Value Creation with IoT Driven Supply Chain Management for Indian Automobile Battery Industry

Affiliations of Authors:

Sandip Pradhan,
Ph.D. Student of The Assam Kaziranga University,
School of Business, Jorhat, Assam, India. e-mail: sandipp@exide.co.in

Dr. Siddhartha Bhattacharya,
Associate Professor, School of Business,
The Assam Kaziranga University, Jorhat, Assam, India.
e-mail: s.bhattacharya@kazirangauniversity.in, getbhatta@gmail.com

Abstract:

People are living in a digital business world where competing with customers using traditional methods like (a) Normal Product (b) Product Price (c) Old-style Supply Chain etc. are not enough. Digital revolution through technologies like Intelligent Mobile Apps, Internet of Things (IoT) and Social Media forums etc. are helping consumers to be in control with stronger voices, better information visibility, transparency and price comparison with similar brands. The cutting-edge technologies like (a) Artificial Intelligence (b) Internet of Things (c) Cloud Computing (d) Block chain (e) Big Data (f) Advanced Analytics (e.g. Predictive and Prescriptive), (g) Robotic Process Automation (RPA) (h) Virtual Reality (VR) (i) Cyber-Physical systems i.e. Industry 4.0 etc. are forcing organizations to adopt the digitization and automation in their value chain. The Artificial Intelligence (AI) , IoT, Big Data , Industry 4.0 and Advanced Analytics have the potential to revolutionize the Supply Chain dynamics. To satisfy value conscious customers' demands, Organization have to have technology driven Supply Chain so that they can extract value for their customers.

This conceptual research paper will provide a data driven analysis on Supply Chain Management(SCM) particularly for Automobile Battery Industry in India and deliberate on a fundamental question such as "How Organization can derive value from IoT enabled SCM" ?

Research methodology adopted in this study involves review and analysis of the similar research articles. Data is collected from one of the largest market research institutes and leading battery manufacturers in India and face-to-face meeting with various stakeholders, Government reports, balance sheets and internet blogs etc. subsequently statistical analysis of the collected data is done to conceptualize the right supply chain strategy and extract value for customers as well as organizations.

Keywords: *Supply Chain Management, Automobile Battery Industry, Internet of Things, Value creation.*

1. Introduction:

Supply Chain (SC) is an integrated business process that deliver the finished goods or related services to the end consumers from the manufacturing plants and movement of raw materials for production. SC has five fundamental phases like (1) Sourcing (2) Making (3) Delivery (4) Return (5) Planning. Supply Chain Management (SCM) is concerned not only with the Material flow, but also the Information flow and Cash flows. These flows may occur in both directions. In the fast-changing digital world, Customer's needs drive the

design of the supply chain for any organization [20,3]. Well informed and value conscious customers' want to make use of high speed, real time information to improve quality of their life and therefore look for smarter products in the marketplace. The key objective of any SC is "To Maximize the Total Value generated by the Supply Chain" where 'Total Value = Benefits Enjoyed by Customers – Costs incurred by the SC'. This Total Value is positively correlated with the bottom line of the organization. In SC, only one source of revenue i.e. Customer. The value of the final product is calculated as "Supply Chain profitability = Revenue generated from customer – Overall cost across the supply chain" [20,7,9]. Companies must revisit their supply chain strategies and make course corrections to realign with the (a) **Current Market Realities** – e.g. Customers desire for extended battery life and faster storage, Integration with electronics with energy storage and Regulatory changes like GST & Emission norms & Introduction of Electrical Vehicles etc. in India (b) **Customer Experiences** – To be the best value-for-money choice and strengthen the loyalty earned through decades of experience. (c) **Trending Technologies** like Artificial Intelligence, Internet Of Things, Industry 4.0 , Big Data Analytics etc. Customers experiences are the new battleground for companies who are seeking competitive advantage. There is a **paradigm shift of competition** from **'Organization against Organization' to 'Supply Chain against Supply Chain'**. Firms that are first to deliver better customer experiences with the help of cutting edge technologies will have an edge and will be able extract more value from the value conscious consumers [13,17,18].

