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The Analytical Hierarchy Process Approach for Assessment of Selected SEZ Units in Gujarat with Reference to Balanced Scorecard Technique

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Abstract

The Analytic Hierarchy Process (AHP) is generally utilized by decision makers and researchers. The definition of criteria and the estimation of their weight are central in this strategy to evaluate the choices. However, there are few studies that focus on them. Special Economic Zone (SEZ) are protected export areas that offer benefits such as duty concessions to manufacturing exports, and have several advantages, such as boost to trade efficiency, innovation, technology and management. The financial benefits of SEZ are well documented across the world. Their achievement in China, however, drew much attention. India has also embarked on the creation of SEZ as the drivers of industrial production and export trade.

The design and use of performance measurement systems has extensive consideration attention in recent years. Performance measurement has developed rapidly over the last two decades, and gives a way to reduce the overload of balanced performance measurement frameworks. Over the period, the center of attention has moved from designing balanced performance measurement systems, through implementation to the use of measures to manage performance. This paper examines the Analytical Hierarchy Process Approach for Assessment of Selected SEZ units in Gujarat with reference to BSC Technique.

Keywords: Analytic Hierarchy Process (AHP), Key Performance Indicator (KPI), Balanced Scorecard (BSC) Technique, Special Economic Zone (SEZ)

1. Introduction

Analytical Hierarchy Process (AHP), as a numerous criteria decision-making tools especially in the problems with spatial nature. Moreover, this investigation treats the steps of AHP, the objective of this study applies the principles and techniques of the Analytic Hierarchy Process (AHP) in the prioritization and selection of criteria in the SEZ units. (FICCI - KPMG, 2002) AHP is one of the fundamental mathematical models currently available to carry the decision theory. When investigating into how organizations decide over which components to implement, we can notice a continuous need to have clear, objective and mathematical criteria (Haas & Meixner, 2005). In any case, decision making is, in its totality, a psychological and mental process derived from the most conceivable sufficient determination dependent on Tangible and Intangible Criteria (Saaty, Extending the Measurement of

Tangible to Intengibles, 2009), which randomly chosen by those who makes the decisions. (Chamber of Commerce and Industry, 2015)

Analytic Hierarchy Process (AHP) proposed by Satty, is an approach for decision making that involves structuring multiple choice criteria into a hierarchy, assessing the relative importance of these criteria, comparing alternatives for each criterion, and determining an overall ranking of the alternatives on the basis of measures (Bhushan & Rai, 2004). The output of the AHP is prioritized positioning demonstrating the general inclination for every one of the choices which is ultimately help the decision maker to select the best approach. This Study adopts AHP as the method for obtaining the weight relationship and degree of importance of different assessment criteria. It Introduced the Fuzzy theory into the AHP developed by (Satty, 1980) to assess the weight of various assessment criteria and sort the importance, by which more objective and reasonable KPI could be stimulated (Lee & Hsu, 2008). This Analytical Process merges the concepts of several scholars, including (Buckley, 1985), (Chen, Hsu, & Tzeng, 2011) and (Chang, Lin, & Northcott, 2002).

2. Literature Review

M.H. Vahidniaa, et al., (2008) have present a paper on **Fuzzy Analytical Hierarchy Process in GIS Application** and come up with a remarkable conclusion: "Due to the disregarding of uncertainty in traditional AHP, the fuzzy form of AHP (i.e., FAHP) and two known approaches of FAHP means Fuzzy Extent Analysis and α-cut-based method were treated. According to somewhat which is said in this paper, the advantage of α-cut-based method is that the conclusion is less notorious and also the uncertainty and the different attitude of decision maker can be took into account in this method but the fuzzy extent analysis is easier in calculation.

Ricardo Viana Vargas (2010) has presented a paper on using the Analytic Hierarchy Process (AHP) to select and prioritize projects in a portfolio. In this paper he has discuss and apply the principles and techniques of the Analytic Hierarchy Process (AHP) in the prioritization and selection of projects in a portfolio. He also discusses the importance and some possible criteria for prioritizing projects, and by using a fictitious project prioritization example, it demonstrates AHP in a step-by-step manner, where the resulting priorities are shown and the possible volatility are determined.

