

## DELIVERY PERFORMANCE IMPROVEMENT IN INDIAN FOOD PROCESSING SMES SUPPLY CHAINS USING ANALYTIC HIERARCHY PROCESS: FRUITS & VEGETABLES SECTOR

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**Abstract**—India, being the second-biggest maker of numerous foods grown from the ground, faces plenty of difficulties and issues in its agri-supply chain. Delivery performance has become a critical issue in the current situation of agri-business in India in various food processing (FP) SMEs due to the high perishability of the products involved. The unpredictable demand in the Indian commercial food business, particularly in the fruits and vegetables (F&V) sector on both local and foreign markets, is leading to delivery problems, intense rivalry, and a loss of customers and high-quality production. The study aims to describe the parameters affecting delivery performance in Indian FP SMEs as of today; FP SMEs are interested to become on-time delivery (OTD) efficient. The purpose of this work is to analyze the delivery parameters by which these FP SMEs should achieve on-time delivery in the F&V sector supply chain and to determine the most critical parameters through an Analytic Hierarchy Process (AHP) model considering the supply chain used in three different food processing SMEs, namely FP SME-1, FP SME-2, FP SME-3. A poll-based study system is utilized and the responses were taken from experts in the Indian food industry, further an AHP model is established. Nine parameters are set up from literature, descriptive research, and conducting interview sessions with managers, supervisors, store heads, and retailers in the Indian F&V sector.

A methodology is proposed using AHP, based on criteria weights, relative priorities, and rankings for the fruits and vegetable sector in India. These parameters show that the delivery performance is highly affected by changes or impacts on these parameters. It is suggested that more food processing SMEs in India should focus on these delivery parameters to achieve On-Time Delivery in the competitive market. This investigation proves that FP SME-2 is more responsive towards delivery performance improvement w.r.t other FP SMEs. It is suggested that every FP SME dealing with the F&V sector should adopt delivery performance improvement to achieve opportunism in the global market. This examination gives a solidified

way to deal with recognising, breaking down, assessing, and prioritising the delivery affecting parameters delivery in the F&V sector of the Indian supply chain.

**Keywords**—Analytic Hierarchy Process, delivery performance, delivery improvement, fruits & vegetable sector, Indian food processing SMEs, on-time delivery, perishable supply chain

## I. INTRODUCTION

India is a country that comes among the world's biggest makers of numerous leafy vegetables & fruits, like onion, cabbage, potato, tomato, custard, mango, banana, citrus natural products, and so forth. It is positioned among the best five biggest makers of more than 80% horticultural produce, including numerous different harvests such as cotton, coffee, and so on [37]. Although more than 75 sorts of vegetables are filled in our country, more accentuation is given to famous vegetables like tomato, stew, peas, potato, onions, and so on India has an amazing record underway of foods grown from the ground, just as in the promoting area, nonetheless, and it has a few limits as well. Despite the fact, that the food area is a significant fragment of our economy, containing a portion of 9-10% of our GDP in the horticulture and manufacturing sector. The country lacks an on-time delivery performance for the distribution of fruits and vegetables from the farmer level to the retailer level. [31]

India has a gigantic chance to turn into the world's driving food provider if just it has a versatile, responsive, and effective production network that considers delivery as a critical aspect of supply chain management. The F&V area is the most productive endeavour of generally all cultivating exercises as it gives countless business openings and gives an extension to improve the general pay of cultivating the local area. In India, F&V establish about 92% of the complete cultivation creation. [56] The food industry in India has caught foreign direct investments (FDI) worth huge millions of USD during the time frame April 2000 to January 2020, according to the most recent information distributed by the Department of Industrial Policy and Promotion (Department for Promotion of Industry and Internal exchange, Ministry of Food Processing Industries, Govt. of India).