The research paper will try to address today's Supply Chain Challenges:

Companies everywhere face issues like [7,11,13,14]:

- Managing the full customer experience and volatile demand
- Heightened expectations for responsiveness
- Supply chains grow more complex and extend their reach across the globe
- Disconnected data sources and processes
- Ad-hoc collaboration over Email, Excel
- "Siloed" planning decisions without considering constraints or profit
- Difficult or impossible "What-if" scenario modelling

1. Current Market Reality in the Energy Storage Solutions [7,11,13]:

The lead acid battery industry is being driven by the following factors:

- **Customers' Want:** End consumers desire for extended battery life, faster storage, minimum maintenance, proactive service and pressing need for higher storage efficiencies with lightning fast empty to full charging [13].
- **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.

- **Trending Technologies**: 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 [10].

2. Challenges by the stakeholders in the Value Chain of Automobile Battery Industry:

Challenges and concerns of the stakeholders in the supply chain are summarized in the following paragraphs. This research paper attempts to address some of the concerns that may help create enhanced value to the retail customers [7,11,13-15,17-20]:

Customer:

The customers need to do registration of battery serial no. and have warranty information, have visibility of remaining charge and time to discharge of the battery, raise requests, complaints with status updates, get visibility of battery state of charge/heath. They also need to get proactive alerts for the charge/discharge initiation for extending the life of the battery. Finally, they should also get auto-reminders for up to date data download and renewal of service contracts.

Dealer:

Dealers need to get insights for proactively reaching out to customers for replacement. They also need to have access to remote diagnosis.

R&D Engineer:

R&D Engineers need to benchmark the installation performance data for faster diagnosis and root cause analysis and also get warranty claim insights. Additionally, they also need to incorporate product performance and warranty data for product improvement, product design etc.

Service Center In-charge:

Being in-charge, he should have the battery health visibility, proactive services delivery and faster turnaround of customer requests.

Service Technician:

Service Technicians should be able to install data capture at site and also have Geo Tagging of installation location. Additionally, they must have battery health visibility, remote diagnosis and be able to capture installation periodic test and inspection data.

Sales and Marketing:

Multiple tasks are allotted for the Sales and Marketing team. They need to retain customers by proactively reaching out for life based replacement, have inventory visibility, proactively reach out to customers for AMC service contract renewal etc. They need to segment the customers based on the usage information and other attributes, offer pay per use and premium services model, proactively reach out to the customers for upsell/cross sell opportunities. Finally, they need to offer right product at right price and point to the right customers for increased sales.

