisations are increasingly being aware and are concerned about environmental and social impact of their business activities. Environmental management is becoming a key strategic issue for SC performance (Kafa, Hani, & El Mhamedi, 2013; Q. Zhu, Sarkis, & Lai, 2008). Environmental impacts occur across all stages of a product's life cycle, from the raw material extraction, to manufacturing, use and reuse, final recycling, and disposal. Green Supply Chain Management (GSCM) has become an important strategy for companies to achieve profit and market advantages by reducing the environmental risks and improving efficiency.

According to Salam (2008), an environmental response is an important management resource. Integrating environmental initiatives into corporate management can lead to increased business, improved business performance, and further enhancement of their credibility with stakeholders (Koplin, Seuring, & Mesterharm, 2007; Sisco, Chorn, & Pruzan-Jorgensen, 2010; Svensson, 2007). The enhanced environmental concerns necessitate performance measurement and reporting systems catering to green initiatives (Morgan, 2007;

Morhardt, Baird, & Freeman, 2002). An effective, balanced and dynamic performance measurement system is critical for monitoring, controlling and improving a Green SC.

Number of frameworks and models for performance measurement have been developed since 1980s. The traditional PMS based on financial metrics alone have been deemed inadequate and more attention is being paid to non-financial metrics. Several broader PMS have been designed, of which BSC has been the least criticised and most widely accepted (Bititci et al., 2000). Many practical difficulties however, are associated with the implementation of BSC for performance measurements in Green SC (Gomes et al., 2004a; Shaw, Grant, & Mangan, 2010). This Chapter is an attempt to use AHP integrated with modified BSC to tide over the limitations of BSC.

7.1 Green Supply Chain Management (GSCM)

GSCM has emerged as an effective management tool and philosophy for proactive and leading manufacturing organizations (Nainii, Aliahmadi, & Jafari-Eskandari, 2011; Q. Zhu et al., 2008). GSCM involves all areas of the SC form green purchasing to reverse logistics. According to Morhardt et al., (2002), organizations adapt green initiatives due to a sense of social responsibility and desire to adhere to societal norms. There is also a feeling among firms that active environmental management retains the firm's legitimacy. Where reporting of environmental and social performance is not mandatory, organisations appear to be doing it because of peer pressure and to improve employees and other stakeholders' perceptions of the company's environmental performance (Morhardt et al., 2002). SC sustainability is the management of environmental, social and economic impacts, and the encouragement of good governance practices, throughout the lifecycles of goods and service (Chorn, Sisco, & Pruzan-Jorgensen, 2010). This implies that the aim of SC sustainability is to create, protect, and grow long-term environmental, social and economic value for all stakeholders involved in bringing products and services to market (Sisco et al., 2010).

Naini Jalali et al., (2011) observed that environmental SCs are the set of supply chain management policies held, actions taken, and relationships formed in response to concerns related to natural environment with regards to the design, acquisition, production, distribution, use, reuse and disposal of the firm's goods and services'. According to Hervani, Helms, & Sarkis, (2005), the 'Green' in Green Supply Chain Management (GSCM) indicates the effect the SC has on the environment. Hervani et al., (2005) defines GSCM as the sum of Green

Purchasing, Green Manufacturing, Green Materials Management, Green Distribution and Marketing and Green Reverse Logistics. The possible environment friendly activities at the various links of the supply chain are given at Table 7.1.

Table 7.1 Green Activities at SC Links (Bergmiller, 2006; Dheeraj & Vishal, 2012; Green, Morton, & New, 1998; Hassini, Surti, & Searcy, 2012; Hervani et al., 2005; Shukla, Deshmukh, & Kanda, 2009)

PURCHASING	• Certifying suppliers • Purchasing environmentally sound materials • Minimize wastes
Product Design and Development	• Minimum waste generation • Use of safe materials • Design for dis-assembly, recycle and reuse
Manufacturing	• Pollution control • Minimize operational wastes • Minimum energy consumption • Low carbon footprint
Marketing	• Environment friendly packaging • Transportation with minimum carbon foot print • Responsible advertising
Reverse Logistics	• Reuse • Remanufacturing • Recycling • Repair

7.2 Green Supply Chain Performance Measurement System (Green SCPMS)

Broadly accepted standards for measuring the total environmental footprint of a SC could not be found in literature. However, SCs are increasingly incorporating Green performance measurements in their SCPMs (Ansari & Kant, 2017; Morhardt et al., 2002). There have been some significant contributions in the field of Green SCPMS in the current decade which are briefly reviewed in the succeeding paragraphs.