As the number of inhabitants in our nation is expanding, the interest in F&V is additionally expanding. To fulfil this enormous need and to keep up the food quality and sustenance, an effective supply chain assumes a significant part in this area, particularly when the nature of the item is transient and has a short period of usability. It assists with reducing expenses, keeping up and improving the nature of items delivered, which have high perishability. [47]

Delivery performance is a term used to describe the level to which products/goods/services supplied by a firm meet the customer's expectation or demand. It provides a measure of the capability of the supply chain in providing products/goods/services to the customer. On-Time Delivery emphasizes the timely delivery of raw, semi-finished, or finished goods, resulting in a good reputation in the market, satisfied customers, and uniform cash flow. [38] Delivery performance parameters include material procurement, non-value-added activities, demand, admin & HR, lead-time, outsourcing, production rate, cycle time, and transportation & logistics. Delivery performance can likewise be estimated, as far as cost, cost, and time. [43] Delivery performance management addresses the administration of the entire arrangement of tasks including the production of fruits & vegetables, packaging, storage, transportation and

distribution by which the consumer has profited from an ideal item. It covers the sector of demand management also within and across channel partners, intermediaries, wholesalers, retailers, etc.

After studying various Indian fruits and vegetables supply chains, one thing that was quite evident was the issues associated with delivery management throughout the supply chains. The entire supply chain is a value chain that should be free from unnecessary diversion &/or bottlenecks as much as possible. The relationship between demand and supply affects the quality of delivery. Delivery performance management can help the wholesalers, retailers, etc. distinguish the unrivalled providers, sellers, and merchants and encourages them to superior suppliers, vendors, and distributors and helps them to improve on-time delivery, which at last cuts down client costs. [31] [38]

There are many existing challenges for the food processing sector in India like lack of proper infrastructure, and logistics arrangement which leads to delivery issues and postures as a major danger as there is a vulnerability to satisfy the need of growing customers. [31] [34] Delivery issues result in a critical issue called food wastage (especially in perishable sectors like fresh fruits & vegetables). The loss can be in the form of rotting, drying, microbial attacks, mechanical damage, and ageing of products. The cause behind these losses can be improper handling, poor transportation, lack of outsourcing, poor lead time management, logistics, etc. It is assessed that, in India, around 8-10% of misfortune happens in foods grown from the ground during post-harvesting. The food preparation area can assume a significant part in building the necessary framework, presenting best practices for transportation, stockpiling, infrastructure, handling, and dispersion (IIFT, Ministry of Agriculture, and Government of India). The issue of delivery is more vital in closed-loop fruit and vegetable supply chains where the amount and nature of returned products will change immensely with an undeniable degree of vulnerability. [26]

As per a report, in India, there is an absence of an appropriate framework for capacity, and a lack of suitable infrastructure for storage, packaging, value addition, etc. which impacts the delivery performance in return. [57]

The literature revealed that there are significant gaps in the supply chains of fruits and vegetables which lead to food loss and wastage due to delivery issues. There is a need for further research in the above-mentioned area (IIFT, Ministry of Agriculture, and Government of India). [58]

This study identifies some critical delivery performance parameters in Indian FP SMEs and analyzes them utilizing multi-rules choice demonstrated through the Analytic Hierarchy Process (AHP). To achieve our research objectives, we built up a grouping of areas insightful region-wise among North India F&V retailers and mandis (fresh agri-produce direct distribution sites) and examined not only the general parameters affecting delivery performance but also derived a decision model using the AHP technique. Our paper is coordinated as follows: Section II presents a review of the literature; Section III represents methodology and execution activities. Section IV represents the results and discussion. Finally, Sections V&VI

address the conclusion and limitations and administrative ramifications for additional exploration.

## II. THEORETICAL FOUNDATION

### A. Literature Review

First and foremost, the idea of delivery arose out of an idea of giving and taking, for example, a business objective. It is generally propelled by individuals in the business, people at the receiving end, and the stakeholders. Various theoretical perspectives are present on Indian fruit and vegetable supply chains. The research papers were gathered for a very long time (2000-2020) and papers managing fresh fruits and vegetables were taken into consideration. References of papers identified with supply chains of fruits and vegetables were eluded to discover more pertinent papers tending to supply-side and delivery-side issues. Consequently, a cross-referring approach was likewise embraced to discover other important papers. We evaluated a portion crafted by the main creators with subtleties like the year of publication, journal type, methodology/philosophy utilized, and the research tools applied for the study. The results derived from the study were also studied and research gaps identification is done. [2] [4] [5] [8]

### B. Delivery Performance Parameters

The most significant delivery performance parameters are identified from the literature and organized into nine main areas namely material procurement, non-value-added activities, demand, admin & HR, lead-time, outsourcing, production rate, cycle time, and transportation & logistics as shown in Table I. From the literature review on delivery issues and challenges in the Indian food processing industry, the performance parameters were identified.