Yagmur Kara and Aylin Cigdem Kone (2012) have assessed The Analytic Hierarchy Process (AHP) approach for assessment of regional environmental sustainability in Turkey. And come up with conclusion that the country has taken the part in highly vulnerable group and it is ranked by Environmental Performance Index as 72nd out of 149 countries. As a candidate state to the EU, Turkey has been balanced between the national environmental constitution with the EU environmental acquits. Besides, the important efforts have been made to increase access of the public to environmental information.

2.1 Objectives of the Study

The research has focused on the following objectives:

1. To study the key performance indicators practiced in selected SEZ Units in Gujarat.
2. To examine the Key Performance Indicators of Balanced Scorecard in Performance Measurement in selected SEZ Units in Gujarat State.

In order, to serve the AHP calculations for a prioritization, the development of invented decision model for the SEZ Units (Maharashtra Economic Development Council, 2008) has been chosen (Hsu, 1998).

The First Step to build the AHP model lies in the determination of the criteria that will be used. (Vargas, 1990)

2.2 Hypothetical Case Application

In this section a detailed hypothetical example of how the AHP can be used in Balanced Scorecard Technique about selection in Perspective with reference to their criteria and sub – criteria.

Building the AHP Model

To make a decision in SEZ unit way to generate priorities we need to divide the decision into the following objectives:

1. Define the Criteria and Sub-Criteria for Determine the Requirement in Perspectives. (Kim & Kim, 2010)
2. Structure the Decision Hierarchy from the Top with the Goal of the Decision, then the objectives from a Perspective, through the Criteria on which subsequent elements depend to the set of the alternatives.
3. Construct a set of pair-wise comparison matrices. Each element in an upper level is used to compare the elements in the level immediately below with respect to it.
4. Use the Priorities obtained from the comparisons to weigh the priorities in the level immediately below. Do this for every element. Then for each element in the level below add its weighed values and obtain its overall or global priority.

3. Research Methodology

The challenging part of this research study has to construct an AHP model that included relevant to SEZ Units and give priority criteria and could be readily applied to a variety of economic applications. So, that here researcher has used the questionnaire method to analyze the respondent's data with using the AHP model & Balanced Scorecard Technique. (Paralikar & Shetty)

3.1 Research Instrument

The Questionnaire Consists: Explanations for Answering, Questionnaire Contents, and Data Basis of the Respondents. The Scores range from 0 to 10; thus, the higher the score, the higher the importance attributed to the item. The Second stage applies the AHP method to analyze the results of the questionnaire survey and screen out the success factor. A Complete Hierarchical Structure is established for the questionnaire design under the AHP. The Questionnaire Consists of the following: (1) Evaluation Criteria to rank each individual criterion in terms of relative importance and (2) Evaluation Methods to measure the results on 1 to 9 scales and compare pairs according to the answers provided in the questionnaires.

3.2 Research Design

This Study adopts the opinion of (Kaplan & Norton, 1992) regarding the BSC, referring to the literature and suggestions from various scholars in the determination of the hierarchical structure of KPI of the SEZ Units. The ultimate goal of this structure is to identify KPI to improve the performance of selected SEZ Units. In addition, (Satty, 1999) has recommended that each dimension should not exceed seven factors. Therefore, the seven key assessment criteria in four perspectives include Financial Perspective, Learning & Growth Perspective, Internal Business Processes Perspective and Customer Perspective.

3.3 Sampling Design

Table 1: Sampling frame – Kandla SEZ and Mundra SEZ

Name of the Zone	State	District	Date of Notification	Product Type	Area (In hectares)	No. of Units Approved
Mundra Economic Zone	Gujarat	Kutch	01/11/2000	Multi-Product	400	168
Kandla Economic Zone	Gujarat	Kutch	23/06/2006	Multi-Product	2733	169

Table 2: Sampling unit

Name of the Zone	Units Name	No. oF EMPLOYEES	Sample of Respondents
Mundra Economic Zone	Adani Power	7666	224
	Adani Ports and Special Economic Zone	2587	91
	Adani Wilmar	3634	109
Kandla Economic Zone	Rishi Shipping	2248	76
	D.B.C Sons (Gujarat) Pvt. Ltd.	1692	50
Total		17827	550

Table 3: Sampling size

Name of the Zone	Units Name	Nature of SEZ Units
Mundra Economic Zone	Adani Power	Manufacturing
	Adani Ports and Special Economic Zone	Service
	AdaniWilmar	Multi-Products
Kandla Economic Zone	Rishi Shipping	Wholesaler/Retailer
	D.B.C Sons (Gujarat) Pvt. Ltd.	Construction, Packing & Packaging, Transportation

3.4: Sampling Method: Non-probability Convenience Sampling

4. Data Analysis & Interpretation

4.1: Multi Criteria Decision Making

Decision Making is the process to choose among alternatives based on various criteria. In every one of these choices, deep in our mind; have several factors or criterion what to consider and also having several alternatives choices that is decide. On group decision making these criteria and alternatives are more noticeable and must be determined first before give any judgment score. The values are number within any certain range; say from 1 to 10 or -5 to 5. Higher value indicates higher level of the factor or preferable values. Table 4 exhibits the scale.

