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Balanced Scorecard approach in deducing supply chain performance

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ABSTRACT

Supply chain management showcases a major role in enhancing organizational efficiency and effectiveness. A proficient supply chain can lead to abridged costs, augmented market shares, improved transactions and sustainable customer relationships. Nevertheless, designing a supply chain alone may be inadequate in bettering the overall performance of an organization which can only be improved through evaluation. For deducing supply chain performance, the Balanced Scorecard (BSC) is an appropriate tool, apart from Supply Chain Operations Reference models (SCOR), Analytic Hierarchy Process (AHP), Data Envelopment Analysis (DEA) and Heuristic techniques based models. Modern firms face inabilities in measuring their real performance against the demanded performance. Real performance is often greater or lesser than the demanded performance which leads to uncertain and delicate supply chains. Accounting for this ambiguity and improving supply chain performance using Balanced Scorecard model is the emphasis of this research effort, by providing an approach to inspect value creation from four standpoints such as financial, customer, internal business process, learning and growth. In this paper, the drag factors which affects the above four standpoints have been explored and removed, to mend the supply chain for better profits.

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1. Introduction

Computing the performance of supply chain is a judgement comprising complete operation level, the node enterprises in the supply chain, the cooperation relationship between the node enterprises, etc [1]. With continuous development in theories and advancements in exercise, a supplementary effective index system is to be arrayed for enactment of measuring the supply chain with following doctrines.

- It should lay emphasis on vital points and an exhaustive inquiry on the key performance indices should be abided.
- Performance score indices which replicate the real trade process should be embraced.
- Performance score indices must be capable of revealing the standing of the overall supply chain, instead of revealing just the status of single node enterprises of supply chain.

- Grade policy should be to a certain extent pooled with real time analysis so as to be competent to cover the scope of measurement to a level within which the real time operation information can be mirrored.
- While construing performance on a chain, the rating indices which mirror the association between supplier's manufacturers and the clients should be espoused, as to be able to cover the scope of measurement to a level which includes the kin enterprises of the chain.

Balanced Scorecard (BSC) is a strategic performance management tool, a quasi-standard structured testimony sustained by upheld design methods, used by administrators to keep track of the execution of events within their control and observe penalties arising from these actions. It is feasibly the superlative of numerous such frameworks, and was widely embraced in western nations and Scandinavia in the early 1990s. Since 2000, use of BSC, its offshoots (e.g. performance prism), and alike tools (e.g. Results Based Management) have become communal in the Middle East and Asian nations. In brief, a BSC is a performance management framework that abides

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- strategically significant intents
- measurements that can be castoff to quantify progress towards these intents
- targets for performance ranks within timescales required
- plans and actions that will be executed to attain the intents

2. Literature review

Varying customer requirements and technological imbalance compel the industrialists to develop nimble supply chain proficiencies to sustain. Copious concerns have stressed on greener areas like suppleness and swiftness in order to respond to the distinctive needs of customer and arcades. In order to ration the level of dexterity and make comparisons for future developments, enterprises now look for effective performance measures. The course of choosing selective supply chain performance measures is growing cumbersome due to the complexity of the production systems. It is twenty years since Norton & Kaplan published their first article about the Balanced Scorecard in 1992. Ever since, the Balanced Scorecard as a tool, approach and philosophy, has changed almost beyond acknowledgement. It has developed from initial basic measures control system, through to an approach that has buoyed strategy execution and the management of performance over the latter years [2,3]. Globalization of economy, e-business, and commencement of innovative technologies pose newfangled challenges to all establishments chiefly for Small and Medium Enterprises (SMEs). In this consequence, efficacious implementation of supply chain management can give SMEs a brink over contestants [4,5]. Supply chain performance must orbit around intents of the supply chain and evaluate the working conditions of all sectors and complete supply chain operations in diverse time and space [6,7]. In order to achieve larger feat in new business settings, syndicates must have an interaction with suppliers, customers and even competitors and work composed to achieve a level of agility. In fact, firms need to work composed within a supply chain so that they can reach the agility levels [8,9].

In a constant fluctuating world, a syndicate can attain competitive gains by cultivating its flair to adventure intangible assets, aiming less on financial results [10]. The most suitable performance dimension method used to detect and exemplify the chief drivers of the business, and which offers also an important sight on organization's strategy is the BSC model that lines up and focuses every fragment of the organization on cultivating and executing the strategy [11]. Balanced Scorecard offers an approach to inspect value creation from four diverse perspectives such as Financial, Customer, Internal Business Process, Learning and Growth [12–14]. BSC methodology was hosted due to some flaws of the customary performance evaluation that the current systems like financial parameters and other perspectives being ignored [15]. The modernism of the BSC technique is to improve process, motivate and educate employees and to evaluate a business from four perspectives, including financial, customer, internal process, and learning and growth [16–18].

