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Conceptualization of an efficient Supply Chain for Automobile Battery Industries in India

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Abstract:
People are living in a digital era where digitization has reached every aspect of the lives and will continue to transform industries such as energy and its end-consumer. Today, every business is a technology business where industry boundaries are getting blurred and market leaders are becoming history suddenly, it is very much akin to the sudden death situations in football where the 1st mover scoring a goal takes it all. Renowned brands are disappearing from the market suddenly because of (a) failure to sense the changing customer preferences, (b) being blind to technology advances adapted by others. Now, Organizations are not competing with their competitors. Rather it can be said, the Supply Chain of Organization A (Leader-A) is competing with the Supply Chain of Organization B (Leader B) and others. Operations and Supply Chain Management (OSCM) has a vital role to satisfy the value conscious customers' wants. Organizational success depends on superior design, planning and operation of their Supply Chain (SC). Firms must revisit their Supply Chain (SC) design in response to changing the technology and customer's need. [8], [19].

This research paper will provide a data driven conceptual analysis on supply chain strategy particularly for Automobile battery industry in India and deliberate on a fundamental question such as "what is the right supply chain strategy (SC) for Automobile Battery?" based on a conceptual framework designed for automobile accessory manufacturing firms in India. [7].

Research methodology adopted in this study involves the review and analysis of the similar research articles & primary market research data to find out the ground reality, technology trends and research gaps. The data has been collected from one of the largest market research institutes and from some of the leading battery manufacturing firms in India. Subsequently, statistical analysis like Mean, Standard Deviation, Coefficient of Variation, Trend analysis etc. of the captured data have been carried out to conceptualize the right supply chain strategy.

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I. INTRODUCTION

The value creation in lead acid automobile battery industry is driven by three key factors i.e. (1) Cost - In India, unorganized players account to 30-40% market share in the after sales market. This is only because of low cost batteries offered by unorganized players. (2) Market threats – Industry boundaries are getting blurred. Industry leaders like Google, Samsung & Tesla are investing in the sustainable, smart energy generation. There is a constant pressure for Electrical Vehicles (EV) from Govt. of India. (3) Product Performance – E-Savvy consumers want to monitor the product performance on the fly. They want to integrate between Electronics and Storage.

To overcome the above, Organization should have constant focus on cost of the products. The value of the final product is calculated as "Supply Chain Profitability = Revenue Generated from Customer – Overall cost across the Supply Chain". [11].

The estimates of supply chain surplus or profitability are subjective and may vary from person to person and situation to situation. The higher the supply chain surplus indicates the more successful the supply chain strategy, planning and operation.

[11].

There are two distinct supply chain capabilities i.e. Responsiveness and Efficient. Features of a Responsive Supply Chain include (a) it should respond quickly to changing demand situations (b) should be able to handle higher uncertainty in demand/supply (c) should meet shorter lead time, even if the costs are significant (d) its ability to handle high product varieties (innovative products) with short product life cycles (e) meet higher margin because price is not a prime customer driven. Whereas, an Efficient Supply Chain makes sure that (a) it fulfils supply demand at a lower cost (b) adopts lean methods to eliminate waste (c) it minimizes inventory to lower cost (d) it lowers costs through high utilization of resources (e) it can reduce lead time but not at the expense of costs (f) it lowers margin because price is a prime customer driven factors. [10] , [11].

To select an appropriate SC strategy, organization need to consider the nature of the demand for the products one's company supplies. High uncertainty (high forecasting error) in demand calls for a more responsive supply chain whereas low uncertainty (low forecasting error) demand calls for a more efficient supply chain with a focus on cost reduction [10], [11].

The objectives of this research paper are as below:

a.To evaluate and identify the right supply chain strategy for the automobile battery by which manufacturing firms of India can get an assistance for the enhancement of supply chain competiveness.

b. To identify various features or aspects (e.g. inventory, lead time, product design, pricing and manufacturing) of supply chain strategies that can address the needs of an automobile battery industry.