Table 4: Scales for pair-wise comparison

Preferences Expressed in Numeric Variables	Preferences Expressed in Linguistic Variables
1	Equal Importance
3	Moderate Importance
5	Strong Importance
7	Very Strong Importance
9	Extreme Importance
2,4,6,8	Intermediate Values between Adjacent Scale Values

Source: (Saaty, The Analytical Hierarchy Process , 1980)

4.2: Pair Wise Comparison

Now take in to consideration of Paired Comparison which is simpler to understand the values of significant criteria and its sub-criteria, which criteria is most significant than the other and how much it affects in comparison with the each other.

4.3: Making Comparison Matrix

How to fill up the upper Triangular Matrix is using the following rules:

1. If the judgment value is on the **left** side of 1, we put the **Actual Judgment** Value.
2. If the judgment value is on the **right** side of 1, we put the **Reciprocal** Value.

Notice that the entire elements in the Comparison Matrix are either positive or aij> 0.

4.4: Priority Vectors

Having a Comparison Matrix, would like to calculate Priority Vector, which is the normalized Eigen Vector of the Matrix, which is to be finds with following Steps.

CI Formula

$$CI = \frac{\lambda_{max} - n}{n-1}$$

CR Formula

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

Table 5: Random consistency index table (RI)

N	1	2	3	4	5	6	7	8		9	10
RI	0	0	0.58	0.90	1.12	1.24	1.32	1.41		1.45	1.49

Every Business Persons are all basically decision makers, in order to develop good judgments to make decisions about this incident. The need and purpose of the decision, the criteria of the decision, their sub-criteria, stakeholders and groups are affected and the alternative actions to take. Two important issues in Outline of Evaluation Indicators for Dimensions of the BSC are: **How to Aggregate Sub-Criteria or Criteria into a Perspective for the entire dimensions** and **how to construct a factor choice from individual Perspective**. The Criteria may be intangible, and have no measurements to serve as a guide to rank the alternatives, and creating priorities for the criteria themselves. These four dimensions of criteria are suggested by the AHP method and exhibit measures. (Allio, 2006)