The BSC, as of date, is a performance management system that can be deployed by establishments of any dimension to align vision and mission with customer requirements and day to day work, manage and gauge business strategy, observe operational efficiency improvements, shape business ability, and convene evolvement to all employees [19,20]. The scorecard allows to quantify financial and customer results, operations and organization capacity [16,21]. Sustainable Operation Management using BSC as a strategic tool—a method which is new, novel, niche and spirited. There is a prospect to plot and screen the level of success in short and long terms to be accomplished tactically in a stable and 360-degree mode [22,23]. Decision-making is regarded as the cerebral process ensuing in the selection of a belief or a course

of action among plentiful different options. Every decision-making process yields a concluding choice that may or may not induce action [24]. Decision-making is the course of recognizing and picking alternatives based on the tenets and inclinations of the decision-maker. Recently, decision making in business under uncertain environment has become more difficult, the gap which is being filled by BSC approach [25,26]. BSC is a structure that aids establishments to transfer the policy into operational objectives, in order to direct both the business performance and behavior [27]. Triumph of overall supply chain depends on successful execution of the BSC across the trade, region and department irrespective of the nature of business. BSC accentuates the prominence of non-financial and process oriented indicators, apart from the conventional fiscal aims of enterprise performance evaluation [28,29]. The objective of this work is to deploy BSC for calculating a single score for a firm which manufactures and markets different kind of capacitors for the motors. It would support to identify the weightages for the four key stand points namely, Financial, Customer, Internal Process, and Learning and Growth and consequently, it would help to identify the drag factors for attaining the intended performance of the organization.

3. About the organization

The firm located in Tamil Nadu, India has registered a notable presence in the domain of production, retail, wholesale and supply of different types of capacitors such as AC motor capacitors, motor starting capacitors and power capacitors ranging from 2MFD to 24KVAR. The industry also follows all the guidelines of quality prescribed by the Bureau of Indian Standards (BIS) at every step of production to ensure high quality [30,31]. However, in modern epochs it is facing stiff competition and falling customer base which provokes the need for a BSC approach.

4. Methodology

BSC deploys four standpoints such as Financial, Customer, Internal Process, and Learning and Growth [1,16]. The framework aimed at compute a single score through BSC approach for the industry and weightages for each standpoint were attained by preference tables and the target and actual values of each measure were analyzed.

4.1. Stage I

In this stage, the weightage for each standpoint were arrived using preference table. The potential pair wise composites for the pillars of BSC included

- Financial and Customer standpoint
- Financial and Internal Process standpoint
- Financial and Learning and Growth standpoint
- Customer and Internal Process standpoint
- Customer and Learning and Growth standpoint
- Internal Process standpoint and Learning and Growth standpoint

Following deliberations with industrial evaluators, relative weightages for each factor was arrived by pair wise comparison using the preference theory. These standpoints were matched pair wise and 0 or 1 was allocated based on the importance of one standpoint over the other. Pair wise comparisons at each level were deployed to establish the standpoints relative weightage. In the process of judgement, if the first standpoint is more vital than second, 1 for the first and 0 for the second, else 0 for the first and 1

for the second standpoint were allocated. If both standpoints were valued alike, 1 was allocated for both. The weightages were accordingly calculated for the four standpoints as revealed in Table 1.

4.1.1. Financial standpoint

Financial standpoint is the traditional approach to assess the organizational performance. Each and every business has financial goals, and is accustomed in using financial metrics.

The key elements of the Financial standpoint for the business concerned were recognized as Profitability [12], Government Policy [16], Sales growth by year [22], Manufacturing cost, Inventory/Warehouse cost [22] and Cash flow [24].

Six pairs were pondered for pair wise judgement using preference theory and the comparative weightage for each key element of financial standpoint is shown in Table 2.

4.1.2. Customer standpoint

Customer emphasis, coordination, and gratification are key components in the success of a business. Customer will opt competitors if they are unsatisfied or their wants are not being met. Reduced customer gratification leads to gradual financial debility even if the current financial portrait is good.

The key elements for the Customer standpoint for the business concerned were identified as Customer loyalty [12], Product/Service Quality [12,19], On-time Delivery Rate and Timeliness [22].

Four pairs were pondered for pair wise judgment using preference theory and the comparative weightage for each key element of Customer standpoint is shown in the Table 3.