### C. Delivery Performance Parameters: Indian F&V Sector

The thematic study of existing literature on delivery issues, other associated issues, and challenges in the F&V sector is shown in Table 1 based on which the delivery performance parameters were identified.

**TABLE I. KEY PARAMETERS TO DELIVERY PERFORMANCE FOR DELIVERY IMPROVEMENT IN INDIAN FOOD PROCESSING SMES**

<i>References</i>	<i>Brief Description</i>	<i>Key parameters delivery performance improvement</i>
<b>Singh et al. (2019)</b>	Several key conclusions concern the food supply chain, ICT, resource management, Indian small and medium-sized businesses, sustainable growth, and grey-based decision-making trial and evaluation. [45]	Material Procurement
<b>Meena et al. (2019)</b>	The agri-food supply chain was discussed. SWOT analysis was carried	Non-Value-Added Activities

	out. Strategy development in an agri-supply chain. Implementation of AHP & Fuzzy AHP [36]	
<b>Mor et al. (2018)</b>	A structured literature review was carried out on the food processing industry, supply chain, logistics & transportation, and coordination [46]	Transportation & logistics
<b>Mani et al. (2018)</b>	Distribution channels, major food processing sectors, marketing, importers, sales of packaged food	Administration & HR
<b>Grillo. H et al. (2017)</b>	It was discussed how the order promising approach, available-to-promise, affected activities. The product's lack of uniformity was investigated. Perishability and a comprehensive assessment of the fruit distribution network had been addressed.	Outsourcing
<b>Agarwal. S (2017)</b>	Reviews shared on agri-supply, supply chain management, fruits, vegetables, & farmer cooperatives [51]	Demand, administration & HR, Production Rate
<b>Kalidas. K (2016)</b>	The role of consumers, intermediaries, producers, etc. is discussed. Reviewed supply chain management in the vegetable sector in Kerala	Transportation & Logistics
<b>Singla. M (2016)</b>	The study identified the problems slowing down the growth of the Indian food processing sector. The study also focused on many promising dynamics which supported the potential for growth of this industry.	Administration & HR, transportation & logistics,
<b>Negi et al. (2015)</b>	Cold chain facilities, a fragmented supply chain, stakeholder integration, facilities, packaging materials, technology, farmer expertise, safety and quality standards, a dearth of efficiency in the supply chain, produce losses and wastage, transportation modes and	Transportation & logistics, administration & HR, demand management, material procurement

	facilities, and market information are a few of the themes that were explored.	
<b>Sheoran et al. (2015)</b>	Fruits and Vegetables, Indian as global market, food wastage, supply chain management, cold storage, and factors affecting Indian Fruits and Vegetables supply chain management [49]	Demand, transportation and logistics, cycle time
<b>Negi et al. (2014)</b>	Discussed utility and impacts of agribusiness, supply chain efficiency, post-harvest losses, and logistics in the fruits and vegetable sector in India	Transportation & logistics, material procurement
<b>Chaudhuri et al. (2014)</b>	Focus on supply uncertainty in the food industry and suggestions for coping Strategies	Demand, lead time, logistics
<b>Hsiao. H. I et al. (2009)</b>	Role of logistics outsourcing, the impact of service, food industry, the uncertainty involved in the supply chain of the food industry	Outsourcing, demand

The selected delivery performance parameters are discussed below for a better understanding of the work carried out.

