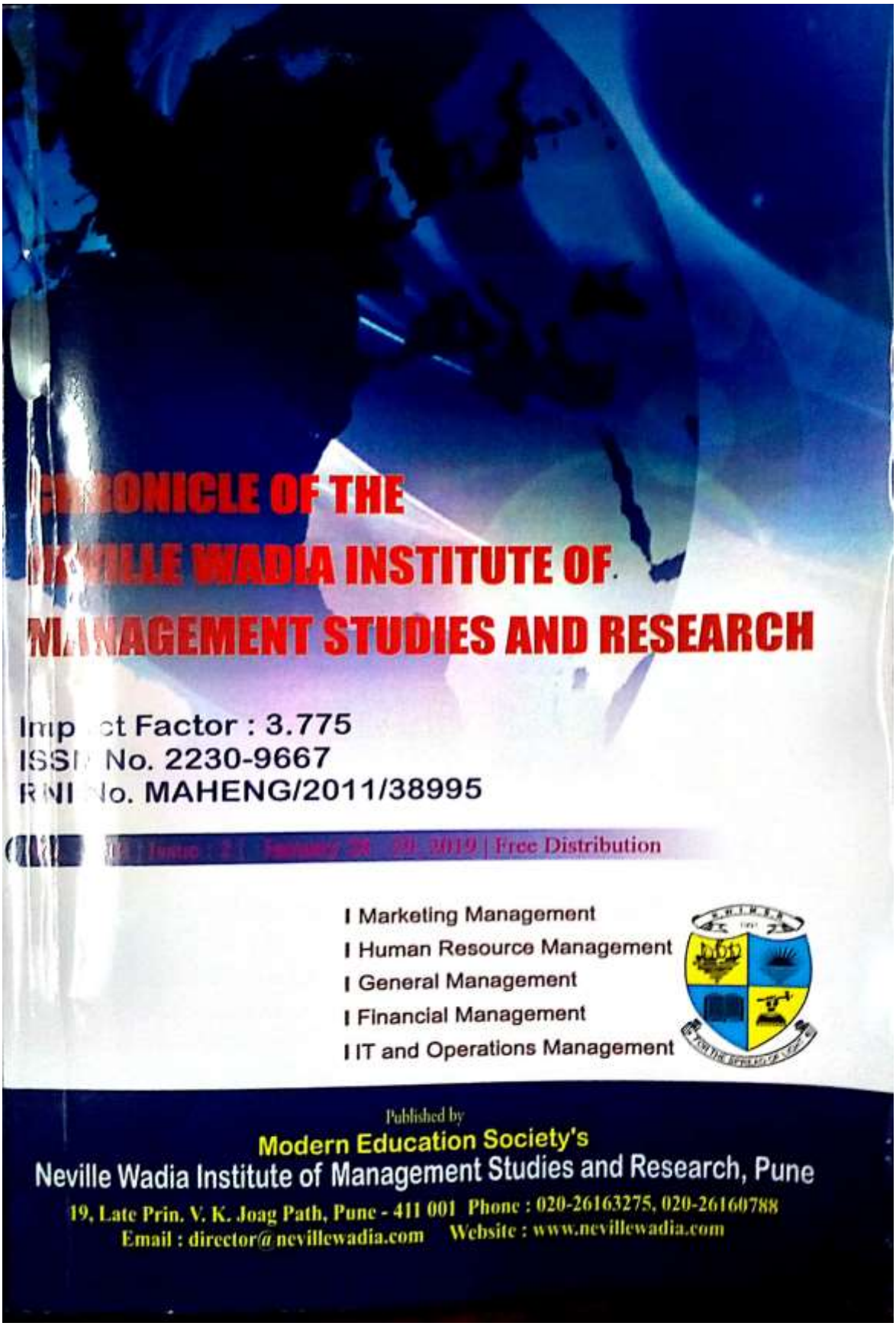

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INDUSTRY 4.0 WILL CHANGE THE RULES OF THE GAME IN INDIAN AUTO ANCILLARY INDUSTRY, A STUDY INTO FUTURE PROSPECTS