7.2.1 Taxonomy of GSCM Performance

Shang, Lu, & Li, (2010) conducted a study to identify the taxonomy of GSCM capability and firm performance which identified, on the basis of a factor analysis, six GSCM dimensions: (i) Green manufacturing and packaging; (ii) Environmental participation; (iii)

Green marketing; (iv) Green suppliers; (v) Green stock and (vi) Green eco-design. (Shang et al., 2010) Shang et al. (2010) identified 37 performance measure attributes for Green SCPMS. However, based on respondents' perceptions top five GSCM attributes in respondents' firms identified are as under:

1. Design of products to avoid or reduce use of hazardous products and manufacturing processes
2. Substitution of polluting and hazardous materials/parts
3. The manufacturing process capability to reduce the noise pollution
4. Production planning and control focused on reducing waste and optimising materials' exploitation, and
5. In purchasing, supplier's certification for green product conformance

A GSCM framework should include economic, environmental and social objectives and corresponding performance indicators (Varsei, Soosay, Fahimnia, & Sarkis, 2014). However some authors argue that since SC is a complex system involving a number of participating firms, it is not practical to consider all the aspects of the three dimensions of sustainability developing a SCPMS (Matos & Hall, 2007; Varsei et al., 2014).

7.2.2 The ISO 14031

The ISO 14031:2013 Environmental management - Environmental Performance Evaluation – Guidelines gives guidance on the design and use of environmental performance evaluation, and on identification and selection of environmental performance indicators. This allows any organisation regardless of size, complexity, location and type to measure their environmental performance on an on-going basis ("ISO 14031:2013 - Environmental management -- Environmental performance evaluation -- Guidelines," n.d.). ISO 14031 defines environmental performance indicators as "a specific expression that provides information about an organisation's environmental performance" and divides environmental performance indicators into three classifications:

1. Environmental condition indicators (ECI), for presenting achievements in context

2. Operational performance indicators (OPI), used to demonstrate change in resource use

3. Management performance indicators (MPI), for showing cost savings and improvements in training

7.2.3 Green Supply-Chain Operations Reference-model (Green SCOR)

Supply Chain Operations Reference-model (SCOR) is a process reference model developed by the management consulting firm PRTM and endorsed by the Supply-Chain Council (SCC) as the cross-industry performance measurement tool for supply chain management (Stewart, 1997). GreenSCOR integrates environment best practices and metrics into the entire supply chain planning process (“Supply-Chain Operations Reference-model,” n.d.). It also enables a systematic study of the supply chain to unearth opportunities for making the supply chain greener. GreenSCOR identifies five environmental metrics that can be measured across the supply chain. The SCOR model details hierarchical levels for processes and metrics that roll up to strategic, organisation-wide measurements. The GreenSCOR metrics are carbon emissions, air pollutant emissions, liquid waste generated, solid waste generated and the percent of solid waste that is recycled. When applied within the SCOR framework, these metrics allow for targeted data collection that ultimately makes it easier to create a total view of an organisation’s internal and supply chain-wide environmental performance. GreenSCOR “incorporates industry best practices for making the supply chain more environment friendly, such as collaborating with partners on environmental issues, reducing fuel and energy consumption, and minimizing and reusing packaging materials. Adoption of the SCOR version nine framework increases the chance of success of any green initiative. It also enables more efficient use of resources and increases the visibility of financial and operations benefits of Green supply chain practices and the metrics can be effectively used to monitor the progress an organization is making towards a green supply chain (Archie Lockamy & McCormack, 2004; *Supply Chain Operations Reference Model,* 2010).

7.2.4 “Modified Balanced Score Card (BSC) for Green SCPMS

BSC proposes that a company should use a balanced set of measures that allows top managers to take a quick but comprehensive view of the business from four important perspectives (Tangen, 2004). These perspectives provide answers to four fundamental questions as explained in Chapter 2; viz.: (i). How do we look to our shareholders (financial perspective)? (ii). What must we excel at (internal business perspective)? (iii). How do our customers see us (the customer perspective)? (iv). How can we continue to improve and create value (innovation and learning perspective)? The BSC includes financial performance measures giving the results of actions already taken. It also complements the financial performance measures with more operational non-financial performance measures, which are considered as drivers of future financial performance. By giving information from four perspectives, the BSC minimises information overload by limiting the number of measures used. It also forces managers to focus on the handful of measures that are most critical (Shaw et al., 2010). Further, the use of several perspectives also guards against sub-optimisation by compelling senior managers to consider all measures and evaluate whether improvement in one area may have been achieved at the expense of another (Bhagwat & Sharma, 2007; Chang, Hung, Wong, & Lee, 2013; Kaplan & Norton, 1992).