- **Material Procurement** The term ‘material procurement’ stands for the action of obtaining or procuring raw material, semi- finished material, or fully finished material. It is the demonstration of discovering, procuring, and purchasing products, administrations or works from an external source, regularly employing an offering or bidding measure. It manages the sourcing exercises, exchange, and vital determination of merchandise and ventures that are as a rule of significance to the industry.
- **Non-Value Added Activities (NVAA)** They allude to deal with steps that neglect to meet at least one than one of the accompanying models [27]:
  - a. The step changes the thing towards culmination and something changes.
  - b. The step is done well interestingly and isn't a rework step.
  - c. The client minds (or would pay) for the progression to be finished.

It additionally implies that any action that doesn't add to the benefits, market worth or capacity of the item is a non-value-added activity or the "wastage" that ought to be eliminated or be at least. The time associated with such on-value-added activities is known as non-value-added time and it is the measure of the production cycle duration that doesn't straightforwardly deliver any merchandise or administrations. Further, this is the measure of time when merchandise is not effectively being worked upon. So, non-value-added time is equivalent to move time, investigation time, and holding uptime. The non-value-added exercises

produce a non-value-added cost. One that adds to the overall cost of an item or administration yet doesn't upgrade its incentive from a customer point of view. It is expressed as anything for which the client would pay.

- **Demand** The manufacturing firms need a channelled strategy for the usage of their resources due to the rise in the number of units needed for sales. Cheap labour is no longer in demand due to increased opportunities, especially in areas like China and India where it was formerly possible to get the labour for very little money. Demand is the volume of a good or service that people purchase at a particular price. The types of machinery have always served as the centre of high production and optimal utilization, and they still are [26]. The difficulties experienced by different manufacturing sectors across the world depend on the many business sectors they are involved in as well as on geographical factors like climate, resources, financing, etc.
- **Administration & HR** The administrator and HR directors are assigned to enterprises to encourage regulatory concerns, everything being equal, and to keep up physical and advanced workforce records like business agreements and PTO demands. They update the inward data sets with recently added team member data. Additionally, make and disperse rules and FAQ archives about organization approaches [37].
- **Lead-Time** It is characterized by the dormancy between the commencement and execution measures. It incorporates acquisition time, handling time, and processing time. The lead-time decrease is a significant piece of delivery performance improvement. It is the contrast between when a thing is made and when the thing enters its last stage [3].
- **Outsourcing** It is training utilized by different organizations to diminish costs by moving segments of work to outside providers as opposed to finishing it inside because of a few imperatives, for example, time requirements, assets limitations, conveyance requirements, and so forth. It is a successful expense saving and efficient system when utilized appropriately, subsequently prompts on-time deliveries [36] [47].
- **Production Rate** In the manufacturing industry, a company's production rate is determined by how many goods it can supply in a certain time frame. The length of time it takes to produce one unit of a good, on the other hand. Overall, it refers to the pace at which workers are expected to do a certain task that has been assigned to them [24] [26] [7].
- **Cycle Time** It is specified by the entire duration of the engagement, as described by the client or customer, from the beginning to the concluding point. It incorporates process time and delay periods. It incorporates measure time, during which a unit is followed up on to carry it more like an ideal yield, and time of delay, during which a unit of work is spent holding on to make the following move. The decrease in cycle time improves the quality [26].
- **Transportation & Logistics** The enhancement of transit methods reduces the strain of relocating, increases delivery speed, enhances administration quality, lowers activity costs, maximizes the effectiveness of offices or facilities, and reduces energy consumption. In logistics management, the regulation of strategic chains is an important component. Multiple

information sources and yields are part of the production measures. The management of the flow of commodities through their origination to their point of use to satisfy the needs of customers or industries [26, 31] defines logistics.

To assess the examination advancements and course of future exploration work in delivery performance management of the Indian food processing sector, the following research questions are asked:

1. What are the parameters influencing delivery performance in the Indian Fruits and vegetables supply chain (Indian food handling area)?
2. What is the relationship between selected parameters affecting delivery performance in the Indian Fruits and vegetables supply chain (Indian food handling area)?
3. Define future exploration in the area of delivery performance management in the Indian Fruits and vegetable supply chain (Indian food handling area).