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ABSTRACT

Now a days Industry 4.0 is a buzz word in Indian industry. This is also known as Smart Manufacturing or Fourth Industrial Revolution. This topic has gained a lot of attention from industrialist, professionals as well as researchers. It is believed to have potential to transform end to end supply chain operation starting from designing of product, its manufacturing and delivery to end customers. This paper is about exploring the potential for the same as its implications can change the rules of the game. Whole focus is on throwing the light on unexplored topic of Industry 4.0 for Tier-1 supplier for their end to end operations. It is apparent that understanding and deployment of Industry 4.0 in Indian auto ancillary industry is still in nascent stage and hence there is lack of understanding. Indian industries also far behind in implementation as compared to industries in European countries. Firstly, focus is on explaining the drivers and barriers of Industry 4.0 in India. The study demonstrates the potential implications from Industry 4.0 for all functions within a supply chain. Practicing managers and researchers can use the scenarios as a reference to automate and digitize their supply chain.

1. Introduction:

Creating customer value is the main goal for the enterprise survival and this helps in alignment for achieving superior financial performance. Traditionally marketing was considered as custodian of this value alignment however this was supported by operational functions, conventionally that were not the associated with marketing like supply chain management. In fact, the marketing function is must to maintain the momentum with volatile market and exploring the most valuable product and service proposition. On the other hand, supply chain management (SCM) function is responsible for delivery the product/services at the right time at optimum cost. The main challenge for SCM function is to balance cost and service. It is very important for any organization to integrate and collaborate marketing and SCM functions to balance demand and supply situation.

There are many firms that have created competitive advantage by creating interface between marketing and SCM. Yet the current organizational practise still lacks a comprehensive understanding of the tools supporting the information processing mechanisms that allow serving customers with the appropriate products, while reducing

the constraints that emerge throughout supply chain transactions. The key success between these two internal functions and external customers is the exchange of market and product fulfilment related real time information. Information processing mechanism are considered of foremost importance to effectively manage the interface between SCM and marketing processes.

2.Literature review:

Industry 4.0 is the current buzzword in industry (Hermann et al., 2016). In recent years, organizations are seeking to adopt sustainability aspects in their business activities (Mangla et al., 2015; Govindan et al., 2016; Luthra et al., 2017; Sarkis and Zhu, 2017). On the other hand, industries are struggling to fulfill the continuously changing preferences of customers along with ensuring a sustainable evolvement in business (Stock and Seliger, 2016). These technologies including Industry 4.0 significantly transforming the behavior of supply chain management (SCM) (Tjahjono et al., 2017). Industry 4.0 based sustainability-oriented concept helps industrial managers not only to incorporate environmental protection and control initiatives but also to couple process safety, such as resources efficiency, employee and community welfare, smarter and flexible processes measure in their supply chains. The fourth industrial revolution provides tremendous industrialization growth, but may also disturb the sustainability of current industrial systems (Hermann et al., 2016; Liao et al., 2017). This may further cause earth ecological imbalance in terms of higher resources consumption, global warming, climate change problems, and higher energy requirements (Tseng et al., 2018). In addition to this, rapid industrialization also contributes to degradation of health and safety of workforce. In this sense, industrial production systems need to be balanced environmentally, socially and economically in employing modern technologies. The majority of studies on Industry 4.0 considered the manufacturing sector context and ignored the supply chain system. Industry 4.0 initiatives transform a production system and supply chain into a smart production system largely based on cyber physical interaction of connected elements. This allows business process and activities to integrate and making manufacturing system more flexible, economical, and environmental friendly (Wang et al., 2016). Form an organizational supply chain context, Industry 4.0 involves several challenges like data quality and credibility, unemployment, complexity issues, less human control, and higher negative environmental impacts. Hence, rigorous research is needed to address sustainability implications in Industry 4.0 based smart industrial value chain systems (Sarkis, 2012; Schmidt et al., 2015; Stock and Seliger, 2016; Waibel et al., 2017).