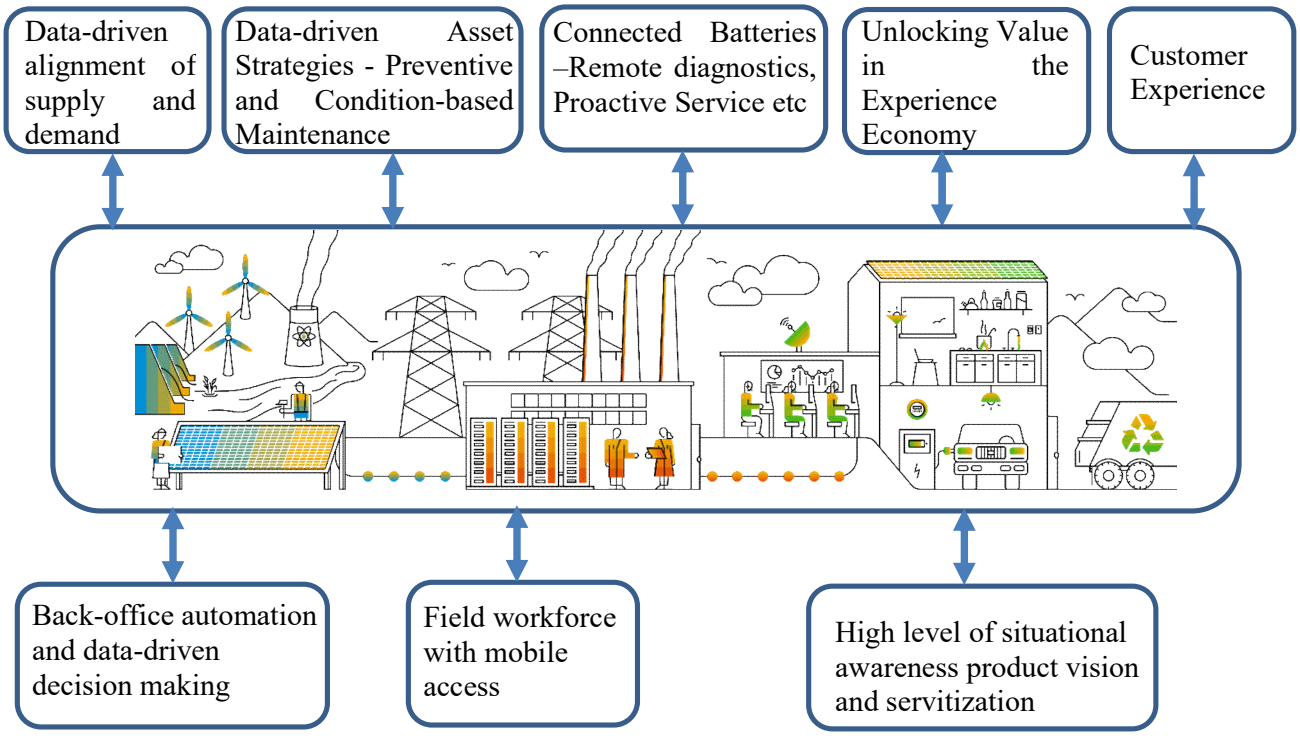
SCM:

Head of SCM would like to identify causes of high time and cost of transportation of battery from customer location to service centre for warranty claims. They need to forecast the demand on monthly basis based on different factors like - historical sales data, current inventory, due date of delivery, delivery location, weight of battery, truck capacity etc. for optimization of load and route.