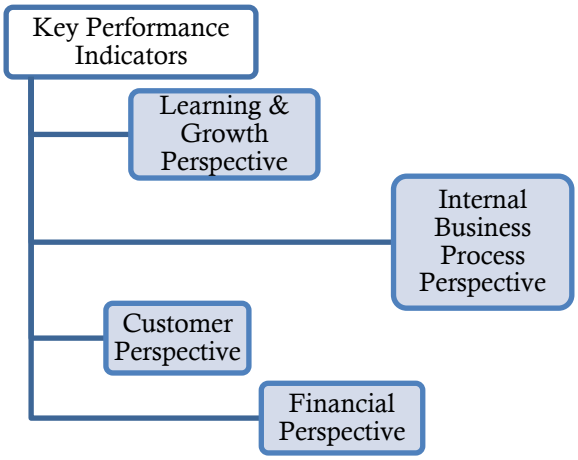


Figure 1: KPI's initial group of criteria for SEZ units

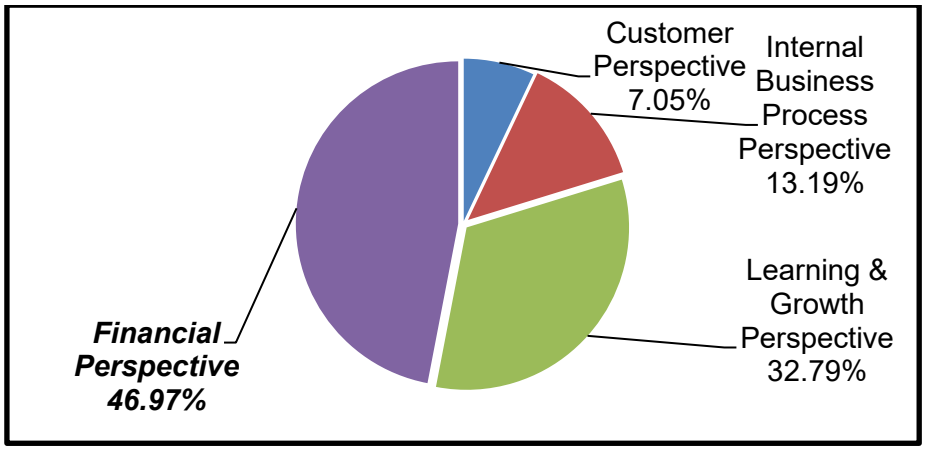
After the Hierarchy has been perceived, the Criteria must be evaluated in pairs so as to determine the relative importance between them and their Relative Weight to the Global Goal. The Evaluation begins by determining the Relative Weight of the initial criteria groups for SEZ Units (Figure 1). Table 6 shows the Relative Weight data between the criteria that have been determined by Respondents.

Table 6: Comparison matrix for all BSC's perspectives for selected SEZ units

	Customer Perspective	**Internal Business Process Perspective**	**Learning & Growth Perspective**	**Financial Perspective**
Customer Perspective	1	1/2	1/4	1/7
Internal Business Process Perspective	2	1	1/2	1/5
Learning & Growth Perspective	4	2	1	1
Financial Perspective	7	5	1	1

Source: Primary Survey

The Next Step is to look for any data inconsistencies. The Objective is to capture enough information to determine whether the decision makers have been consistent in their choices (Triantaphyllou & Manns, 1995) (Triantaphyllou, 2002). It states that the respondents are given the favour to Financial Perspective are important than the Learning & Growth Perspective Criteria followed by Internal Business Process Criteria.



Source: Primary Survey

Figure 2: Result of comparison matrix for priority vector for selected SEZ units

Just like it was done with the Initial Criteria Group for the KPI's of SEZ Units, it is necessary to evaluate the Criteria's Relative Weights for the Second Level of the Hierarchy (Figure 2). This Process is executed just like the step to evaluate the first level of the Hierarchy (Criteria Group) as it was shown above.