3. Barriers of Industry 4.0

1. **Employment Disruptions –**
   It is defined as the disruptions brought in the employment due to the emerging technologies and automation. Current jobs in the manufacturing sector are prone to be automated resulting in human job losses. The residual manufacturing jobs will comprise more knowledge work as well as more short-term and hard-to-plan tasks.
2. **High Implementation Cost –**
   This refers to the capital expenditure which the organizations will have to incur for developing the industry 4.0 infrastructure in their organizations. Industry 4.0 is

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difficult to adopt in small and medium industries as there is a lack of fund for appropriate technologies. Emerging technologies such as IoT, always carry a noteworthy threat for investments to organizations as there can be potential financial losses and no recovery of investments.

3. **Organizational and Process Changes –**
This refers to the process changes which will be prompted due to the advent of CPS and smart factories. Organization functions may change owing to automation Industry 4.0 will give rise to decentralized organizations. Decision making will lie at the shop floor level. By far and large, IoT applications and solutions, despite being beneficial across industries carry significant challenges which pertain to the internal and external integration of vertical, heterogeneous, and closed systems. These are recognized as significant concerns for most of the enterprises.

4. **Need for Enhanced Skills –**
With the implementation of the Industry 4.0, the skills and qualifications of the workforce will become the key to success of a highly innovative factory. The companies should be focused on the development of qualified workforce by the Human Resources Management. Efficient design and deployment of IoT solutions require a lot of prerequisite knowledge which cuts across various technical and non-technical disciplines.

5. **Lack of knowledge management systems –**
Knowledge management systems refer to information technology systems that store and retrieve knowledge, improve collaboration, locate knowledge sources, mine repositories for hidden knowledge, capture and use knowledge, and enhance the knowledge management process. Knowledge management can benefit by embedding IoT and processing incoming big data collected from IoT devices [60] however; the existing systems may not handle the real-time data. Comprehensive technical skills are needed to switch from operational to more strategic tasks. Shortly, there will be demand for data analysts who will create value through optimization and forecasting.

6. **Lack of clear comprehension about IoT benefits –**
IoT is defined as the network of physical devices embedded with sensors, electronics, software, sensors, actuators, and connectivity for sending and receiving data. No doubt the adoption of IoT in new businesses is related to potential financial gains. On the contrary, enterprises must have a clear-cut understanding regarding the nuances of IoT deployment, i.e., of value creation, delivery, and capture. Enterprises should evaluate the variances accordingly if they are to consider the business model with IoT applications. Several applications and technologies from IoT are still in the initial development stages. There lies an uncertainty in the potential cost-benefit expectations that may be derived from the deployment of IoT. Hence, IoT deployment is deemed as a crucial encounter faced by most of the industries.

7. **Lack of Standards and Reference Architecture –**
The design and selection of an Industry 4.0 architecture for different applications have been a significant challenge particularly if we consider wireless sensory

network. As the concept of industry 4.0 is new, there is a lack of standards and reference architecture. For example, the formation of efficient IoT architecture throughout supply chains involving objects, network, data services, and applications layers is perceived as a significant barrier to successful IoT adoption.