II. Related Literature Review:

Harvard Business Review has suggested a simple framework which will help to find out the right supply chain strategy. The author has developed a structure from his ten years of research and consulting on supply chain issues in various industries. This helps supply chain manager to understand the nature of demand for their products and decide the best fit supply chain accordingly. Supply chain strategy depends on the nature of demand for the products. Based on the demand pattern, products can be classified into two categories which are functional and innovative. Each category needs different kind of supply chain. The various aspects of functional products are, for example, predictable demand, longer product life cycle, low contribution margin, low product variety, average stock out rate 1% to 2% , very high lead time required for made-to-order, etc. For innovative products aspects are, for example, unpredictable demand, shorter product life cycle, high margin, high product variety, average stock out rate 10% to 40% , very low lead time required for made-to-order, etc. [7]

Suggested Framework: Devising the ideal Supply-Chain Strategy

Products → Supply Chain Strategy	Functional Products	Innovative Products
Efficient SC	Match	Mismatch
Responsive SC	Mismatch	Match

Heikkila (2002) emphasized, to meet the customer's hunger with efficiency in supply chain is a challenging job for any organization. Good customer experience and efficient SC are needed to sustain in the business battleground. Relationship between strategic customers and suppliers and good demand information flow contribute to higher efficiency in Supply Chain surplus. The need is to find out a good balance between customer experience and supply chain efficiency which is an ongoing process. In a case study, the author analysed that supply chain should start from the customer end and give more focus on demand chain management. The right demand chain provides good customer-supplier relationships and reliable information flows which contribute to higher efficiency. [8].

Tjahjono et al (2017) highlighted that Industry 4.0 is a digital manufacturing solution. It is a global network of machines that helps to set up a smart

connected manufacturing plant by exchanging information and controlling each other. Industry 4.0 is a cyber physical system and operate autonomously. This is to further gain on productivity, visibility of operations, optimize resource utilization and increase in quality of their products in their plants, enable end to end traceability and genealogy tracking across the manufacturing process. Transparency is one of the key area to satisfy the customer. It can be achieved through collaboration between suppliers, manufacturers and customers. Authors analysed that order fulfilment and logistics are the most affected area due to introduction of Industry 4.0 in the manufacturing plants. Statistics says that 53.84% of the impact of the technology will be opportunities in order fulfilment area and 61.54% of the impact can be identified in transport logistics. Ultimately, Industry 4.0 shows 71.43% of the opportunities within the procurement function and 28.57% may be opportunities or threats. [9], [27].

The internet has changed the way of thinking and standard of living. Also, it has a great impact in the business world. Based on the internet, a new concept has emerged i.e. IoT(Internet of Things) . It connects all the things like devices, machines, sensors even the animals etc. and exchange information. Using IoT, a Supply Chain manager can bring transparency, visibility and efficiency in the Supply Chain. As per Forester Research statistics, 44 % online consumers say that chatting while purchasing is very useful and companies are utilizing this channel to increase the web traffic and reduce the phone calls. Future of marketing and consumer behaviour has shifted from social network to messaging platform. One of the preferred messaging platform is ChatBot(Chatting with robot). In the corporate world, it is becoming more popular particularly in Supply Chain Management. Due to huge information in the corporate's website, customers may confuse and take time to find out the relevant information. Here Chatbot will help to provide the contextual information to the Customers. With the help of ChatBot, Firms can generate leads, sell products, take the feedback, warranty registration and conduct survey, etc.[15],[16], [24].

Pradhan et al (2019) emphasized that transportation is one of the major cost component in the Supply Chain. To reduce the cost, one can install GPS device in the vehicle which will ensure the false billing by fleet owners. Also, reduce the fuel cost, idle time and overtime etc. Based on historical data, Vehicle Tracking System(VTS) can suggest optimized routes and deals with theft. [25],[26].

Azhagan (2015) enlightened in his research paper that the balance between responsiveness and efficiency is a vital factor for designing a supply chain network and it is a strategic decision for any organization. Responsive supply chain fulfils customer demands within a reasonable timeframe and maintain competitive advantages whereas efficient supply chain mainly focuses on cost reduction. Efficiency improvements are internal (e.g. Just-in sequence production) whereas effectiveness related to external activities (e.g. Customer satisfaction) in the supply chain management. The primary goals of the supply chain are to manage the demand and forecasting efficiently, proper inventory management, enhance collaboration with partners (suppliers, distributors, customers and others) ultimately step towards increased profits and market share. Author has suggested four key decision areas in the supply chain area in his case study : (a) Location – It is a long term decision to select the location in creating a supply chain. (b) Inventory – Inventory management directly related to customer service levels it's a strategic as well as operational decision. (c) Production- What products to produce? Which plants to produce? Sourcing? Integration with Strategic partners ? etc. are all strategic decisions. Operational issues are like Master Production Scheduling, Machine scheduling , workload balancing, quality control and machine maintenance etc. (d) Transportation – The mode of transportations (e.g. Highway, Water, Air, Rail, Pipelines, Hand deliveries etc.) in the supply chain is the more strategic ones. [2].