### III. METHODOLOGY

This investigation starts with the identification of parameters influencing delivery in the Indian food processing industry from various literature resources. This examination uses the information of a poll overview directed at delivery improvement. The survey is sent through email to specialists from the scholarly community and the food industry. The arrangement of inquiries in the survey has been outlined and advanced after the meeting to generate new ideas with specialists. This examination uses this study information to introduce a relative report for small and medium enterprises in the Indian Fruits and vegetable industry.

To show the case, a theoretical circumstance is thought of. The associations viable are little and medium endeavours, which are picked district shrewd in Northern India. Three Indian FP SMEs (FP SME-1, FP SME-2, and FP SME-3) are considered for the study and their names are not referenced because of privacy purposes, as they are contenders of one another in the Indian Food Processing market situation. The organization's aggregate yearly turnover is under ₹90 lakh.

An analysis of delivery performance parameters into material procurement, non-value-added activities, demand, admin & HR, lead time, outsourcing, production rate, cycle time, and transportation & logistics are modelled through AHP.

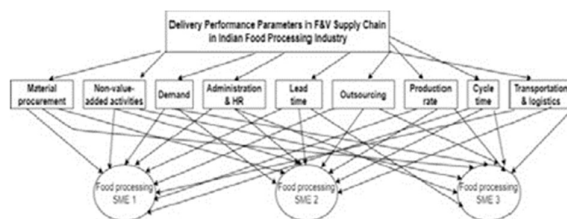


Fig.1. Three-tier AHP Model for Delivery Performance Improvement in Indian Food Processing Industries

Source: Conceptualized by the author as per the research framework

Fig. 1 shows the AHP model where, delivery performance improvement has been portrayed as objective, parameters for the model are different delivery performance parameters and options or alternatives are of three food processing SMEs, as talked about in the previous section.



AHP is a science that examines intangibles compared with one another. In this methodology of relative measurement, the variables to be evaluated are known, and then a scale of priority is established through pairwise comparison measurements [50].

The use of AHP to a choice issue includes the following advances [17] [18] [19] [20] [21] [22][23]:

1. The step includes organizing the choice issue into various levelled models. It incorporates the deterioration of the choice issue into chosen components as indicated by their basic attributes and the arrangement of a progressive model having various levels. For the most part, there are three levels, for example, objective, measures, and choices, in a straightforward AHP model.

2. This step includes making pairwise examinations and acquiring the critical network. Here, the components of a specific level are contrasted with deference with a particular component in the quick upper level. The subsequent weights of the components are known as the local weights. The assessment of a chief is evoked by looking at the chosen components. Components are looked at pairwise and decisions on the relative effect of components are caught utilizing a rating scale. Generally, a component accepting a higher rating is viewed as better looked at than another that gets a lower rating. If the property doesn't hold for all the chosen components, the degree of irregularity can be caught by a measure called the Consistency Ratio. An estimation of CR under 0.1 is viewed as worthy since human decisions need not be consistently predictable, and there might be irregularities presented as a result of the idea of scale utilized. The capacity to recognize conflicting decisions through the estimation of consistency proportion is viewed as one of the solid places of AHP.

3. The last step involves the determination of the local weights of the components utilizing the Eigenvector technique. The standardized Eigenvector compared to the key Eigen estimation of the judgemental matrix gives the weights of the related components. Even though the Eigen esteem technique is followed generally in conventional AHP calculations, when it is utilized, the Consistency Ratio (CR) can be registered. For a reliable framework, CR= zero, and if CR for a grid is more than 0.1, decisions ought to be inspired indeed by the decision-maker until he gives more predictable decisions.

#### **IV. RESULT AND DISCUSSION**

The choice of selecting FP SMEs is random & the analysis is intended to deliver the best performer FP SME having the most appropriate set of parameters. After applying the AHP technique, it is considered that the FP SME that used the delivery performance parameters has been best ranked and the overall delivery is very good. In the above results, it was found that FP SME 2 was best ranked so that the system becomes sounder. Delivery in the food processing industry plays an essential role in their economic growth, customer satisfaction, and market goodwill.