The BSC provides a high level strategic view of corporate performance and could be adapted for Green SCPMS. Shaw et al., (2010) proposed the use of modified BSC by incorporate environmental measures. The two ways in which Green or environmental measures could be expressed within the balanced scorecard are:

1. As a fifth "environmental" perspective, or
2. As part of the four existing perspectives

By incorporating environmental measures within the balanced scorecard framework as a fifth perspective or as part of the four existing perspectives, organisations are identifying that environmental management is one of their strategic goals. It raises the profile and importance of environmental management and satisfies the stakeholders that it is being treated as a core value. A modified BSC framework, proposed by Shaw et al., (2010), incorporating environmental measures within the balanced scorecard framework as well as a fifth perspective is shown in Figure 7.1.

Review of related literature indicates certain limitations and weaknesses to the BSC approach. The main weakness of this approach is that, it is primarily designed to provide senior managers with an overall view of performance (Ghalayini & Noble, 1996). Thus, it is not intended for (nor is it applicable to) the factory operations level. Furthermore, an argument was put forward that although the BSC is a valuable framework suggesting important areas in which performance measures might be useful, it provides little guidance on how the appropriate measures can be identified, introduced and ultimately used to manage business (Neely, 2005).

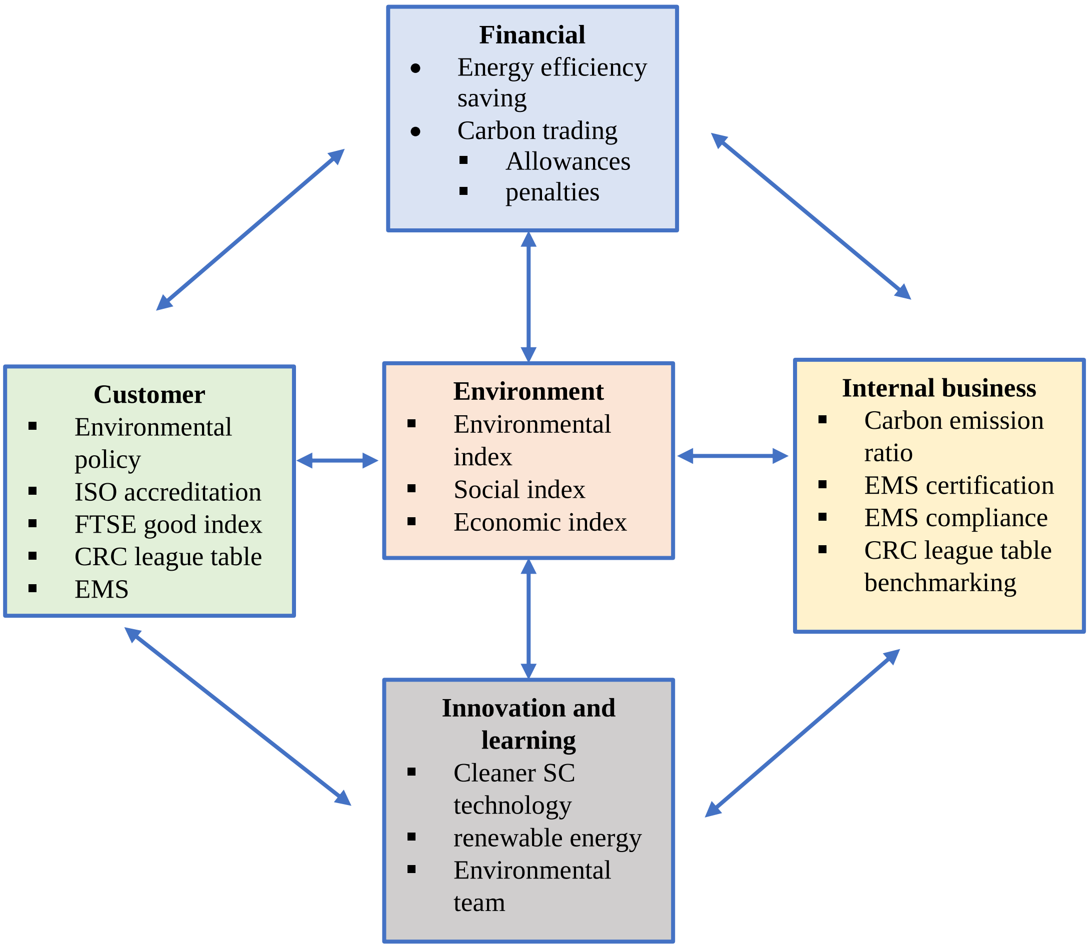


Figure 7.1 Modified BSC for Green SCPMS (Shaw et al., 2010)