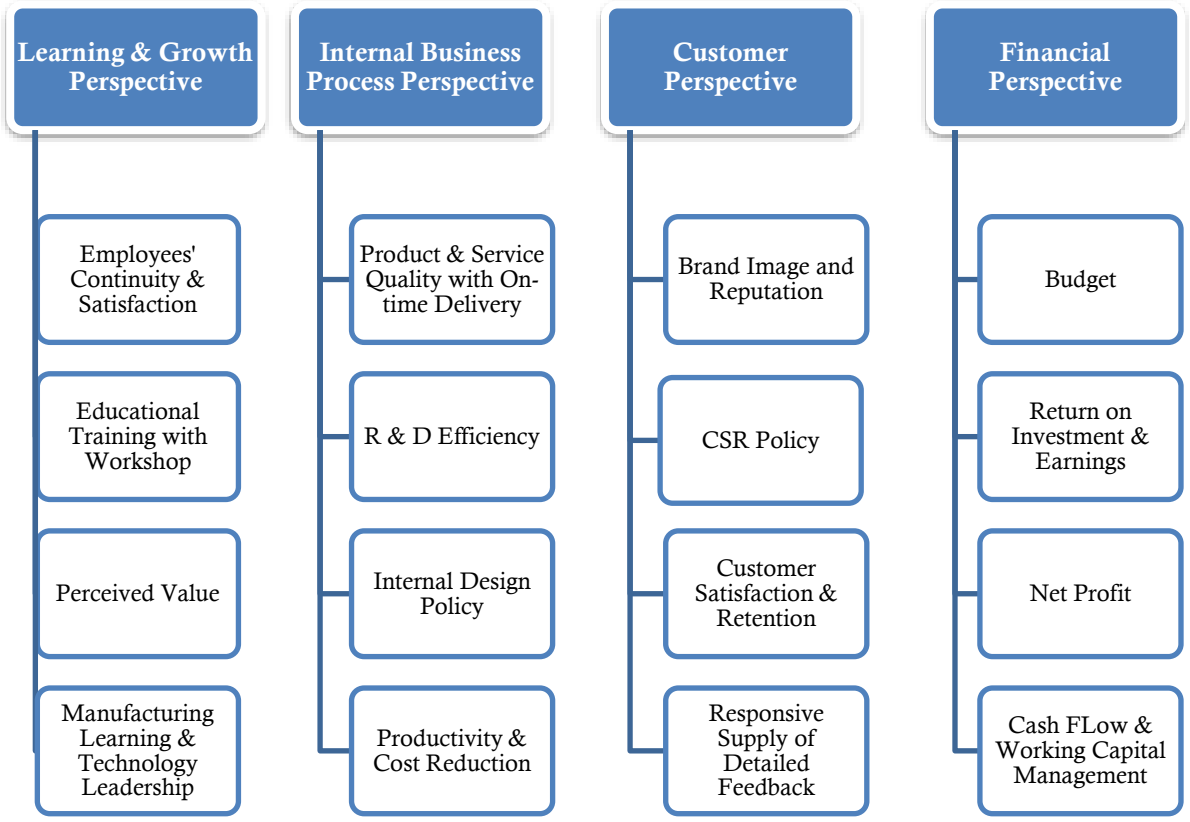


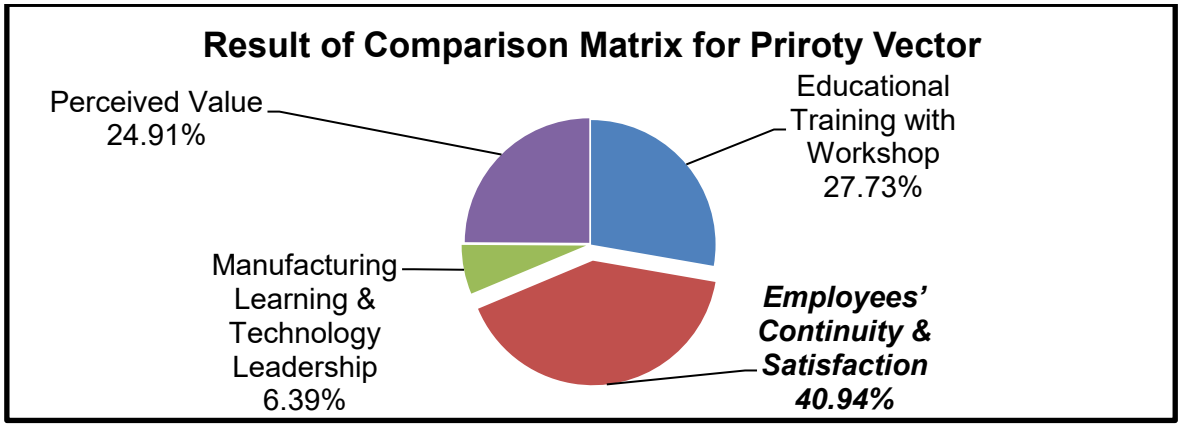
Figure 3: Hierarchy of criteria for KPI's of SEZ units highlighting the second hierarchy level

The following table shows the Comparison Matrix for the Sub-Criteria for respective Perspectives with the Pair-Wise Comparisons already taken by the respondents.

Table 7: Comparison matrix for learning & growth perspectives' group of criteria

	Educational Training with Workshop	Employees' Continuity & Satisfaction	Manufacturing Learning & Technology Leadership	Perceived Value
Educational Training with Workshop	1	1/2	3	2
Employees' Continuity & Satisfaction	2	1	8	1
Manufacturing Learning & Technology Leadership	1/3	1/8	1	1/4
Perceived Value	1/2	1	4	1