8. **Lack of Internet coverage and IT facilities –**
   Refers to the lack of IT infrastructure that is required to support the Industry 4.0 implementation. IoT plays a vital role in Industry 4.0 framework. Lack solutions for effective communication and signal coverage may act as a significant blockade for various products/ services. Signal attenuation occurs due to weak signal coverage in certain manufacturing premises.
9. **Security and Privacy Issues –**
   There is a huge amount of information flow that occurs on the Industry 4.0 platform posing cybersecurity threat and data privacy issues. Virtual work on servers or platforms obligates employees to be aware of cyber security. A critical aspect of the CPS is cybersecurity. CPS is more susceptible to cyber-attacks with the recent advancements in IT. Cyber-security risks related to verification, authorization, privacy, access to the system, applications, network, and data remain significant challenges for the organizations.
10. **Seamless integration and compatibility issues –**
    These are the issues which may arise while upgrading the existing machines and equipment for the industry 4.0. Establishing seamless integration and interoperability between different technologies and network systems is one of the significant barrier associated with the adoption of IoT solutions to create a cyber-physical infrastructure of IoT ecosystems.
11. **Regulatory Compliance issues –**
    Regulatory compliance refers to the goal that organizations seek to achieve in their efforts to ensure that they are aware of and take essential steps to comply with applicable laws, policies, and regulations. Organizations need to have stricter rules in place for IT security, working with the machine, or working hours.
12. **Legal and Contractual Uncertainty –**
    Digitalization poses a challenge for the law as the competition gets fierce. Laws about data protection, liability for artificial intelligence, standardization must be considered while deploying a digital strategy. Without a legal personality, the virtual organization does not legally exist and so cannot be identified as a legally independent entity. Every virtual organization that uses ICT needs to guarantee that by transferring data online they do so in a secure manner, and they do not infringe privacy regulations or that the contracts concluded are valid and enforceable.

4. Drivers of Industry 4.0

1. **Data** - An influx in the use and subsequent abundance of data can be attributed to the advancement of Industry 4.0 and has called for businesses to review their systems. The rise in data volumes has led to the coinage of the term "big data." This has caused a greater need than ever for companies to store and gather information and, in doing so, make better use of it. Organizations are now making use of

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historic data with advanced analytics, thus enabling cognitive machines to self-diagnose and configure. The use of cyber-physical systems to detect issues increases productivity and quality. Businesses are also turning to smarter energy consumption by using product life-cycle platforms and cloud computing.

2. **Connectivity** - The age of economic globalization has also been a driving factor in Industry 4.0. Global supply chains are becoming increasingly common but are accompanied by efficiency issues due to distance and time zones. The Industry 4.0 solution for this is to create a virtual global factory — a network of businesses from multiple regions that can resolve issues of connectivity between companies and for the relationship between the customer and the supplier. The increasing use of technology such as remote database access (RDA) and radio frequency identification (RFID) to collate and distribute information supports the concept of the Internet of Things as a potential global digital infrastructure.
3. **Customer** - The end customer's evolving needs have also energized Industry 4.0. Innovative technology, such as 3-D printing, enables the conversion of a digital design into a physical product. This is rapidly materializing at an industrial level. Consequently, products can become customized to the individual, though they are made at a mass production level.
4. The use of a digital system to design and create products creates flexibility for both business-to-business transactions and the end user. The combination of the customer's human input and dynamic data analysis and response may mean that in the future a digital ecosystem will be created whereby human decision is augmented through algorithms.

5. Industry 4.0 : Implication on end to end supply chain for Tier 1 supplier

Every organization consists of three interactive and highly interdependent components: people, process and technology. It is the interaction between these three variables that determines the success of organizational changes. While the variable "people" obviously refers to the human domain within an organization and Industry 4.0 is going to help in reducing the impact of human factor on process variation and output to an extent by digitization and automation.

Any tier 1 supplier is having following process steps:

Figure 1: Standard Process flow in auto ancillary Industry

Car manufacturers rely on the information and visibility provided by their suppliers to plan their own production as well as dispatches to the dealers. It is imperative to have accuracy and real-time data availability for suppliers to run their operations effectively and efficiently.

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Below table illustrates how processes may be impacted by Industry 4.0.