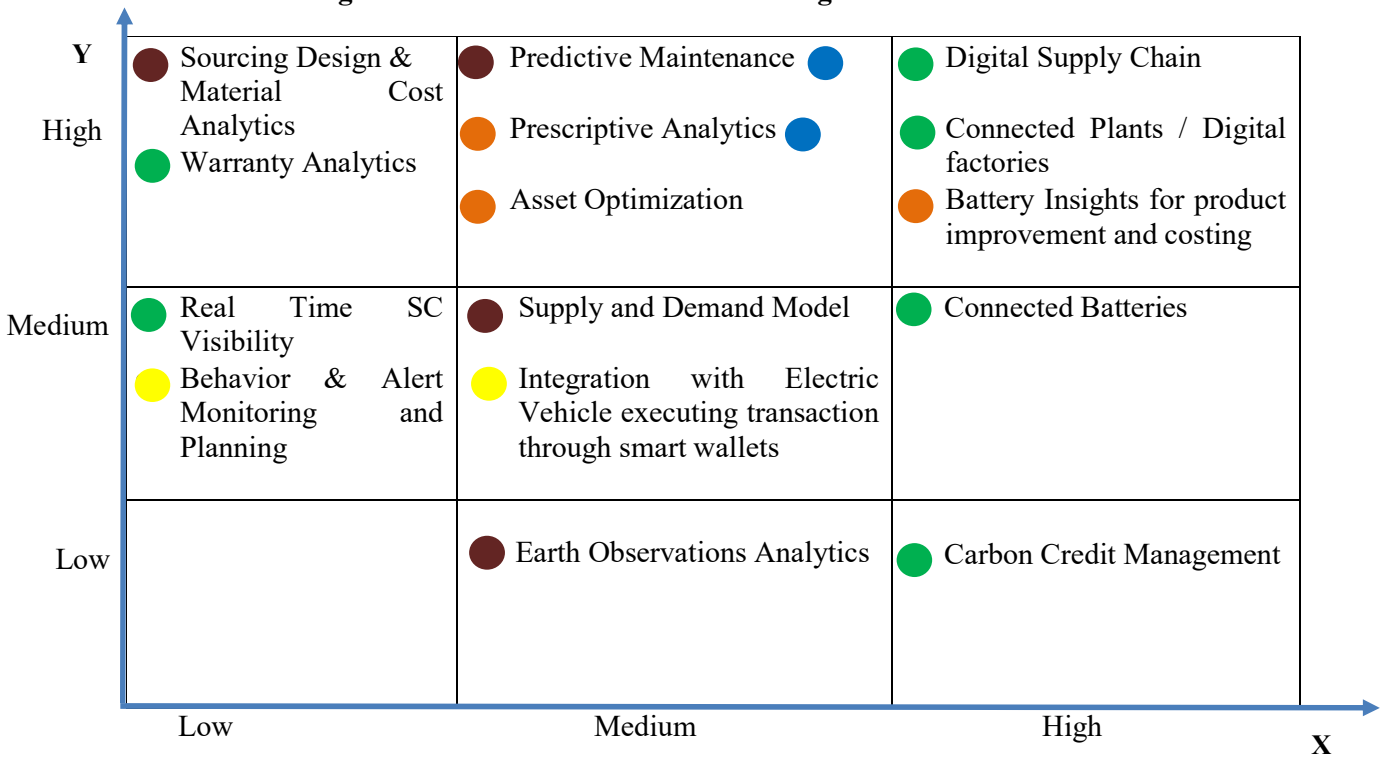
SCM solutions are increasingly becoming SMART and INTELLIGENT with Big Data implementation, IoT Infrastructure, Advanced Analytics, Data Mining & Business Intelligence, Business Processes

Reengineering, Digitization, Automation, Collaboration with strategic partners (vendors & customers), Integration with Information Technology. The new SSCM will help organizations for achieving cost reduction, efficiency improvement, new-age customer experiences [8-10].

3. Reimagining Value Chain [13,18]:



Value Chain: Strategic Drivers Matrix & use of Technologies :