The process of evaluation of delivery performance begins with recognizable proofs of parameters affecting delivery and then, the other options, from the literature. The pairwise comparison matrix of alternatives, based on nine delivery performance parameters, was created

through meetings to generate new ideas in a conference with the specialists from the scholarly community and industry as demonstrated in Tables V, VI, VII, VIII, IX, X, XI, XII, & XIII. The criteria weight of the selected parameters was assessed utilizing easy use & understanding of AHP BPMSG programming. The matrix inconsistency for each pair astute table is additionally introduced. This demonstrates that decisions made are reliable & consistent as CR is beneath 0.1.

Figure 2 shows the final chart acquired by the execution of the AHP strategy for the assurance of ranking the chosen delivery performance parameters relying on their separate criteria weights. For the assessment of food processing SMEs, the outline unmistakably shows that FP SME 2 has the most elevated position, in this way making it a situation with the best assessment as per the goal of accomplishing the greatest estimation of target work. Along these lines, according to the setup standards, FP SME 2 has the best parameters for furnishing high delivery execution with decreased waiting times and superfluous postponements, continually looking to improve its delivery practices through training and qualified representatives who can comprehend the detailing behind the meaning of on-time deliveries and valuable consumers.

TABLE II. PAIR-WISE COMPARISON MATRIX

<i>Parameters</i>	<i>Material</i>	<i>Non-</i>	<i>Demand</i>	<i>Administration &amp; HR</i>	<i>Lead time</i>	<i>Outsourcing</i>	<i>Production rate</i>	<i>Cycle</i>	<i>Transportation &amp;</i>
Material procurement	1	9	1/5	2	1	1	3	2	1
Non-value-added activities	1/9	1	1/9	1/5	1/7	1/9	1/7	1/5	1/9
Demand	5	9	1	6	5	5	6	3	1
Administration & HR	1/2	5	1/6	1	1/3	1/3	2	1/2	1/8
Lead time	1	7	1/5	3	1	2	2	1	1/3
Outsourcing	1	9	1/5	3	1/2	1	4	2	1/3
Production rate	1/3	7	1/6	1/2	1/2	1/4	1	1/3	1/8
Cycle time	1/2	5	1/3	2	1	1/2	3	1	1/7
Transportation & logistics	1	9	1	8	3	3	8	7	1

The calculation of  $\lambda_{\max}$  is done by solving the equation i.e. addition of ratio values/ Total no. of parameters.

**TABLE III. COMPUTATION OF CRITERIA WEIGHTS**

<i>Parameters</i>	<i>Criteria weights</i>
Material procurement	0.108998
Non-value-added activities	0.014066 3
Demand	0.290002
Administration & HR	0.042811 4
Lead time	0.092367 9
Outsourcing	0.095357 5
Production rate	0.037421 5
Cycle time	0.067804
Transportation & logistics	0.251172

**TABLE IV. RANKING CHART**

<i>Selected parameters</i>	<i>Relative priorities</i>	<i>Ranking (ascending order)</i>
Material procurement	10.90%	7
Non-value-added activities	1.41%	1
Demand	29.00%	9
Admin & HR	4.28%	3
Lead time	9.24%	5
Outsourcing	9.54%	6
Production rate	3.74%	2
Cycle time	6.78%	4
Transportation	25.12%	8

& logistics		
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Examinations of alternatives regarding each of the selected delivery performance parameters are shown below:

**TABLE V. EXAMINATION OF ALTERNATIVES REGARDING MATERIAL PROCUREMENT**

	<i>FP SME1</i>	<i>FP SME 2</i>	<i>FP SME 3</i>	<i>Weights (Eigenvector)</i>	<i>Relativepriority</i>
FP SME 1	1	0.5	2	0.310814	31.08%
FP SME 2	2	1	2	0.493386	49.34%
FP SME 3	0.5	0.5	1	0.1958	19.58%