Source: Primary Survey



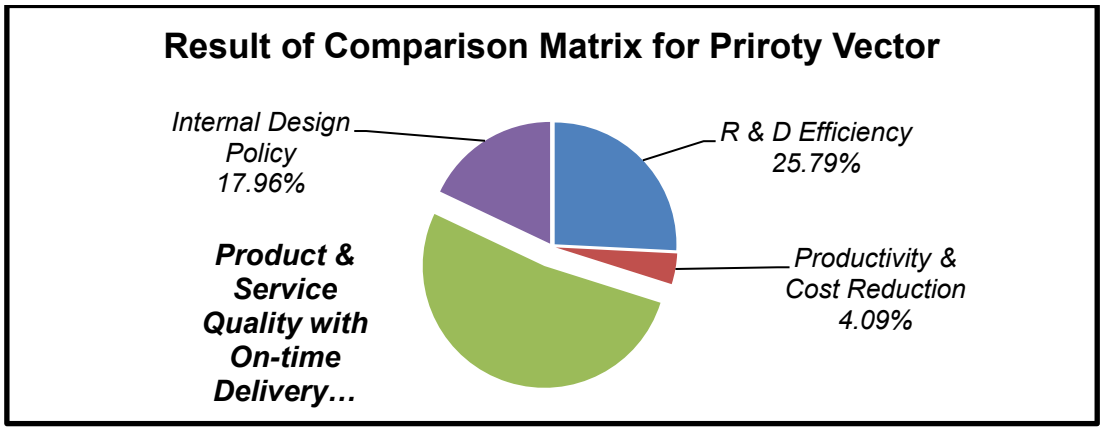
Source: Primary Survey

Figure 4: Result of comparison matrix for priority vector for learning & growth perspective

Table 8: comparison matrix for internal business process perspectives' group of criteria

	R & D Efficiency	Productivity & Cost Reduction	Product & Service Quality with On-time Delivery	Internal Design Policy
R & D Efficiency	1	7	1/3	2
Productivity & Cost Reduction	1/7	1	1/9	1/6
Product & Service Quality with On-time Delivery	3	9	1	3
Internal Design Policy	1/2	6	1/3	1

Source: Primary Survey



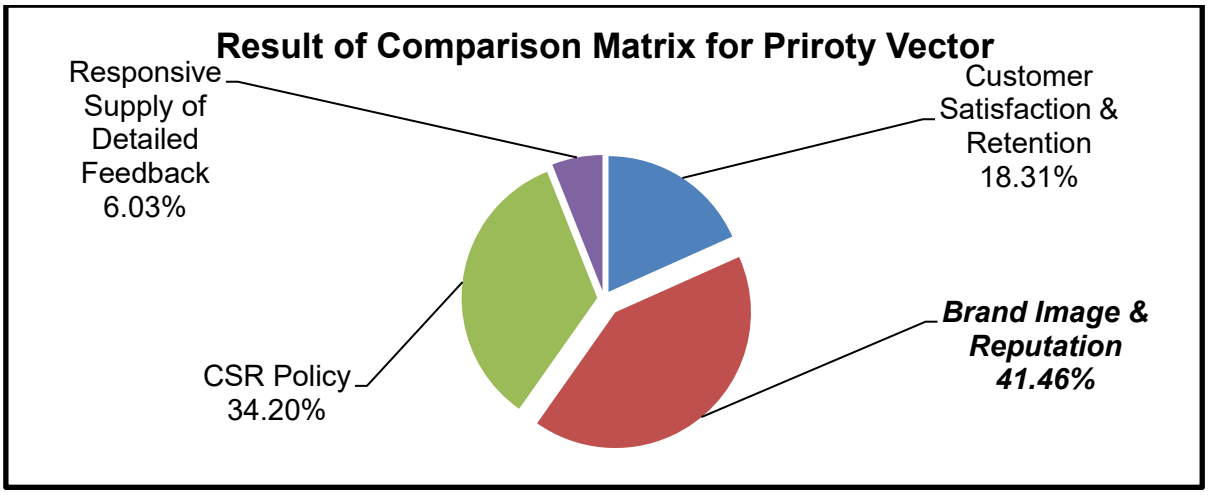
Source: Primary Survey

Figure 5: Result of comparison matrix for priority vector for internal business process perspective

Table 9: Comparison matrix for customer perspectives' group of criteria

	Customer Satisfaction & Retention	Brand Image & Reputation	CSR Policy	Responsive Supply of Detailed Feedback
Customer Satisfaction & Retention	1	1/2	1/3	4
Brand Image & Reputation	2	1	2	5
CSR Policy	3	1/2	1	6
Responsive Supply of Detailed Feedback	1/4	1/5	1/6	1