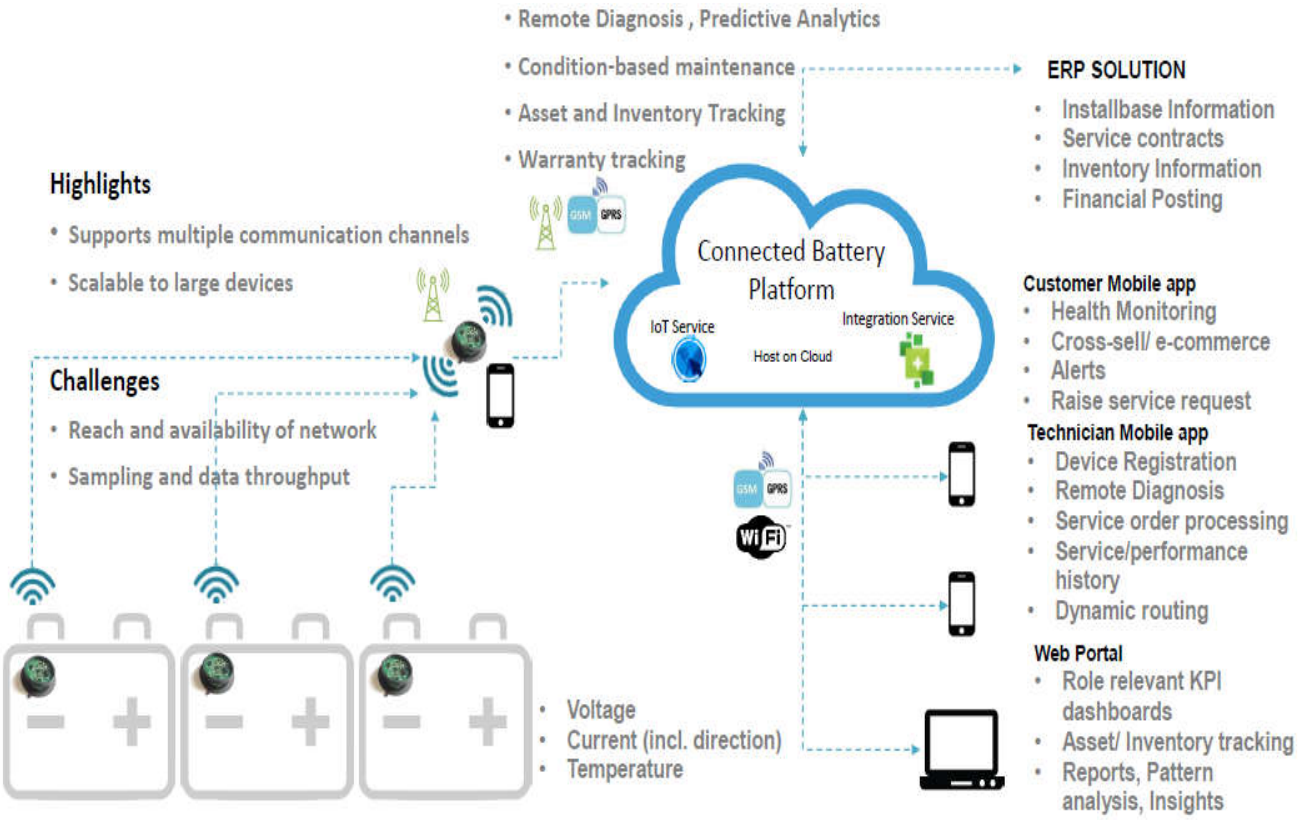


X - Axis: **Time to Action** , Y – Axis: **Impact on Business**

Technology Legend:

- Machine Learning capability
- Internet Of Things (IoT)
- Big Data
- Predictive Analytics
- Blockchain

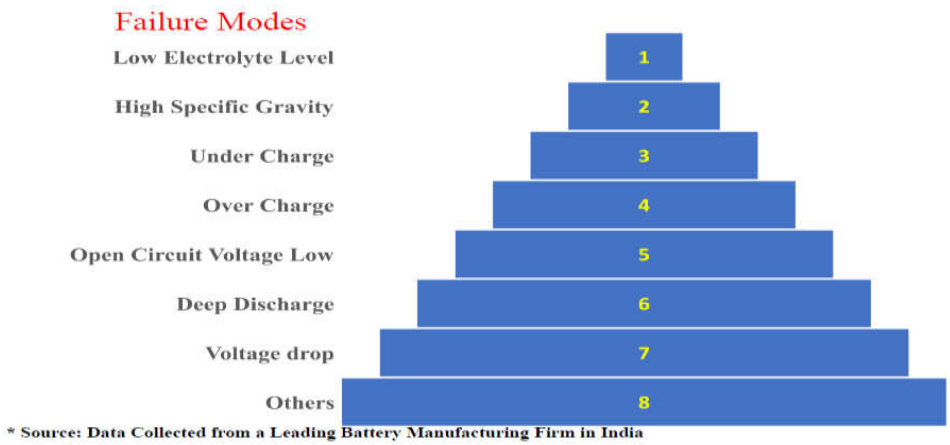
4. Block Diagram of Connected IoT enabled Smart Battery [13,18]:



5. Value Creation in the Value Chain: How IoT Product reinvents SCM ?

a. New-age Customer experiences [13]

In India, most common causes of failure modes in Automobile segment are Low Electrolyte Level, High Specific Gravity, Battery under charge and overcharge. The graphical representation (Rank Analysis) of failure modes are as below:



* Source: Data Collected from a Leading Battery Manufacturing Firm in India

The IoT enabled battery will offer to customers by providing the visibility of back-up remaining, battery health status, state of charge , notification for discharge and specific gravity etc. as pro-active service.

b. **Better Maintenance Practices**: Every SC relies on the health of equipment. When a machine like factory equipment or logistic vehicle breaks down, it can create inefficiencies in the Supply Chain. One can address this issue with the help of IoT sensors. Smart IoT sensors can collect data and is then analyzed to predict issues. These predictive analytics help companies to save money by preventing expensive equipment failures. Also, would be able to extract value for Customer by providing right time delivery.



c. **Asset Tracking**: With the help of Asset Monitoring Tool, Firms can increase the Supply Chain efficiency. By introducing IoT sensor, battery location is tracked using linkage to GSM. The Asset is tracked against user, region, state etc. Sensors can be used to provide the status updates and alert notifications for items based on monitoring workflows. The last known location, its history of movements and time in each area can log and record. It shall be possible to geo-fence and the breaches are to be alerted to marked users.

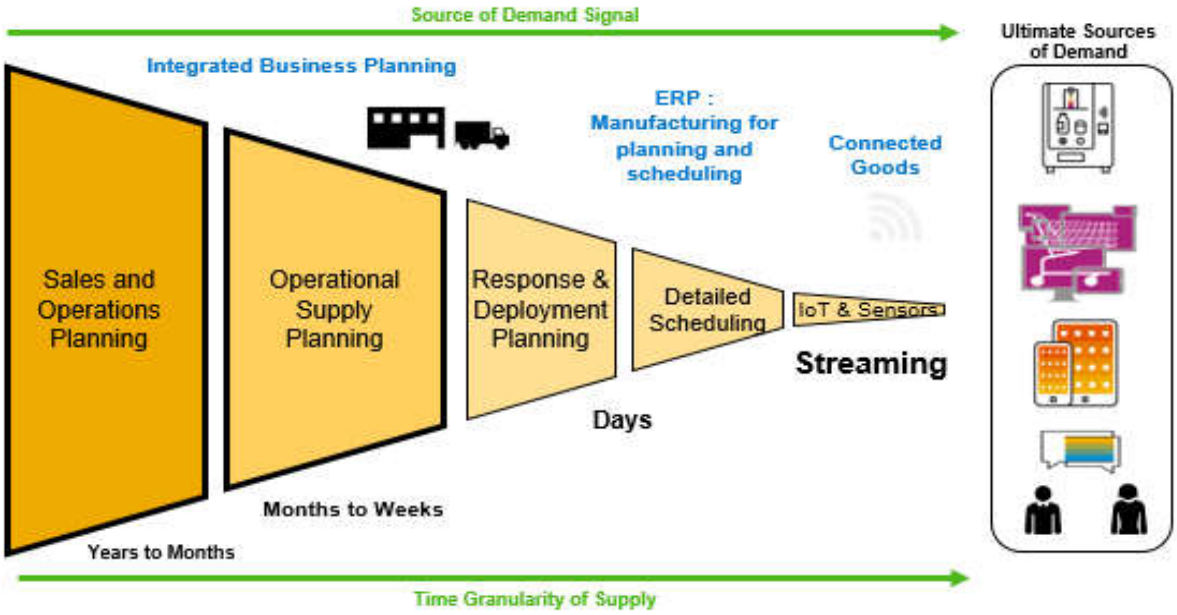


d. **Improved Inventory Practices**: Collecting historical sales data, usage pattern, geography, price points, category of battery bought etc. into an Enterprise Data Warehouse platform, one can forecast the demand of batteries using statistical tools or machine learning based models which could help production planning and reduce the average inventory storage time.

e. **Enhanced Collaboration and Market Share**: Gain significant competitive advantage in the automotive batteries segment by being the first to Go-to-Market with Intelligent Connected Batteries concept. Leverage Intelligent batteries concept to differentiate vis-a-vis competition and gain opportunity to charge premium pricing for batteries in same market segment.

f. **New Business Model / New Line of Business**: Connected batteries will introduce new posibilities for innovative sales and marketing techniques. By taking advantage of newfound data, firm can provide personalized services to their customers. As the concept evolves, Organization can look to the launch a completely new line of business – Provide batteries on pay by use model, charge for units of power consumed or pay per mileage.