III. Current Market Reality in the Energy Storage:

The energy storage industry is being driven by the following critical forces [25]-[26],[3]:

- Customers' Want: End consumers desire for extended battery life, faster storage, minimum maintenance, proactive service and pressing need

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for higher storage efficiencies with lightning fast empty to full charging.

- Integration of Electronics with Storage: E-Savvy consumers want performance monitoring on the fly.

- Regulatory Changes: Introduction of GST and increasing focus on renewables and electric vehicles having the potential to alter the demand profile.

- Intelligent Applications: Intelligent cutting edge technologies like Artificial Intelligence (AI) helps to get the advanced analytics in procurement, production, sales & marketing, R&D , and logistics etc. Internet Of Things (IoT) and Block chain facilitate improved customers engagement , transform products , introduce new business models and optimized operations through connected products and factories. Cloud computing is helping to adopt the quickest path to new business models and software upgrades.

IV. Overview of Indian Automobile Battery Market:

Indian automotive market, a key end-user battery segment is poised for growth. The automotive segment accounts for a bulk of lead acid battery demand in the country. The domestic lead acid battery in India is a duopoly with two leading battery manufacturing companies controlling the organized market. In the replacement market, unorganized players account for a bulk of the market share. However, in a post Goods and Services Tax (GST) regime, their position is facing stiff competition with established market players. This will be primarily due to non-compliant unorganized manufacturers losing their share. Automotive demand has remained strong despite the two major events mainly the implementation of Bharat Stage IV emission norms in April 2017 and GST from July 2017. Surging scale of automobile manufacturers across two-wheelers, three-wheelers and four-wheelers has driven the ancillary market including batteries. The growth of the battery market will also be driven by factors such as (a) new segments in industrial batteries - e-Rickshaw, Motive Power and Solar applications (b) widening growth of telecom towers, driven by a robust growth plan telecom operators-the implementation of smart grid projects (c) deployment of vehicle charging infrastructure (d) increasing usage of hybrid and electric vehicles (e) growing installation of renewable energy systems [19].

Infrastructure push from Governments, creation of smart cities and the development of dedicated freight corridors are some of the reasons for expectations of sustained growth in this segment. Creation of mass rapid transport system may have a positive impact in bus production. However, Electrical Vehicles (EV) introduction in local transportation may have some adverse impact on the same. To meet BS (Bharat Stage) VI norm and improve fuel efficiency, CV (Commercial Vehicles) manufacturers are looking at every opportunity to reduce battery weight and thereby reduce cost.[19], [25].

V. Strategic Drivers to Overcome the Current Market Reality:

To overcome the current market realities and technology trends, Organization should decide their strategic drivers accordingly. Energy solutions providers should consider the following strategic drivers [1],[11],[18],[19]

(a) Operational Efficiency:
- Increase efficiency of energy storage solutions
- Contain costs to drive profitability

(b) Innovation:
- Focus on bringing new age technologies – in conventional and digital space
- Remain prepared for impending disruptions

(c) Customer Experience:
- To be the best value for money choice
- Strengthen the loyalty earned through decades of experience

(d) Digital Pillars:
- Empower Employees: To be the best value for money choice
- Strengthen the loyalty earned through decades of experience

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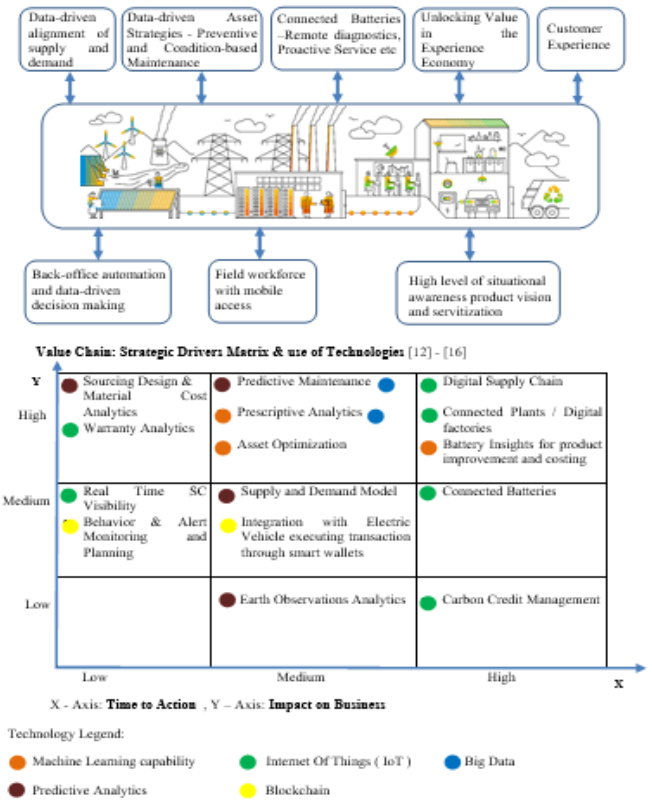
VI. Reimagining Value Chain:



VII. Research Method:

The research has been carried out via face-to-face meeting with various stakeholders like Materials Head, Production Heads, Sales Heads, Service Heads and Supply Chain Heads, literature survey including articles, magazines, government reports, balance sheets of interested firms, market research data, internet blogs, YouTube videos and related books etc.

Renowned research papers like Science Direct, Emerald, BARC University, Indian Institute of Management, Harvard Business School etc. were identified and referred to. Within this portfolio, various journals like

International Journal of Integrated Supply Management, International Journal of Advanced Scientific Research and Development, Harvard Business Review , International Business Research , International Journal of Logistics Management, International Journal of Information Management, Journal of Operations Management, Supply Chain Management etc. were referred to.

Market research data were collected from one of the world's largest market research institute and collected from one Indian financial services firm. Also, data collected from two leading battery manufacturing companies in India and face to face interview with key stakeholders of SCM.

In this research paper, it has been tried to fit the data on the framework of supply chain strategy suggested by Harvard Business Review. [4]-[7].

VIII. Nature of Demand: Statistical Analysis

Data Source: Market share data collected from GFK (https://www.gfk.com/industries/automotive/)

Assumptions: Company A is the leader in Automobile Batteries with respect to Market Share % and Company B is the competitor of Company A. Here, total market share of Company A and B is more than 80%. So we can conclude that automobile battery industry is a duopoly with Company A and B. Rest of the market share with unorganized players (called here Others).

Time Series Data: April 2017 to December 2018 (21 months).

Market Segment: All India and four geographical regions.

Table-1: All India Market Share %

Month	Company A (Avg%)	Company B (Avg%)	Others (Avg%)
Apr'17	49	32	18
May'17	50	30	19
Jun'17	49	30	19
Jul'17	49	32	18
Aug'17	48	33	18
Sep'17	46	34	19
Oct'17	45	34	19
Nov'17	44	34	20
Dec'17	45	33	21
Jan'18	44	33	22
Feb'18	43	34	23
Mar'18	43	34	23
Apr'18	43	34	22
May'18	44	34	22
Jun'18	44	34	22
Jul'18	44	34	21
Aug'18	44	34	22
Sept'18	44	34	22
Oct'18	44	33	22
Nov'18	45	33	21
Dec'18	45	33	21
Mean (μ)	**45.3**	**33.2**	**20.7**
Standard Deviation (σ)	**2.3**	**1.2**	**1.6**

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Graphical Analysis:

Table-2: All India Automobile Batteries

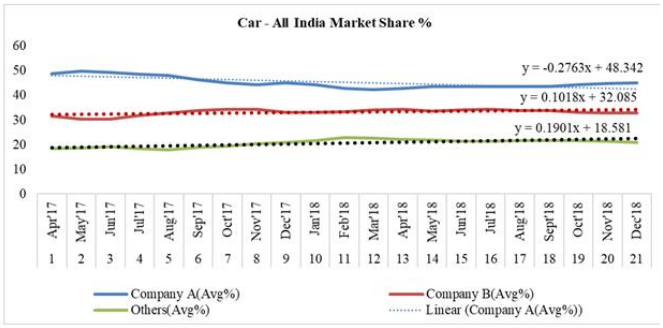


Table-3: Region wise Trend Analysis – North

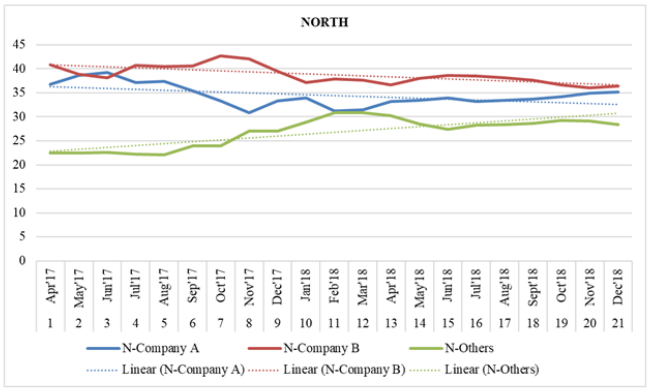


Table-4: Region wise Trend Analysis – East

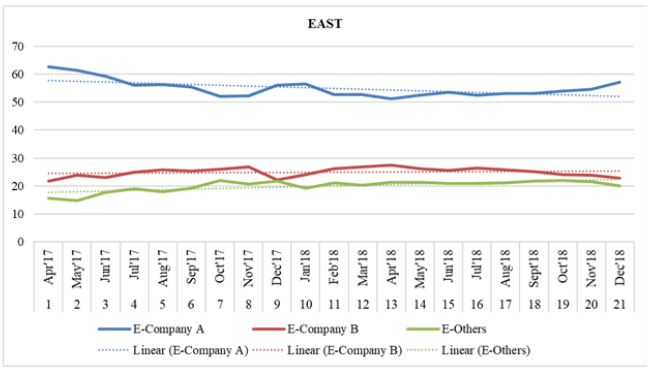


Table-5: Region wise Trend Analysis – West

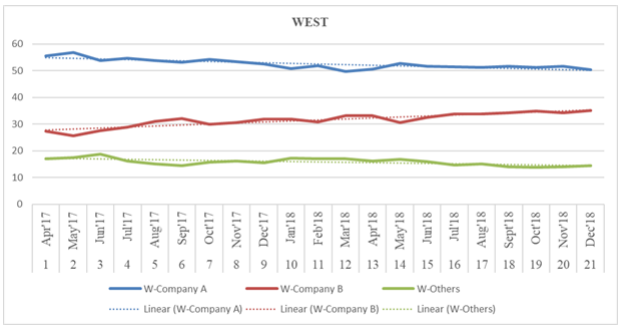
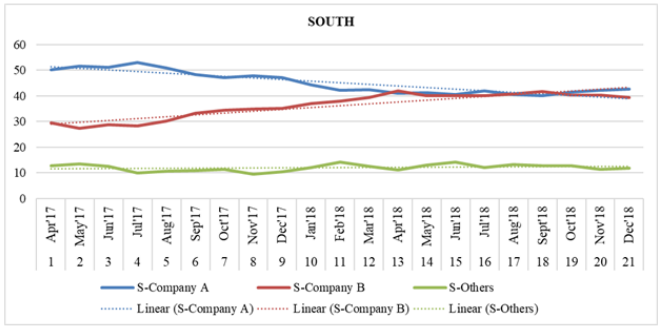


Table-6: Region wise Trend Analysis – South



IX. Product Classifications Framework:

Before designing the supply chain strategy, one should understand the profile of the product either functional product or innovative product. Efficient supply chains are more suitable for Functional products and Responsive supply chain for innovative products [7].

Table-7: Framework for Product Classifications (Ref. Harvard Business Review)

Criteria	Functional Product	Innovative Product
Product Life Cycle	Greater than 2 Years	3 Months to 12 Months
Aspects of demand	Predictable	Unpredictable
Product Variety	Low (10 to 20 variants per category)	Very High (Often thousands of variants per category)
Average Forecasting Error	Low (10 %) Better forecasting	Very High (40% to 100%)
Lead Time required for made-to-order products	Large	Very Small

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Contribution Margin	Lower	Higher
Average Stock Out	Very Less	Very High (10%-25%)

X. RESULTS:

Table-1 shows the following outputs:

- Coefficient of Variation (CV) of A = (**σ** / **μ**) *100 = (2.3 /45.3) * 100 = 5.5 % = 6% (approx..)
- CV of B = (**σ** / **μ**) *100 = (1.2 /33.2) * 100 = 3.6 % = 4 % (approx.)
- CV of Others = (**σ** / **μ**) *100 = (1.6 /20.7) * 100 = 7.7 % = 8% (approx..)