Process	Industry 4.0 Scenario	Impact on current process
Customer Order Management	• Increased connectivity • electronic data interchange • Order placement portal	• Order receipt at the real-time basis • No communication error and delay. • Order life cycle can be maintained and viewed as per requirement
Production Planning	• Increased traceability of material and components that are equipped with Bar code or auto ID technology • Production planning and execution may be far more accurate as this will be planned on current state and visibility of future material receipt as well as customer requirement. • Point of sale data may be can be shared with all relevant members and this real-time data will help to align their current production plan	• Real time visibility of inventories across the supply chain will enable relevant stakeholders to optimize their resources. • Actual production against the production plan can be tracked remotely via mobile and this will allow to build more agility in the chain. • Production planning will become automated with integrated Enterprise resource planning. • Since consumption data is transmitted on real time basis in continuous manner, supplier will get time to respond and react proactively. This will increase supplier flexibility and agility in case of sudden changes in the demand signals. • When suppliers and customers can communicate directly on real time basis, cyber physical system will initiate production at both sites without any human intervention.
Procurement	• eProcurement is the next level from ERP • eProcurement is not only limited to use of technology for operative procurement but this also has another	• In auto sector, suppliers are enforced to get connected through EDI, however due to lack of IT infrastructure and unease of working with automated system, still there is

	dimension of e sourcing for tactical or strategic procurement task like e auction. • The contribution of Industry 4.0 can be considered as free flow of information between supplier and customers with the extent of implementation of lean electronic procurement concepts like electronic Kanban or Just in time /Just in sequence. • The "free flow" on the other hand implies a much higher degree of exchangeability of data itself, more automation of the information exchange at real time and possibly integrated use of the data under the concept of "big data analytics".	struggling to implement with complete supplier base. • Demand will be transmitted digitally and E Kanban will be used extensively to recognise short term demand and fill level. • E Kanban may be deployed using sensors or electronic way of data exchange. • Mid-term requirement will be shared with relevant stakeholders using MRP output whereas short term information may be fed directly into material planning system. Kanban signal may be transmitted on real time basis. • This real-time requirement and inventory sharing will help to optimize inventory across supply chain as well balancing manpower required for managing procurement.
Warehousing	• Industry 4.0 technologies not only improve productivity, increase capacity and lower costs, but they are inherently easier to adopt operationally. • OEM's as well as suppliers are opting for third party warehousing operations. • Warehousing service providers are providing state of art facilities along with automation. • These include warehouse management system, randomized warehousing with conveyors, automated guided vehicles and robotization to an extent. • Industry 4.0 technologies are	• Fixed and flexible automation: automated storage and retrieval systems (AS/RS) and carousel goods-to-person systems are part of fixed automation and mobile robots are part of flexible automation. This will increase productivity as well as accuracy of warehouse. • Automation will bring followings: • Enable greater operational flexibility • Reduce operational costs • Drive more modular and adaptable automation • Warehouse consolidation and automation will bring operational cost down and

	flexible, scalable, and responsive to changing market conditions.	inventory accuracy up.
Packaging	• Automotive industry is poised to move towards returnable packaging and many suppliers have already initiated for returnable packaging. • This is treated as bill of material, unless packaging is available in the factory. • Digitization and automation can help in providing the real-time inventory status as well as current location of packaging. This will bring visibility in aligning their production plan.	• At high level, industry may more towards mass implementation of returnable packaging. This will bring down their packaging cost as well as carbon foot prints. • Using RFID technology real time information regarding packaging can be made available for packaging. • Currently manual stock tracking will be digitized with the help or RFID or Bar code.
Delivery & Logistics	• Due to the increased visibility and digitization of material flow, delivery processes can be synchronized with demand signals and supply plan. • This will be helpful in case of wide variety of products with different cycle time. This will make milk runs more optimum based on demand driven not time driven. • Internal material flow will also be impacted by incorporating high flexibility and real time delivery on assembly or production location.	• Current delivery process in auto sector is little fragmented in terms of full container load and less than container load (LCL). • Synchronization in demand and supply will help to optimize container load. • Current milk runs will become more dynamic in terms of accommodate demand signals. Real time location of containers will be available with the implementation of technology like RFID. • Drivers will be assisted by traffic situation, which will allow them to choose optimum route.