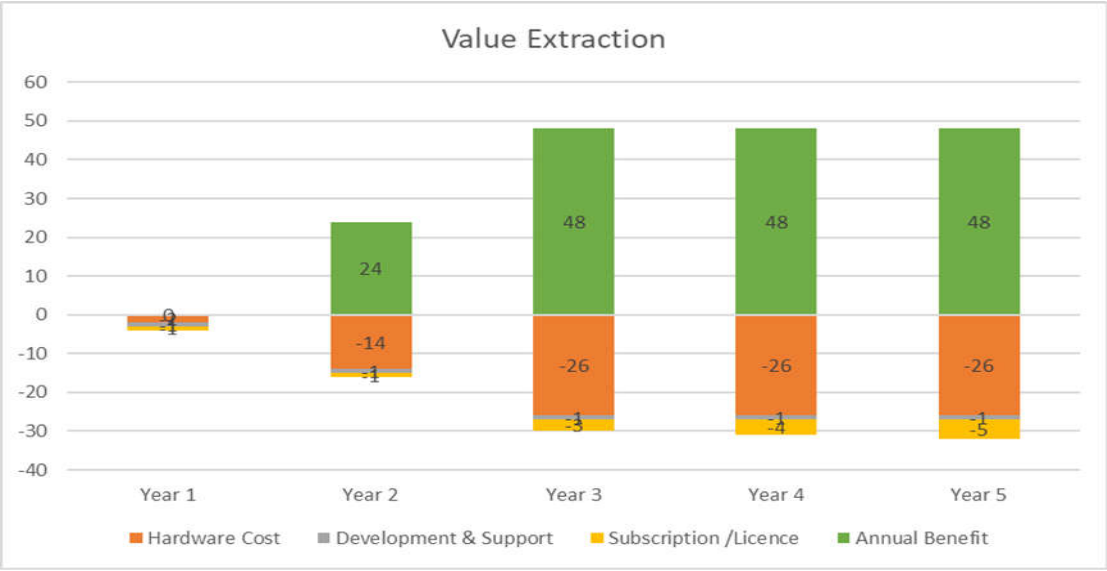
g. **End-to-End Supply with Digital Response and Supply Management** [www.sap.com]:



h. **Value creation** : Yearly Cost and benefits analysis [14-16,19]

Projected Figures (Rs. In Cr.)	Year 1	Year 2	Year 3	Year 4	Year 5
Sales (Revenue)	4 (8k Nos.)	40 (80K Nos.)	78 (156K Nos.)	79 (158K Nos.)	80 (180K Nos.)
Hardware Cost	-2	-14	-26	-26	-26
Development & Support	-1	-1	-1	-1	-1
Subscription /Licence	-1	-1	-3	-4	-5
Total Cost	-4	-16	-30	-31	-32
Annual Benefit	**0**	**24**	**48**	**48**	**48**

Assumptions: (1) Data collected from Leading battery manufacturing companies in India (2) Averag Cost (Hardware, Development & Support etc.) taken from leading software vendor in World and leading IoT manufacturer in India (3) Average battery selling price (Automobile) = Rs. 5000/- per battery.