From the above figures, it is cleared that Coefficient of variations are less than equal to 8%.
From the Table-2, we get the following linear equations:
For Company A, $Y_A = A + BX_A$ (where, A = 48.32 , B = -0.28)
For Company B, $Y_B = A + BX_B$ (where, A = 32.08 , B = 0.10)
For Others companies, $Y_O = A + BX_O$ (where, A = 18.58 , B = 0.19)
Where Y is independent variable and dependent on X (Market Share %).
Graphical representation of (Table-2 to Table-6), it is cleared that the trend lines are liner in nature. These trend lines indicate that the demand of automobile batteries are stable in nature.
Co-Variances of Manufacturing firms and graphical analysis of four sssregions indicate that data points i.e. demands are more consistent, more uniform, more stable and more homogeneous.

Data collected from the leading battery manufacturing firms:

Table-8: Benchmark Vs. Estimated Value w.r.t. Table-7

Criteria	Benchmark Value	Estimated Value
Product Life Cycle	Greater than 2 Years	2-3 Years (Ref. Warranty master data collected from their websites)
Aspects of demand	Predictable	More uniform, More stable and More homogeneous (Ref. GFK Data)
Product Variety	Low (10 to 20 variants per category)	Segment / category: Nos. of variety CAR: < 6 2WL: < 5 3WL: < 3 LCV *: < 5 HCV **: < 4
Average Forecasting Error	Low (10 %) Better forecasting	Low (8%) to Medium (22%)
Lead Time required for made-to-order products (New Product Development)	Large	More than 6 Months
Contribution Margin	Lower	Medium (Average 13%)
Average Stock Out	Very Less	Very Less (2-3 days)

* LCV – Light Commercials Vehicles, ** HCV – Heavy Commercials Vehicles

The above product classifications matrix indicates that automobile batteries are falling under functional products.

In view of that, Organization should adopt the efficient supply chain strategy for their automobile batteries.

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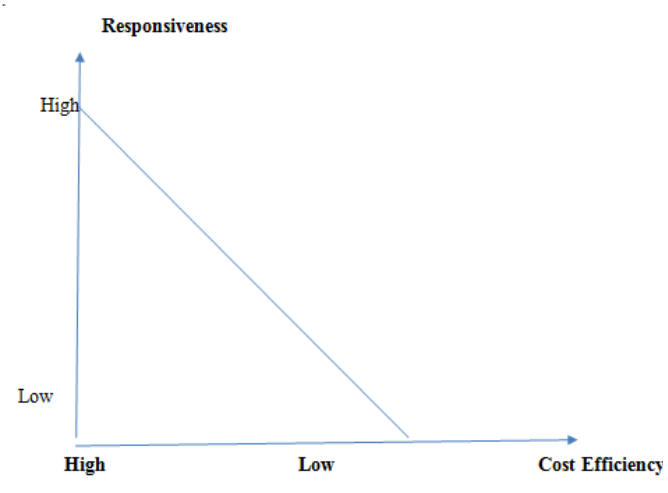
XI. Aspects of Efficient Supply Chain:

Today, the Supply Chain of an Organization is competing with the Supply Chain of others. Wrong supply chain strategy can destroy the organization. On the other hand, right SC strategy will help to rise the organization at an exponential rate. As per Gartner research, if stock is not available for the desired goods, 47% customers will move to the next competitor. An inefficient supply chain means (a) high cost (b) poor inventory management (c) lost sales (d) dissatisfied customers etc. So, organization should assess and design their SC strategy carefully. It is a strategic decision and to be reviewed at periodic interval after getting the market feedback. There are two distinct supply chain capabilities i.e. Responsiveness and Efficient Supply Chain.

If a supply chain (a) hold huge stocks (b) has underutilized production capacity (c) uses faster transportation modes like Air (d) state-of -the-art information systems like integrated business planning (e) vast transportation capacity etc. , this SC will respond to customer's demand quickly. But, it will incur extra costs and the SC will be less efficient with respect to cost. Supply Chain cost, time and service levels are contradicting each other [10], [11], [20].



Tradeoff between efficiency vs. responsiveness

This research paper has analyzed that the efficient supply chain is the best fit for automobile battery industry due to stable and homogeneous demand etc. The efficient SC has the following aspects [10]-[11]:

- Primary Goal: Fulfil the customer's demand at the lowest cost is the primary goal of any efficient supply chain management.

- Inventory Strategy: Minimize the stock to reduce the cost and stock holding days to be minimized with the inventory strategy.

- Lead Time Strategy: To reduce but not at the expense of costs.

- Supplier Strategy: Strategic sourcing based on cost and quality but not on speed, flexibility and reliability.

- Product design strategy: Maximize the performance at a minimum cost

- Pricing Strategy: Lower margins, due to customer driven price.

- Manufacturing Strategy: Try to utilize the maximum capacity so that cost can reduce.