BSC is more like a strategic management tool, rather than a true complete PMS5. Another drawback observed in BSC is that it does not specify any mathematical logical relationships among the individual's scorecard criteria. It is thus difficult to make comparisons within and across firms using BSC (Soni & Kodali, 2010). The present work is an attempt to provide a framework which overcomes these limitations of BSC by providing a mathematical and logical relationship within the scorecard criteria by integrating AHP with modified BSC

7.3 Integration of AHP with Modified BSC for Green SCPMS

The AHP, as explained in Chapter 3, is a general problem-solving method that is useful in making complex decisions (e.g., multi-criteria decisions) based on variables that do not have exact numerical consequences. Detailed methodology on AHP including examples are available in literature (Dey & Cheffi, 2013; Forman & Gass, 2001; Islam & Rasad, 2005;

Jovanovic & Krivokapic, 2008; Saaty, 2008). Software packages are also available for solving problems using AHP (Ossadnik & Lange, 1999).

Using the framework of the Modified BSC for Green SCPMS's five perspectives, generic performance measures were identified for the purpose of analysis and developing the current model. The measures considered are in line with other researchers (Shaw et al., 2010) and is depicted in Table 7.2.

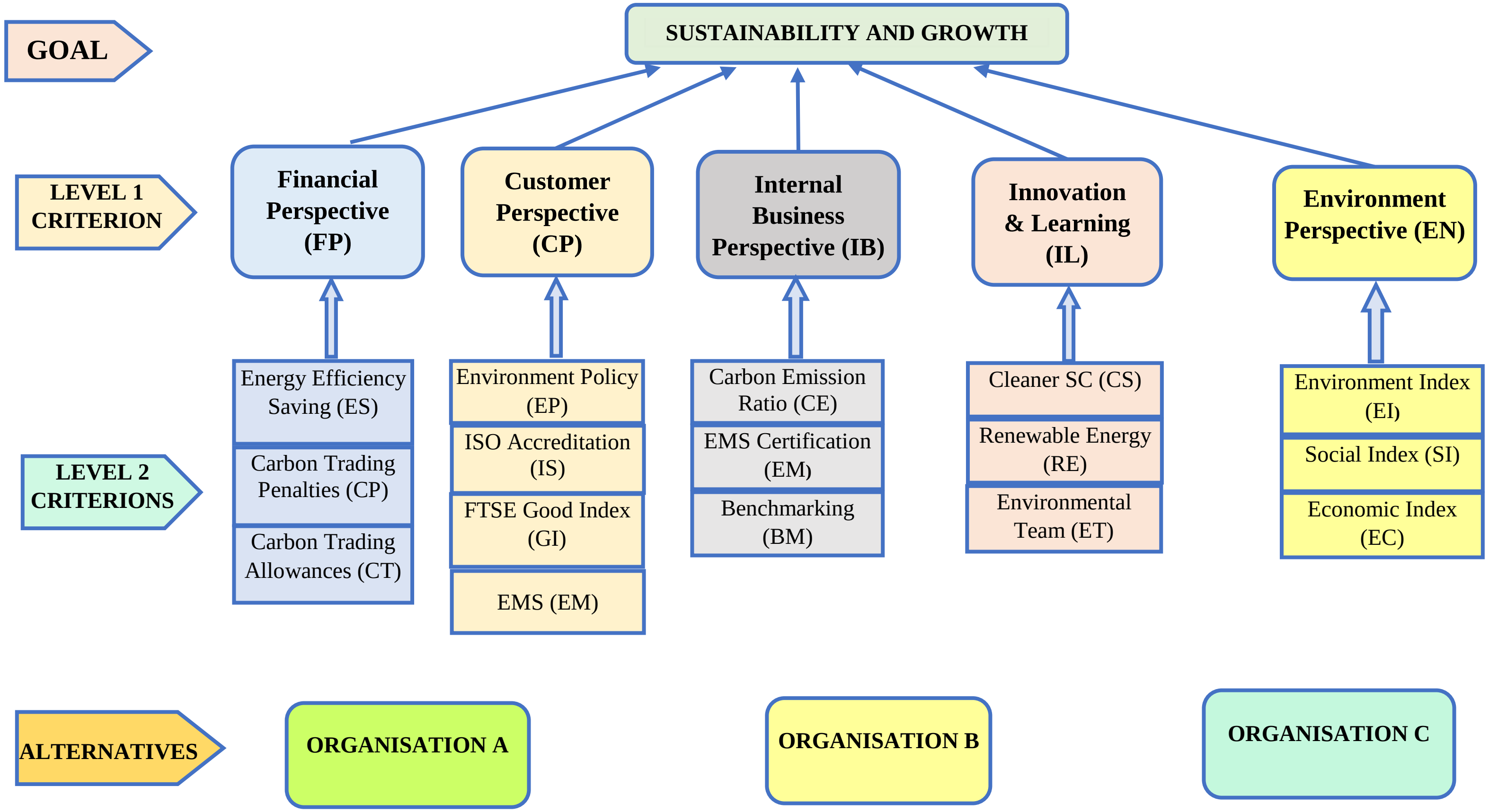
Table 7.2 List of Measures Used

Financial Perspective (FP)	Customer Perspective (CP)	Internal Business Perspective (IB)	Innovation and Learning (IL)	Environment (EN)
1. Energy Efficiency Saving (ES) 2. Carbon Trading Allowances (CA) 3. Carbon Trading Penalties (CT)	1. Environment Policy (EP) 2. ISO Accreditation (IS) 3. FTSE Good Index (GI) 4. EMS (EM)	1. Carbon Emission Ratio (CE) 2. EMS Certification (EM) 3. Benchmarking (BM)	1. Cleaner SC (CS) 2. Renewable Energy (RE) 3. Environmental Team (ET)	1. Environment Index (EI) 2. Social Index (SI) 3. Economic Index (EC)

7.3.1 Building 'Hierarchy'

The first step in solving a decision problem by APH is decomposing the problem into a hierarchy of criteria and alternatives. A hierarchy is structured from the top (primary objective(s) or goals), then intermediate levels which are criteria/sub-criteria on which subsequent levels depend to the lowest level which is usually a list of alternatives from which to choose or compare. Based on the criteria selected for performance measurement using Modified