- Pay back Period ~ Year-2

6. Conclusion:

The use of IoT devices is still in the evolutionary stage and adoption is limited to a few application areas in India. This research paper is based on data collected from leading battery manufacturers in India and limited to a segment i.e. Automobile primarily in aftermarket. Through the analysis and results showed that there are potential benefits in the Supply Chain. But our findings may not be applicable for other industries and global market. Nevertheless, the concept can be used for other segments like Lithium Ion , Inverter and e-Rickshaw etc. [1-3]. Organizations may face challenges to consider this IoT technology. Many different technical options are available in the market to deploy end-to-end IoT solutions, including network infrastructure, sensor devices, cloud platforms and integration with other back office processes. Security and compliances are another important consideration. IoT sensors will generate huge volume of data. Processing of such volume of data would be a major challenge. Battery Manufacturing firms of India may use this concept to benchmark their performance in terms of new-age customer experiences as well as the performance of the Supply Chain Management which is essential to sustain in the current volatile and consumer driven markets [4,10,12]. With the introduction of IoT , Firms can move towards intelligent or self-running enterprise by providing three key capabilities (a) Visibility and Transparency across the SCM (b) New-Age customer experiences through Proactive Services (c) Agile SC to empower business [5-7,9-10].

SCM has a vital role for the success of any organization. They should re-visit their supply chain at regular interval and take the corrective actions. The key success of SCM is to make the balance between responsive and efficient SC i.e. Strategic Fit.. The IoT based SCM will help overcome the challenges like (a) Demand and Supply uncertainty (b) Market reality and external threats (c) Trending technology (d) Sustainability etc. [12,19].

In conclusion, this research paper is presented as a guideline to develop the strategic decision making framework in the area of Supply Chain Management.

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] Jones, B. B. *Material demand for batteries and potential supply constraints*. IEA Seminar on e-Mobility, March 7, 2018.

[3] 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.

[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] 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.

[7] Chopra, S., Meindl, P., & Kalra, D.V.(2016). *Supply Chain Management – Strategic, Planning and Operation.* Bengaluru, Karnataka: Pearson India Education Services Pvt. Ltd.

[8] 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.

[9] Moniruzzaman, M.,Kurnia, S., Parkes, A., & Maynard, S.B. *Business Intelligence and Supply Chain Agility*. Australasian Conference on Information Systems, Adelaide, South Australia .

[10] Trkman, P., & Ladeira, M.B. (2010) . *The Impact of Business Analytics on Supply Chain Performance*. Decision Support Systems , 49(3), 318-327.

[11] Lee, I. , & Lee, K.(2015). *The Internet of Things (IoT): Applications, investments, and challenges for enterprises*. ScienceDirect: Business Horizons,58, 431-440.

[12] Alam, A.I., Rahman, M., & Subho R.H. (2018). *IoT Based Supply Chain Management*. BRAC University, Department of Compter Science and Engineering.

[13] 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: Uttkarsh Prakashan., 256-264.

[14] Hofmann, P. , & Reiner, G.(2006). *Drivers for Improving Supply Chain Performance an empirical Study.* International Journal of Integrated Supply Management , 2(3).

[15] Gandhi, J., Shah, D.A. , & Kamath, S. (2018). *Batteries: Huge Opportunities, but challenges too.* Motilal Oswal .Mumbai. Retrieved from https://www.motilaloswal.com

[16] 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.

[17] Alam, A.I., Rahman, M., & Subho R.H.(2018, April) *IoT Based Supply Chain Management*. BRAC

[18] Pradhan, S., Bhattacharya, S. & Goswami, R.T. (2019, July). *Conceptualization of an efficient Supply Cain for Automobile Battery Industries in India.* New Paradigms in Global Business & Research, Apeejay School of Management and School of Business, Thomas Jefferson University, New Delhi: Excellent Publishing House, pp. 7-17. ISBN: 978-93-86238-74-0.

[19] Mengru, T., Ming, L, & Yang, M. (2018). *IoT-based production logistics and supply chain system-part2: IoT-based cyber-physical system: A framework & evalution*. Industrial Management and Data Systems, https://doi.org/10.1108/IMDS-11-2016-0504.

[20] Chase, R.B., Shankar, R., & Jacobs, F.R. (2014) . *Operations and Supply Chain Management.* Chennai, TN: McGraw Hill Education (India) Private Limited.