XII. Conclusion:

The research paper dealt with here to evaluate and identify the right supply chain strategy for the automobile battery segment. The analysis is carried out based on market research and data collected from leading battery manufacturing firms in India and limited to automobile segments (e.g. CAR, 2WL, 3WL, LCV & HCV etc.) . Twenty one months of data (April 2017 to December 2018) has been taken for demand analysis in the automobile batteries. So, the recommendations may not be true and applicable for other segments like Inverter, e-Rickshaw and Gen Set etc. Also, the findings may not be applicable for other industries and in the global market. However, this conceptual framework can be evaluated for other products. This analysis will help the automobile battery manufacturing firms to select the competitive strategy [24], [26].

SCM has a vital role for the success of an organization. Firms should re-evaluate their SC strategy at regular interval and act accordingly. Responsive and Efficient SC are conflicting each other. The key success of supply chain management is to make the balance between responsiveness and efficiency i.e. Strategic Fit. There are a lot of challenges in achieving the strategic fit. The Supply Chain Strategy provides competitive advantages by overcoming challenges like (1) uncertainty of supply and demand (2) globalization affects – Opportunities & Risks (3) Ownership of SC (4) current market reality (5) technology trends (6) environment (7) sustainability, etc.[27].

In conclusion, the research paper is presented as (a) a foundation to develop a mathematical model (2) guidelines to automobile accessories firms to develop the strategic decision on SCM (3) and expects to add other factors to consider in the product classifications

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framework.

XIII. REFERENCES

1. Mauricio, A.L., &Jabbour, A.B.L.S. Critical Success Factors for GSCM adoption: Case Studies in the Automotive Battery Industry.(2017). Gestão&Produção ,24(1), 78-94.
2. Azhagan, C.T. (2015). Effectiveness of Supply Chain Management – A Case Study on Plastic Industry. International Journal of Advanced Scientific Research and Development , 02(02),450-455.
3. Chang, Wen-Yeau. "State of Charge Estimation for LFP Battery using Fuzzy Neural Network." International Journal of Electrical and Electronics Engineering Research (IJEEER) 6.5 (2016): 25-32.
4. Parkhi, S., Joshi, S., Gupta, S., & Sharma, M. A.(2015). Study of Evolution and Future of Supply Chain Management. Symbiosis International University, 9(2), 95-106.
5. James, A.M.J. (2012). A New Introduction to Supply Chains and Supply Chain Management: Definitions and Theories Perspective. International Business Research , 5(1), 194-206.
6. Abrol, Sanchita, and Deepak Chhabra. "Experimental investigations of piezoelectric energy harvesting with turbulent flow." International Journal of Mechanical and Production Engineering Research & Development 8.1 (2018): 703-710.
7. Dougher,C.& Johnson, T.L.(2018, April). Breaking Down the Lithium-Ion Cell Manufacturing Supply Chain in the U.S. To Identify Key Barriers to Growth. Nicholas School of the Environment of Dule University.
8. Mitra, S., &Datta, P.P. (2013, Feb). A Survey of Sustainable Supply Chain Management Practices in Indian Manufacturing Firms.. India Institute of Management .
9. Fisher,M.L.(1997). What is the Right Supply Chain for your Product?. Harvard Business School Publishing, Boston, MA 02163(1997).
10. Dasgupta, Somsuvra, and A. K. Panigrahi. "Studies on the effect of aquatic pollution on ichthyofaunal diversity of the east kolkata wetlands." International Journal of Research in Applied, Natural and Social Sciences 2.4 (2014): 145-152.
11. Heikkila, J. (2002). From Supply to Demand Chain Management: Efficiency and Customer Satisfaction. Journal of Operations Management, 20(11), 747-767.
12. Tjahjono, B., Esplugues, C., Ares, E. ,&Pelaez, G.(2017, June). What does Industry 4.0 mean to Supply Chain? Manufacturing Engineering Society International Conference, Vigo (Pontevedra), Spain: Elsevier B.V.
13. Chase, R.B., Shankar, R., & Jacobs, F.R. (2014) . Operations and Supply Chain Management. Chennai, TN: McGraw Hill Education (India) Private Limited.
14. Rathod, C. H. A. N. D. A. R., and GONDI KONDA Reddy. "Experimental investigation of angular distortion and transverse shrinkage in CO2 arc welding process." International Journal of Mechanical Engineering, 5 (4), 21 28 (2016).
15. Chopra, S., Meindl, P., &Kalra, D.V.(2016). Supply Chain Management – Strategic, Planning and Operation. Bengaluru, Karnataka: Pearson India Education Services Pvt. Ltd.
16. Gunasekaran, A., Papadopoulos, T., Dubey,R., &Wamba,S.F (2017). Big Data and Predictive Analytics for Supply Chain and Organizational Performance. Journal of Business Research, 70, 308-317.
17. Moniruzzaman, M.,Kurnia, S., Parkes, A., & Maynard, S.B. Business Intelligence and Supply Chain Agility. Australasian Conference on Information Systems, Adelaide, South Australia .
18. Trkman, P., &Ladeira, M.B. (2010) . The Impact of Business Analytics on Supply Chain Performance. Decision Support Systems , 49(3), 318-327.
19. Lee, I. ,& Lee, K.(2015). The Internet of Things (IoT): Applications, investments, and challenges for enterprises. ScienceDirect: Business Horizons,58, 431-440.
20. Chang, Wen-Yeau, and Po-Chuan Chang. "Application of Radial Basis Function Neural Network, to Estimate the State of Health for