BSC, given at Table 7.2, an AHP hierarchy model has been prepared. The hierarchy model consists of the 'goal' at the top, the contributing levels of 'criteria' and 'alternatives'. The five perspectives of the modified BSC form the Level 1 criterion and the performance measures which contribute to each of the five perspective forms the second level criteria. The competing SCs form the 'alternatives' in the AHP hierarchical model. The AHP hierarchical model for modified BSC for environmental performance measurement is shown at Figure 7.2.

Figure 7.2. AHP Hierarchy Scheme for GreenSCPMS



7.3.2 Establishing priorities

After decomposing problem into levels of criteria and building the hierarchy, the next step is generating the priority matrix for each level of criteria. AHP uses pair-wise comparison of the same hierarchy elements in each level (criteria) using a scale indicating the importance of one element over another with respect to a higher-level element. The importance of scale between elements is shown in Table 3.3 (Chapter 3). For each level of Criteria, by '*Paired Comparison'* and by using '*Comparison Values', 'Comparison Matrix'* is generated. Delphi technique is used for generating the Comparison Matrix. The Comparison Matrix for Level 1 criteria is given at Table 7.3. Comparison matrices for Level 2 criteria are included as part of the respective Eigen matrices at Table 7.5.

Table 7.3 Comparison Matrix for Level 1 Criteria

PAIRED COMPARISON	FINANCIAL PERSPECTIVE (FP)	CUSTOMER PERSPECTIVE (CP)	INTERNAL BUSINESS PERSPECTIVE (IB)	INNOVATION AND LEARNING (IL)	ENVIRONMENT (EN)
Financial Perspective (FP)	1	1/3	2	3	2
Customer Perspective (CP)	3	1	3	4	2
Internal Business Perspective (IB)	1/2	1/3	1	2	1/3
Innovation and Learning (IL)	1/3	1/4	1/2	1	1/2
Environment (EN)	1/2	1/2	3	5	1

7.3.3 Generation of Eigen Vectors

Based on the priority matrix, Eigen Vectors are calculated for each level of criteria. The Eigen vector represents the Priority Measure of each criterion. Consistency of comparative matrices are checked to see whether the 'paired comparisons' are logical. This is to check the consistency of judgment of the decision maker. The consistency Index (CI) is calculated as:

$$CI = \frac{\lambda_{\max} - n}{(n-1)} \tag{7.1}$$

Where,

λ_{max} – Principal Eigen Value

$$\lambda_{\max} = \sum (Sum\ of\ column\ values\ of\ comparison\ matrix \times Eigen\ vector\ element) \tag{7.2}$$

n = Number of criterion under paired comparison.