4.1.3. Internal process standpoint

Internal processes standpoint helps the manager to discern how well the industry is running and whether its products and services follow market demand.

The key elements for the Internal Process standpoint for the business concerned were recognized as Quality [8], Customer Order Cycle Time, Manufacturing Cycle Time, Inventory replenishment cycle time, No of Defects per Order [19] and Waste Reduction [32].

Six pairs were pondered for pair wise judgment using preference theory and the comparative weightage for key element of Internal Process standpoint is shown in Table 4.

4.1.4. Learning and growth standpoint

Learning and Growth standpoint clutches employee preparation and commercial cultural outlooks related to both individual and corporate self-improvements.

The key elements for the Learning and Growth standpoint for the business concerned were recognized as Team Players [12], Technology upgradation [16], Process innovation [16,22,33] and Information flow [24,34].

Four pairs were pondered for pair wise judgment using preference theory and the comparative weightage for key element of learning and growth standpoint is shown in Table 5.

Table 1
Weightage for four standpoints.

S. No.	Factors	1–2	1–3	1–4	2–3	2–4	3–4	Weightage
1	Financial	1	1	1				0.4286 (a ₁)
2	Customer		1		0	1		0.2857 (a ₂)
3	Internal Process			0		1	0	0.1429 (a ₃)
4	Learning and Growth				0		1	0.1429 (a ₄)

4.2. Stage II

The targeted performance values were benchmarked based on consultation with industrial evaluators. These targeted performance values were later compared with actual performance values currently achieved. At this juncture, the actual and targeted values for each of the key elements were tabulated to arrive at the targeted and actual weightages for the focused business as shown in Table 6, Table 7, Table 8 and Table 9 below.

5. Measuring supply chain performance

According to BSC theories, the weightages were multiplied and summed to reach at a solitary score to indicate the actual performance of the industry against the targeted performance of 100%.

Actual Performance

$$\begin{aligned}
 &= [a_1(b_{1c1} + b_{2c2} + b_{3c3} + b_{4c4} + b_{5c5} + b_{6c6}) + a_2(b_{7c7} \\
 &+ b_{8c8} + b_{9c9} + b_{10c10}) + a_3(b_{11c11} + b_{12c12} + b_{13c13} \\
 &+ b_{14c14} + b_{15c15} + b_{16c16}) + a_4(b_{17c17} + b_{18c18} + b_{19c19} \\
 &+ b_{20c20}) \times 2] \\
 &= \{0.4286[(0.2000 \times 0.3750) + (0.2000 \times 0.3750) \\
 &+ (0.1500 \times 0.3333) + (0.1500 \times 0.3846) + (0.2500 \times 0.3750) \\
 &+ (0.0500 \times 0.2857)] + 0.2857[(0.2000 \times 0.3750) \\
 &+ (0.3000 \times 0.3836) + (0.3000 \times 0.3750) + (0.2000 \times 0.3333)] \\
 &+ 0.1429[(0.1818 \times 0.3878) + (0.0455 \times 0.2857) \\
 &+ (0.1818 \times 0.2857) + (0.2273 \times 0.3333) + (0.1818 \times 0.3750) \\
 &+ (0.1818 \times 0.2308)] + 0.1429[(0.1429 \times 0.3478) \\
 &+ (0.1429 \times 0.3750) + (0.4286 \times 0.3560) \\
 &+ (0.2857 \times 0.3333)] \times 2\} \\
 &= 0.7202
 \end{aligned}$$

Hence, Actual Performance = 72.02%.

The bar chart shown in Fig. 1 portrays the gap between targeted and actual performance for the four standpoints and earmarks the overall organizational performance.

6. Results and discussion

It is ardent that the overall performance of the industry (72.02%) is lesser than the targeted performance (100%). It clearly indicates that a gap of 27.98% exists which opens the door for analysing the reasons for underperformance.

Financial standpoint depicts that the industry's existent performance score (73.14%) is lesser than the targeted score. It is apparent that business is diminutive in lines of financial performance. The various drag factors resisting the financial standpoints are lack of sales, inefficient operating practices, high levels of tax, market influences, etc.

Customer standpoint illustrates the industry's existent performance score (73.84%) is diminutive demanding a need for the business to upsurge its consumer fulfilment score. The various drag factors resisting the customer standpoint are poor customer relationship, technical deficiency, higher service time, lack of computerized system, insufficient number of workers and suppliers, longer delivery time, irresponsiveness to mails and messages, etc.