Source: Primary Survey



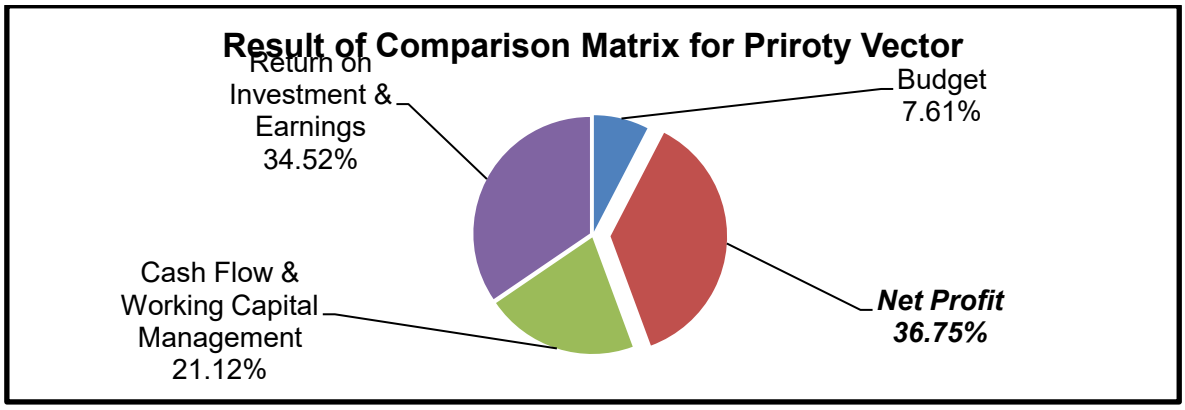
Source: Primary Survey

Figure 6: result of comparison matrix for priority vector for customer perspective

Table 10. Comparison matrix for financial perspectives' group of criteria

	Budget	Net Profit	Cash Flow & Working Capital Management	Return on Investment & Earnings
Budget	1	1/3	1/3	1/7
Net Profit	3	1	3	1
Cash Flow & Working Capital Management	3	1/3	1	1
Return on Investment & Earnings	7	1	1	1

Source: Primary Survey



Source: Primary Survey

Figure 7: Result of comparison matrix for priority vector for financial perspectives

Summary on the Basis of Priority Vector Value

For this research the researcher has structured layer 1 and layer 2 for key performance indicators. The summary of these findings has been included here with this table.

Table 11: Summary on the basis of priority vector value

Layer		Eigen Value max λ from a Comparison Matrix	CI	CR (CI/RI)	Accepted / Rejected	Remarks
1	**Key Performance Indicator**	4.1108	0.1108	4.11%	Accepted	When CR <10%, Subjective evaluation about its importance is consistent and acceptable
2	**Learning & Growth Perspective**	4.2207	0.2207	8.17%	Accepted	
	Internal Business Process Perspective	4.1736	0.1736	6.43%	Accepted	
	Customer Perspective	4.2178	0.2178	8.06%	Accepted	
	Financial Perspective	4.2568	0.2568	9.51%	Accepted	

Source: Primary Survey

Note: for n = 4, RI is 0.90.CI and CR is Consistency Index and Consistency Ratio.

CR < 10%, hence subjective evaluation about its importance is consistent and acceptable.

The Global Priority for each Criterion is determined by the result of the multiplication of each priority on the first level by its respective priority on the second level. The results are shown on the hierarchy depicted on Table 1.9. It must be sum of the weights of all sixteen (16) factors is equal to 1.

Table 12: analysis hierarchy of criteria for the sez units with global priorities for each criterion

Perspective	Weighting	Criteria	Relative Weighting	Global Weights	Ranks
Learning and Growth	0.3279	Employees' Continuity & Satisfaction	0.4094	0.1342	3
		Educational Training with Workshop	0.2491	0.0817	6
		Perceived Value	0.2773	0.0909	5
		Manufacturing Learning & Technology Leadership	0.0639	0.0210	13
Internal Business Process	0.1319	R & D Efficiency	0.2579	0.0340	9
		Productivity & Cost Reduction	0.0409	0.0054	15
		Product & Service Quality with On-time Delivery	0.5216	0.0688	7
		Internal Design Policy	0.1796	0.0237	12
Customer	0.0705	Customer Satisfaction & Retention	0.1831	0.0129	14
		Brand Image & Reputation	0.4146	0.0292	10
		CSR Policy	0.3420	0.0241	11
		Responsive Supply of Detailed Feedback	0.0603	0.0043	16
Financial	0.4697	Budget	0.0761	0.0357	8
		Net Profit	0.3675	0.1726	1
		Cash Flow & Working Capital Management	0.2112	0.0992	4
		Return on Investment & Earnings	0.3452	0.1621	2

Source: Primary Survey

5. Findings

- The final result of the importance of rating (Relative Weight) revealed that the Financial Perspective is considered the most important (46.97%) among the four given performance measures areas by the BSC, followed by Learning and Growth (32.79%), Internal Business Process (13.19%), Customer Perspectives (7.05%).
- In assessment of use of the performance measures of Financial Perspective Net Profit Ratio, the percentage is located at a relative weight of 36.75%, while Return on Investment Earnings is at 34.52%, In addition Cash Flow& Working Capital Management is at 21.12% and Budget at 7.61%.
- After getting the result of all perspective, researcher has found that in Financial Perspective, KPI are ranked Based on Analysis of the global weights of BSC measures with AHP Method in below manner: Net Profit Ratio (1), Return on Investment and Earnings (2), Cash Flow and Working Capital Management (4) and Budget (8).