Maximum Eigen value= 3.05362, C.I. = 0.0268108

**TABLE VI. EXAMINATION OF ALTERNATIVES REGARDING NVAA**

	<i>FP SM E 1</i>	<i>FP SM E 2</i>	<i>FP SM E 3</i>	<i>Weights (Eigenvector)</i>	<i>Relativepriority</i>
FP SM E 1	1	0.33	0.50	0.157056	15.71%
FP SM E 2	3	1	3	0.593634	59.36%
FP SM E 3	2	0.33	1	0.249311	24.93%

Maximum Eigen value= 3.05362, C.I. = 0.0268108

**TABLE VII. EXAMINATION OF ALTERNATIVES REGARDING DEMAND**

	<i>FP SME 1</i>	<i>FP SME 2</i>	<i>FP SME 3</i>	<i>Weights (Eigenvector)</i>	<i>Relativepriority</i>
FP SME 1	1	8	5	0.751042	75.10%
FP SME 2	0.13	1	0.5	0.0871507	8.72%
FP SME 3	0.2	2	1	0.161807	16.18%

Maximum Eigen value= 3.00554, C.I. = 0.00276756

**TABLE VIII. EXAMINATION OF ALTERNATIVES REGARDING ADMIN & HR**

	FP SME 1	FP SME 2	FP SME3	Weights (Eigenvector)	Relativepriority
FP SME 1	1	0.5	5	0.379129	37.91%
FP SME 2	2	1	3	0.507603	50.76%
FP SME 3	0.2	0.333333	1	0.113269	11.32%

Maximum Eigen value= 3.16323, C.I. = 0.0816173

**TABLE IX. EXAMINATION OF ALTERNATIVES REGARDING LEAD TIME**

	FP SME 1	FP SME 2	FP SME3	Weights (Eigenvector)	Relativepriority
FP SME 1	1	5	2	0.559065	55.91%
FP SME 2	0.2	1	0.2	0.088746	8.87%
FP SME 3	0.5	5	1	0.352189	35.22%

Maximum Eigen value= 3.05362, C.I. = 0.0268108

**TABLE X. EXAMINATION OF ALTERNATIVES REGARDING OUTSOURCING**

	FP SME1	FP SME 2	FP SME 3	Weights (Eigenvector)	Relative priority
FP SME 1	1	6	4	0.700974	70.09%
FP SME 2	0.166666	1	0.50	0.106146	10.61%
FP SME 3	0.25	2	1	0.19288	19.28%

Maximum Eigen value= 3.0092, C.I. = 0.00460136

**TABLE XI. EXAMINATION OF ALTERNATIVES REGARDING PRODUCTION RATE**

	<i>FP</i>	<i>FP SME2</i>	<i>FP SME3</i>	<i>Weights</i>	<i>Relativepriority</i>
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	<i>SME1</i>			<i>(Eigenvector)</i>	
FP SME 1	1	0.5	0.5	0.1958	19.58%
FP SME 2	2	1	0.5	0.310814	31.08%
FP SME 3	2	2	1	0.493386	49.33%

Maximum Eigen value= 3.05362, C.I. = 0.0268108

**TABLE XII. EXAMINATION OF ALTERNATIVES REGARDING CYCLE TIME**

	<i>FP SME1</i>	<i>FP SME 2</i>	<i>FP SME 3</i>	<i>Weights (Eigenvector)</i>	<i>Relativepriority</i>
FP SME 1	1	3	2	0.527836	52.78%
FP SME 2	0.33	1	0.33	0.139648	13.96%
FP SME 3	0.5	3	1	0.332516	33.25%

Maximum Eigen value= 3.05362, C.I. = 0.0268108

**TABLE XIII. EXAMINATION OF ALTERNATIVES REGARDING TRANSPORTATION & LOGISTICS**

	<i>FP SME1</i>	<i>FP SME 2</i>	<i>FP SME 3</i>	<i>Weights (Eigenvector)</i>	<i>Relativepriority</i>
FP SME 1	1	3	0.25	0.225535	22.55%
FP SME 2	0.33	3	0.2	0.100654	10.06%
FP SME 3	4	5	1	0.673811	67.38%