Internal Process standpoint portrays the existent performance score (64.26%) is lesser than targeted performance. The various drag factors resisting the internal process standpoint are under qualified employees, improper lighting and ventilation, lack of skilled workers, in availability of machines, lesser awareness about software, operator errors, inefficient production practices, inadequate training, etc.

Table 2

Weightage for financial standpoint.

S.No.	Key Factors	1-2	1-3	1-4	1-5	1-6	2-3	2-4	2-5	2-6	3-4	3-5	3-6	4-5	4-6	5-6	Weightage
1	Profitability	1	1	1	0	1											0.2000 (b ₁)
2	Government Policy	0					1	1	1	1							0.2000 (b ₂)
3	Sales growth by year		1				0				1	1	0				0.1500 (b ₃)
4	Manufacturing cost			1				0			0			1	1		0.1500 (b ₄)
5	Inventory/Warehouse Cost				1				1			1		1		1	0.2500 (b ₅)
6	Cash Flow					0				0			1		0	0	0.0500 (b ₆)

Table 3

Weightage for Customer standpoint.

S. No	Key Factors	1-2	1-3	1-4	2-3	2-4	3-4	Weightage
1	Customer Loyalty	1	0	1				0.2000 (b ₇)
2	Product/Service Quality	1			1	1		0.3000 (b ₈)
3	On-time Delivery Rate		1		1		1	0.3000 (b ₉)
4	Timeliness			1		0	1	0.2000 (b ₁₀)

Table 4

Weightage for internal process standpoint.

S. No	Key Factors	1-2	1-3	1-4	1-5	1-6	2-3	2-4	2-5	2-6	3-4	3-5	3-6	4-5	4-6	5-6	Weightage
1	Quality	1	1	1	0	1											0.1818 (b ₁₁)
2	Customer Order Cycle Time	0					0	1	0	0							0.0455 (b ₁₂)
3	Manufacturing Cycle Time		0				1				1	1	1				0.1818 (b ₁₃)
4	Inventory Replenishment Cycle Time			1				1			1			1	1		0.2273 (b ₁₄)
5	No of Defects per order				1				1			1		0		1	0.1818 (b ₁₅)
6	Waste Reduction					1				1			1		1	0	0.1818 (b ₁₆)

Table 5

Weightage for learning and growth standpoint.

S. No.	Factors	1-2	1-3	1-4	2-3	2-4	3-4	Weightage
1	Team Players	1	0	0				0.1429 (b ₁₇)
2	Technology up gradation	1			0	0		0.1429 (b ₁₈)
3	Process Innovation		1		1		1	0.4286 (b ₁₉)
4	Information Flow			1		1	0	0.2857 (b ₂₀)

Table 6

Actual weightage for financial standpoint.

S. No.	Key Factors	Targeted Values	Actual Values	Targeted Weightage	Actual Weightage
1	Profitability	10%	6%	0.6250	0.3750 (c ₁)
2	Government Policy	5%	3%	0.6250	0.3750 (c ₂)
3	Sales growth by year	10%	5%	0.6667	0.3333 (c ₃)
4	Manufacturing Cost	40%	25%	0.6154	0.3846 (c ₄)
5	Inventory/Warehouse Cost	25%	15%	0.6250	0.3750 (c ₅)
6	Cash Flow	10%	4%	0.7143	0.2857 (c ₆)

Table 7

Actual weightage for customer standpoint.

S. No.	Key Factors	Targeted Values	Actual Values	Targeted Weightage	Actual Weightage
1	Customer Loyalty	15%	9%	0.6250	0.3750 (c ₇)
2	Product/Service Quality	45%	28%	0.6164	0.3836 (c ₈)
3	On-time Delivery Rate	30%	18%	0.6250	0.3750 (c ₉)
4	Timeliness	10%	5%	0.6667	0.3333 (c ₁₀)

Learning and growth standpoint displays the industry's existent performance (72.80%) is lesser than targeted performance. The various drag factors resisting the learning and growth standpoint are inefficient team leaders, lack of communication, high investment requirement, need of training, resistance to change, conflicts between individuals, etc.

By this research effort, the present condition (72.02%) of an organization is portrayed and this helps the organization to identify that drag factors are the foremost reasons for gap analysis. Elimination or suppression of the above drag factors resisting the competence of standpoints will undoubtedly improve the overall organizational performance in lines with strategic goals.