6. Discussion:

Industry 4.0 will bring revolution in overall supply chain management. Automotive industry which is more synchronized with its suppliers, will be benefited with this initiative. There is no replacement of human intervention for strategic decision making, however operational level will be more autonomous. In auto ancillary industry, the

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degree of automation and autonomy at operational level will increase in coming years, as they are yet to experience and evaluate impact of industry 4.0 on overall operations. Human intervention to operation will have limitation to monitoring activities. It is unanswered question whether changes at operative level will have impact on strategic level or not.

In future supply chain members are expected to coordinate more efficiently and they are expected to loosely be connected into cross network using cloud based ERP. The efficiency and flexibility of the network will increase. In automotive industry, integration of suppliers and service providers are existing to an extent, therefore gain against 4.0 and investment needs to analysed properly, so that it not raises any concerns in the mind of suppliers. Logistics service providers and suppliers needs to have very high level of trust between them as well as with OEM's to leverage maximum benefits from industry 4.0 initiative across their supply chain.

Figure 2 illustrates that Digital strategy,Technology, Information management and Process Innovation may act as enablers and it is expected to bring improvements in the cost as well as service level across supply chain.

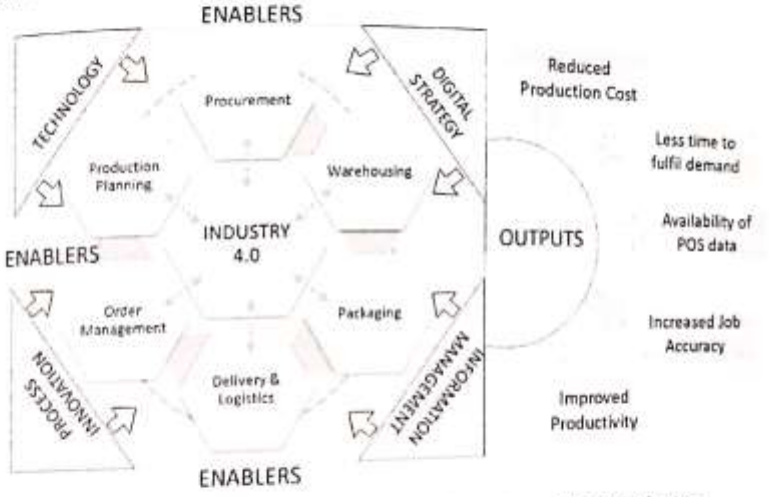

Figure 2: Impact of Industry 4.0 in auto ancillary Industry

7. Conclusion & Limitations:

Industry 4.0 is in nascent phase in India and same is the case with auto ancillary industry. Based on literature review, Industry 4.0 can be described as decentralised, almost human free manufacturing system. The enablers for creating human free environment are IOT, cloud computing, additive manufacturing, smart factories etc. Industry 4.0 technological enablers as well as drivers and barriers are also discussed so as to provide complete theoretical perspective to working managers.

Integrated and smart supply chain can expect real time demand assessment with dynamic and optimised procurement with shorter procurement lead time with the help of dynamic milk route.

Decentralized supply chain is also expected to reduce bullwhip effect and improved production planning based on real time demand data signals. In future, auto ancillary supply chain is expected to undergo radical transformation using Industry 4.0 which will bring real time information flows, transparency and ultimately end to end value creation.

Current study is based on literature review and theoretical understanding of Industry 4.0. Focus was limited to holistic supply chain rather than automotive supply chain. Present study is not able to make universally valid statements about how Industry 4.0 will impact auto ancillary supply chain. Study was more concentrated to potential and opportunities of Industry 4.0 but investment and recurring cost were not the part of this study.

In future, study should be able to provide framework and roadmap for implementation of Industry 4.0 in auto ancillary industry. Cost benefit substantiation would further help in decision making regarding implementation.

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