March - April 2020
ISSN: 0193-4120 Page No. 5627 - 5636

LFP Battery." International Journal of Electrical and Electronics Engineering (IJEEE) 7.1 (2018): 1-6.

21. Alam, A.I., Rahman, M., &Subho R.H. (2018). IoT Based Supply Chain Management. BRAC University, Department of Compter Science and Engineering.
22. Rao,C.M.,Rao,K.P., and Muniswamy,V.V. Delivery Performance Measurement in an Integrated Supply Chain Management: Case Studies in Batteries Manufacturing Firm, Serbian Journal of Management (2011), vol. 6 (2), pp. 205 – 220. Retrieved from https://scindeks-clanci.ceon.rs/data/pdf/1452-4864/2011/1452-48641102205R.pdf
23. Hofmann, P. ,& Reiner, G.(2006). Drivers for Improving Supply Chain Performance an empirical Study. International Journal of Integrated Supply Management , 2(3).
24. Talib, M.S.A., Hamid, A.B.A., & Chin, T. A. (2015). Critical Success Factors of Supply Chain Management: A Literature Survey and Pareto Analysis. Euromed Journal of Business ,Retrieved from https://dx.doi.org/10.1108/EMJB-09-2014-0028.
25. Humbe, A. B., P. A. Deshmukh, and M. S. Kadam. "The Review Of Articulated R12 Robot And Its Industrial Applications." International Journal of Research in Engineering & Technology 2.2 (2014): 113-118.
26. Aziz, K., Rana, R. A., Rashid, M., &Rahat, Q.(2017, Aug). Supply Chain Effectiveness and Efficiency – Case of Chinese Onyx Industry. International Journal of Research , 04(09). Retrieved from https://edupediapublications.org/journals/index.php/IJR/
27. Gandhi, J., Shah, D.A. ,& Kamath, S. (2018). Batteries: Huge Opportunities, but challenges too. MotilalOswal .Mumbai. Retrieved from https://www.motilaloswal.com
28. Minnich, D. ,& Maier, F.H.(2006). Supply Chain Responsiveness and Efficiency – Complementing or Contradicting Each Other? School of Business Administration , 45(01).
29. Ramachandran, S., Nakhava, M.S., & Pratik, K. (2015). Logistics in India: Challenges and Scopes. International Review of Research in Emerging Markets and the Global Economy, 1(2). ISSN: 2311-3200.
30. Alam, A.I., Rahman, M., &SubhoR.H.(2018, April) IoT Based Supply Chain Management. BRAC University, Department of Compter Science and Engineering.
31. Pradhan, S., Bhattacharya, S., &Goswami, R.T. (2019, January). Intelligent Automobile Battery (IAB) for New-Age Customer Relationship Experiences. Paradigm Shifts In Business Practices and Technology, Amity University, Chattisgarh,23rd -24th January. UP: UttkarshPrakashan., 256-264.
32. Ashraf, Y. G. (2019, January). A Study of Eco Friendly Supply Chain Management in Steel Industries of Chhattisgarh. Paradigm Shifts In Business Practices and Technology, Amity University, Chattisgarh,23rd -24th January. UP: UttkarshPrakashan, 102-108.
33. Arya, P., & Jain, M. D.(2018, December). A System Perspective on Managing Eco-Logistics. International Journal of Management Research, 9(1-2), 42-56.