- In reflecting on the evaluation of the KPI used to measure Employee's Continuity & Satisfaction in Learning and Growth Perspective in the SEZ units, the percentage is placed at a relative weight of 40.94%, while Employee's Educational Training with Workshop is at 24.91%, In addition Perceived Value is at 27.73% and Manufacturing Learning & Technology Leadership is weight at 6.39%.
- It is found that in Learning and Growth Perspective, KPI are ranked Based on Analysis of the global weights of BSC measures with AHP Method in below manner; Employees' Continuity & Satisfaction (3), Employee Educational Training with Workshop (6), Perceived Value (5) and Manufacturing Learning and Technology Leadership (13).
- In evaluation of using the performance measures of Product & Service Quality with On-Time Deliveries in Internal Business Process Perspective, the percentage is placed at a relative weight 52.16%, while R & D Efficiency is at 25.79%, In addition Internal Design Policy is at 17.96% and Productivity and Cost Reduction is weight at 4.09%.
- It is found that in Internal Business Process Perspective, KPI are ranked Based on Analysis of the global weights of BSC measures with AHP Method in below manner: Product & Service quality with on- time Delivery (7), R & D Efficiency (9), Internal Design Policy (12) and Productivity and Cost Reduction (15).
- In Valuation the importance of KPI to measure Brand Image and Reputation in Customer Perspective, the percentage is at a weight of 41.46%, while CSR Policy is at 34.20%, In addition Customer Satisfaction & Reduction is at 18.31% and Responsive Supply of Detailed Feedback is weight at 6.03%.
- It is found that in Customer Perspective, KPI are ranked Based on Analysis of the global weights of BSC measures with AHP Method in below manner; Brand Image and Reputation (10), CSR Policy (11), Customer Satisfaction & Retention (14) and Responsive Supply of Detailed Feedback (16) have been considered.

6. Conclusion

SEZ Units are ultimately driving these strategies in combination with other constituents both inside and outside the organization, truly become a "Driving Growth" of a Nation's Economy. to check out which key performance indicator with all criteria are most influenced for consistency, under Analytical Hierarchy Process (AHP) method is used to ensure the relevance with each factor or not. To conclude with which the most key performance indicator is affected, relatively concerned or not, and summing up with result that Net Profit & Return on Investment & Earnings are scored highest from Financial Perspective, Employees' Continuity & Satisfaction, Perceived Value are ranked maximum from Learning & Growth Perspective, R & D Efficiency and Product & Service quality with on- time Delivery scored at top from Internal Business Process Perspective, Brand Image and Reputation and CSR Policy are secured as maximum ranked from Customer Perspectives.

The outcome from AHP method it clearly derived that Customer Perspective having lower priority with a reason that SEZ units are not directly concerned with Customer as they are engaged with Import and Export activity mostly.

The results indicated a support to the existence of links between the perspectives and their measures with the strategic choice of the SEZ Units. Thus, the learning and growth perspective, internal business processes perspective, customer perspective and the financial perspective have a positive relationship with the Balanced Scorecard approach. Gujarat SEZ Units may also come out with their own formula for

performance measurement. This is very essential not only for their survival but also for healthy growth at a global level and to face competition for survival. BSC is the need of the hour; as such every SEZ Units must ponder whether it will opt for the mega implementation of it, and when; as Birch (1998) said it best when he indicated that "The key point to remember is that what get measured gets managed".

Limitations and Further Scope of Study

The Present study is limited to the performance measurement of SEZ in Gujarat. The following are the limitation of the study:

1. The Study is limited to SEZ units only.
2. The Study is based on Balanced Scorecard Technique; other techniques can be used for the performance measurement of the business units.
3. The Same Study can be used for other SEZ in Gujarat and other than Gujarat.
4. The Same Study can also be conducted for Performance Measurement in Special Sector of Industries in India.

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