Table 8

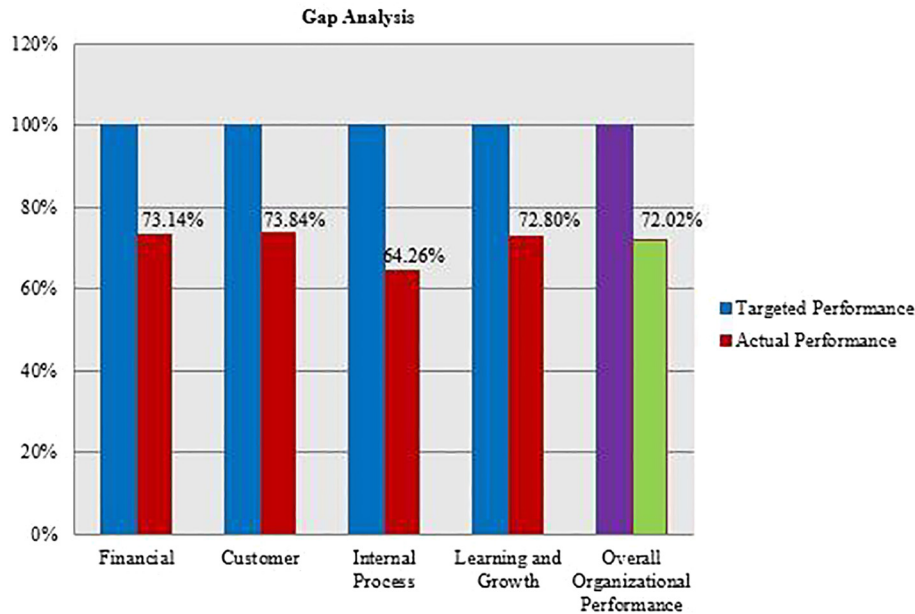
Actual weightage for internal process standpoint.

S. No.	Key Factors	Targeted Values	Actual Values	Targeted Weightage	Actual Weightage
1	Quality	30%	19%	0.6122	0.3878 (c ₁₁)
2	Customer Order Cycle Time	10%	4%	0.7143	0.2857 (c ₁₂)
3	Manufacturing Cycle Time	20%	8%	0.7143	0.2857 (c ₁₃)
4	Inventory Replenishment Cycle Time	10%	5%	0.6667	0.3333 (c ₁₄)
5	No of defects per order	20%	12%	0.6250	0.3750 (c ₁₅)
6	Waste Reduction	10%	3%	0.7692	0.2308 (c ₁₆)

Table 9

Actual weightage for learning and growth standpoint.

S. No.	Key Factors	Targeted Values	Actual Values	Targeted Weightage	Actual Weightage
1	Team Players	15%	8%	0.6522	0.3478 (c ₁₇)
2	Technology up gradation	30%	18%	0.6250	0.3750 (c ₁₈)
3	Process Innovation	35%	22%	0.6140	0.3860 (c ₁₉)
4	Information Flow	20%	10%	0.6667	0.3333 (c ₂₀)

**Fig. 1.** Targeted versus Actual Performance.

7. Conclusions

Nowadays business is pigeonholed by globalization, coarse competition, unreadable customer demands, severe law requirements and the consequent necessity to operate with higher efficiency and reliability [19,20]. Indian syndicates have not yet clouted their supply chain for economic benefit and as such there have not been much strides to quantify the performance of their surviving systems. On the contrary, multi-national corporations are reaping rewards and are also marching towards Information Technology (IT) empowered supply chains. In sight of economy's globalization and liberalization, Indian syndicates are required to modify their methods of making business to overcome competitive maladies. In the present industrial environment, most reformist corporations are reverse engineering their business practices and taking advantage of IT usage to embark the mounting competitive burdens in the arcade. In this milieu, initiatives in lines with supply chain management could serve a workable tool and deducing performance against business standards would go longer way in attaining international recognition.

As the current performance of the organization is identified and the drag factors resisting the performance are discussed, the future work is to eliminate those drag factors by clearly analyzing the various standpoints. BSC facilitated organizations aim to eliminate all the drag factors and develop policies taking into contemplation the probes of all coupled in the business with one competitive and unified approach. It is certain that the pervasive and efficacious enactment of BSC approach across the industry, regardless of nature of business, cutting across geographical, sectional and other barricades will turn valuable for achieving overall supply chain profitability in the closest future.

CRediT authorship contribution statement

M. Balaji: Data curation, Writing - review & editing, Supervision. **S.N. Dinesh:** Conceptualization, Methodology, Investigation, Validation, Writing - original draft. **P. Manoj Kumar:** Validation, Writing - review & editing. **K. Hari Ram:** Writing - review & editing.

Declaration of Competing Interest

The authors declare that they have no known competing financial interests or personal relationships that could have appeared to influence the work reported in this paper.

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