Based on the Consistency Index (CI) and the Random Consistency Index (RI), Consistency Ratio (CR) is calculated as:

$$CR = \frac{CI}{RI} \tag{7.3}$$

Random Consistency Index (RI) values are taken from the *Random Consistency Index Table* (Table 7.4). The condition for consistency of judgement is that Consistency Ratio (CR) < 10% (Saaty, 2008).

Table 7.4 Random Consistency Index Table (source: Saaty, 2008)

Order of Matrix	1	2	3	4	5	6	7	8	9
RI value	0.00	0.00	0.58	0.90	1.12	1.24	1.32	1.41	1.45

Eigen vectors generated and the Priority Matrices for all levels of criteria are calculated and shown at Table 7.5. The calculated CI and CR values are also shown at Table 7.5. The AHP Calculation software by CGI ("AHP Calculation software by CGI," n.d.) has been used to generate the Eigen vectors.

Table 7.5 Tables for Calculated Eigen Vectors (E.V.)

Eigen Matrix for Level 1 Criteria						
	FP	**CP**	**IB**	**IL**	**EN**	**Eigen Vector**
Financial Perspective (FP)	1	1/3	2	3	2	0.2249
Customer Perspective (CP)	3	1	3	4	2	0.3912
Internal Business Perspective (IB)	1/2	1/3	1	2	1/3	0.1032
Innovation and Learning (IL)	1/3	1/4	1/2	1	1/5	0.0627
Environment (EN)	1/2	1/2	3	5	1	0.2179
λ_{max} =5.27236; C.I.=0.0680892; CR = 0.06079						

Eigen Matrix for Level 2 Criteria - Innovation and Learning (IL)				
	CS	**RE**	**ET**	**Eigen Vector**
Cleaner SC (CS)	1	1/4	3	0.2255
Renewable Energy (RE)	4	1	5	0.6738
Environmental Team (ET)	1/3	1/5	1	0.1006
λ_{max} = 3.08577; C.I.= 0.0428833; CR = 0.07393				

Eigen Matrix for Level 2 Criteria - Environment (EN)				
	EI	**SI**	**EC**	**Eigen Vector**
Environment Index (EI)	1	1/5	1/3	0.1047
Social Index (SI)	5	1	3	0.6369
Economic Index (EC)	3	1/3	1	0.2582
λ_{max} = 3.03851; C.I.= 0.0192555; C.R. = 0.033198				

Eigen Matrix for Level 2 Criteria - Financial Perspective (FP)				
	ES	**CA**	**CP**	**Eigen Vector**
Energy Efficiency Saving (ES)	1	4	2	0.5584
Carbon Trading Allowances (CA)	1/4	1	1/3	0.1219
Carbon Trading Penalties (CT)	1/2	3	1	0.3196
λ_{max} = 3.01829; C.I.= 0.00914735; CR = 0.015771				

Eigen Matrix for Level 2 Criteria - Internal Business Perspective (IB)				
	CE	**EM**	**BM**	**Eigen Vector**
Carbon Emission Ratio (CE)	1	5	3	0.6369
EMS Certification (EM)	1/5	1	1/3	0.1047
Benchmarking (BM)	1/3	3	1	0.2583
λ_{max} = 3.03851; C.I.= 0.0192555; C.R. = 0.0331991				

Eigen Matrix for Level 2 Criteria - Customer Perspective (CP)					
	EP	**IS**	**GI**	**EM**	**Eigen Vector**
Environment Policy (EP)	1	3	2	4	0.4471
ISO Accreditation (IS)	1/3	1	1/4	2	0.1280
FTSE Good Index (GI)	1/2	4	1	4	0.3414
EMS (EM)	1/4	1/2	1/4	1	0.0833
λ_{max} = 4.13228; C.I.= 0.0440928; C.R. = 0.048992					

7.3.4 Aggregate Priority Vectors

The aggregate priority vector table is obtained by normalising individual Eigen Matrices. The Normalized Priority Matrix values are calculated such that the values of *Sub*

Criteria are within the weight of its corresponding higher criteria (Parent Criteria). Table 7.5 shows the Normalized Priority Matrix.