Maximum Eigen value= 3.08577, C.I. = 0.0428833

**TABLE XIV: COMPOSITE IMPACTS OF FP SMEs**

<i>Parameters</i>	<i>Computerized criteria weights</i>	<i>FP SME1</i>	<i>FP SME2</i>	<i>FP SME3</i>
Material procurement	0.108998	0.310814	0.493386	0.1958
Non-value added activities	0.0140663	0.157056	0.593634	0.249311
Demand	0.290002	0.751042	0.0871507	0.161807
Administration & HR	0.042811	0.379129	0.507603	0.113269
Outsourcing	0.0953575	0.700974	0.106146	0.19288

Production Rate	0.0374215	0.1958	0.310814	0.493386
Cycle time	0.067804	0.527836	0.139648	0.332516
Transportation & logistics	0.251172	0.225535	0.100654	0.673811
Composite impacts		0.4883694 1	0.785775 9	0.6355387 9

**TABLE XV: FINAL CLASSIFICATION OF THE AHP MODEL**

<i>SM Es</i>	<i>Compos ite impacts</i>	<i>Ran k</i>
FP SM E1	0.48836 9414	Thir d
FP SM E2	0.78577 5903	Firs t
FP SM E3	0.63553 8791	Sec ond

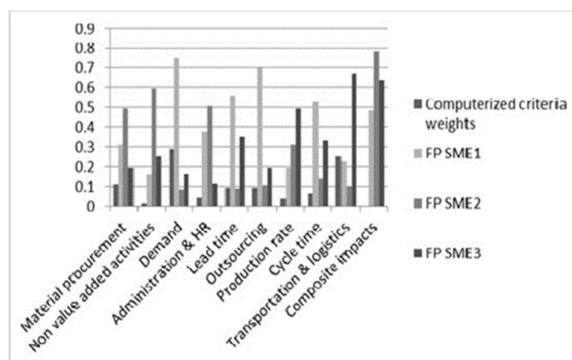


Fig.2. Bar chart showing the gist of AHP calculation done on the delivery performance parameters in the F&V supply chain in India

## V. CONCLUSION

The paper has highlighted the delivery issues in the Indian fruits and vegetable sector. A broad analysis has been done to identify delivery performance parameters. The responses of people connected to the aforementioned sector have been taken into consideration for the study. Furthermore, the model was created utilizing the Analytic Hierarchy Process methodology. The chain of importance structure was set up dependent on the chosen key parameters influencing delivery performance in the Indian fruits and vegetable sector. At that point, the criteria weights

of the measures were allotted by pair examinations and determined using the AHP procedure. The SME's score was determined to assess delivery performance under the chosen parameters of delivery performance improvement. Finally, the ranking of food processing SMEs was determined based by their associated criteria weights. It gives ideas, suggestions and directions for industries to take suitable actions in improving delivery in the Indian food processing industry and in general.

## **VI. LIMITATIONS & MANAGERIAL IMPLICATIONS**

Notwithstanding the advantages of the AHP procedure, specifically that it changes fluffy, inadequately expressed models of frameworks into clear, all-around characterized models, it has certain. One significant downside is that the AHP model got might be affected emphatically by the one-sided assessments of the individual considered for passing judgment on the boundaries, as the relations among the boundaries consistently rely upon the individual's information and knowledge of a specific firm, its store network, and tasks. The AHP model should be approved further and is likewise one of our future exploration plans. The exploration yield gives important experiences to store network individuals in the food handling industry. Store Managers & Area Heads must focus on demand management & transportation & logistics activities since these are the most critical parameters as they are having high relative priorities identified through this research work. Directors and Managers must focus on material procurement, outsourcing, and lead time management. Moreover, social, local, ecological, and occasional viewpoints should be tended to while configuring the delivery performance considering both long and transient procedures in settling on territory explicit choice methodologies. Food processing operational units should be situated near agricultural lands to reduce transportation costs. Also, modern technology & facilities should be there to make the deliveries fresh to the end users. Also, the logistics costs should be minimized to improve profitability and on-time delivery. Our Government should implement a plan for the development of human resources such as managers, entrepreneurs, supervisors, retailers, technologists, etc. in the food processing sector for delivery performance management.

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