Table 7.6 Aggregate Priority Vectors Including All Criteria

Criteria	Calculated Eigen Value	Normalized Eigen Value	% Contribution	
			Level 2	Level 1
Innovation and Learning (IL)				
Cleaner SC (CS)	0.2255	0.0141	1.4139	6.27
Renewable Energy (RE)	0.6738	0.0422	4.2247	
Environmental Team (ET)	0.1006	0.0063	0.6308	
Environment (EN)				
Environment Index (EI)	0.1047	0.0228	2.2814	21.79
Social Index (SI)	0.6369	0.1388	13.8781	
Economic Index (EC)	0.2582	0.0563	5.6262	
Financial Perspective (FP)				
Energy Efficiency Saving (ES)	0.5584	0.1255	12.5584	22.49
Carbon Trading Allowances (CA)	0.1219	0.0274	2.7415	
Carbon Trading Penalties (CT)	0.3196	0.0719	7.1878	
Internal Business Perspective (IB)				
Carbon Emission Ratio (CE)	0.6369	0.0657	6.5728	10.32
EMS Certification (EM)	0.1047	0.0108	1.0805	
Benchmarking (BM)	0.2583	0.0267	2.6657	
Customer Perspective (CP)				
Environment Policy (EP)	0.4471	0.1749	17.4906	39.12
ISO Accreditation (IS)	0.128	0.0501	5.0074	
FTSE Good Index (GI)	0.3414	0.1336	13.3556	
EMS (EM)	0.0833	0.0326	3.2587	
Total	6.0000	2.0000	100	100

7.3.5 Overall Performance Score (OPS)

Overall Performance Score (OPS) of the organisation can be calculated once measures of each criterion is available. The data used is of a hypothetical firm. The scales and units of the performance measures are different. Hence the performance scores are normalised to a uniform scale of 0-100. The normalised performance scores are multiplied by the normalised Eigen vectors (weighting measure) to obtain the overall performance score. The overall Performance Score is calculated at Table 7.6. The aggregate of Performance Score at each level of criterion is calculated to provide the Overall Performance Score of the SC.

Table 7.7 Overall Performance Score (OPS)

Level 1 Criteria	Level 2 Criteria	Original Scale		Score	Normalised Score in Scale of 0 - 100	Normalised Eigen Vector	Overall Performance Score	
		Lower Limit	Upper Limit				Level 1 Score	Level 2 Score
IL	CS	0	10	6	60.00	0.0141	4.30	0.8460
	RE	1	1000	700	69.97	0.0422		2.9527
	ET	0	100	80	80.00	0.0063		0.5040
EN	EI	1	50	20	38.78	0.0228	14.08	0.8842
	SI	1	10	7	66.67	0.1388		9.2538
	EC	-10	10	4	70.00	0.0563		3.9410
FP	ES	0	1	0.8	80.00	0.1256	13.67	10.0480
	CA	20	50	40	66.67	0.0274		1.8268
	CT	-1	1	-0.5	25.00	0.0719		1.7975
IB	CE	0	10	9	90.00	0.0657	8.65	5.9130
	EM	0	1	0.8	80.00	0.0108		0.8640
	BM	100	200	170	70.00	0.0267		1.8690
CP	EP	0	50	20	40.00	0.1749	19.65	6.9960

Level 1 Criteria	Level 2 Criteria	Original Scale		Score	Normalised Score in Scale of 0 - 100	Normalised Eigen Vector	Overall Performance Score	
		Lower Limit	Upper Limit				Level 1 Score	Level 2 Score
	IS	0	100	75	75.00	0.0501		3.7575
	GI	-10	10	0	50.00	0.1336		6.6800
	EM	0	100	68	68.00	0.0326		2.2168
		Overall Performance Index					60.35	60.35

7.4 Results and Discussion

The Normalized Priority Matrix is a useful tool to evaluate importance of each criterion (Measure) in achieving organizational goal of 'sustainability and growth'. AHP provides weightings to the performance measures which indicate its contribution in a quantitative manner. Management can know how much each criterion will contribute to achieving the organisational Goal. For example, from Table 7.5, we can infer that at the first level of criterion, Customer Perspective (CP) has the highest weighting and its contribution to achieve 'sustainability and growth' is 39.12%. The percentage contributions of Level 1 criterion are represented graphically at Figure 7.3. At the second level, Environment Policy (EP) contributes 17.49% whereas the Environmental Team (ET) contributes only 0.63 % to achieve 'sustainability and growth'. The percentage contributions of Level 2 criterion are represented graphically at Figure 7.4. Therefore, based on this analysis, it will be prudent for the management to align its resources and processes more to the criterion which contributes most to achieve organisational objectives. The management can also use this information to look into those performance criterions which are contributing lower than expected to achieve organisational objectives to take steps to improve its contribution.

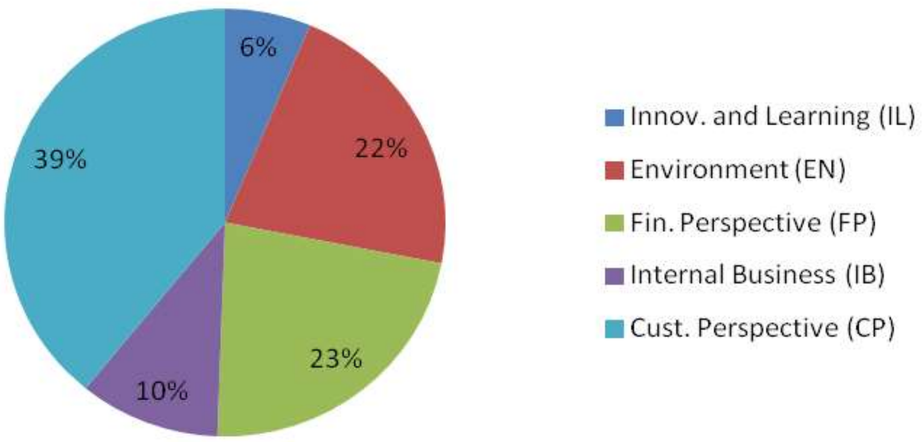


Figure 7.3 Percentage Contribution of Measures at Level 1 Criteria

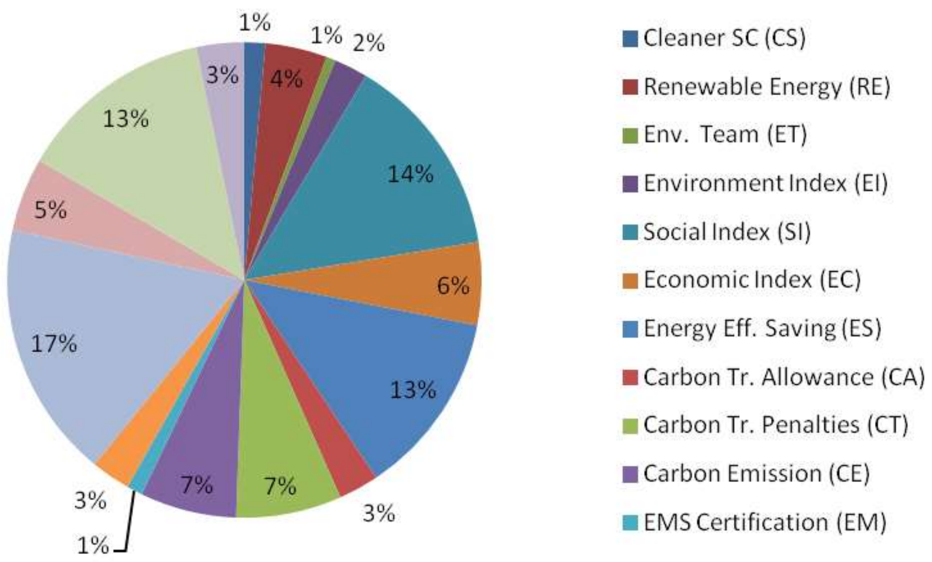


Figure 7.4 Percentage Contribution of Measures at Level 1 Criteria

Overall Performance Index derived through AHP - BSC integrated model (shown at Table. 7.6) quantifies overall performance of a SC. The calculated value of 60.35 overall performance indexes is significant when it is compared with earlier performance indices or compared with performance indices of similar SC. This quantified performance index will help in comparing similar SC, comparing performance of sub units of a SC and also in comparing with earlier performances of the same SC or sub unit. These measures can also be used for target setting and as a feedback for mid-course correction and monitoring**.**

7.5 Conclusion

Properly planned, implemented and managed green SCs enable organisations to be responsible corporate citizens, results in higher profitability and retain competitive advantage. Selection and use of appropriate Green SCPMS is critical for success of the green SC. Industry standard frameworks like SCOR version 9, ISO 14031 and Modified BSC incorporating a fifth dimension on environment are the preferred guidelines available for Green SCPMS.

The limitations of BSC viz. that it is difficult to make comparisons within and across firms and that the measurements making the scorecards unbalanced have been overcome by incorporating AHP with BSC. The AHP framework will be a useful tool to assess importance of each criterion (Measure) in achieving organisational Goal. Management can know how each criterion will contribute in achieving Greening of the SC. Management can thus prioritise its resource deployment and make more informed decisions.

Overall Performance Index derived through AHP- Modified BSC integrated model may also help management for benchmarking of Green initiatives of organisations. The numerical performance index will help in comparing Green initiatives of similar SCs, comparing performance of sub units of a SC and in comparing with earlier performances of the same SC or sub unit in the area of sustainability. These measures can also be used for target setting and as a feedback for mid-course correction and monitoring.