E-commerce, Industry 4.0, & Transportation – Identifying the Potentiality & Problems.

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Abstract

Mobility is always been an important and integrated part of human civilization. It supports social, cultural, & economic interaction. However, amid the COVID-19 pandemic, mobility has been restricted due to fear of coronavirus, and therefore home delivery services started playing a vital role in contributing to economic activities. That led to manifold growth of the E-commerce business. This has significantly affected urban mobility and travel demand. And it is safe to believe that this e-commerce approach will continue to grow even after the pandemic situation gets over. Furthermore, the concept of Industry 4.0, IoT, & ICT will definitely have some role to play in E-commerce and, therefore, in urban mobility. This paper discusses, at a conceptual level, a number of issues related to E-commerce, transportation, Industry 4.0, IoT, & ICT along with logistics and supply chain. This study is important from a futuristic point of view as the future looks more toward an automated internet-based approach, and mobility, transportation, and logistics cannot remain un-impacted by this. Therefore a possible integrated model for passenger metro train and last-mile parcel flow of E-commerce deliveries has been proposed. This study is concentrated on Nagpur urban area and focused on developing a working methodology to understand the concept of Industry 4.0, IoT, ICT, and E-commerce on transportation and mobility.

Keywords
E-commerce, ICT, Mobility, Logistics & Industry 4.0.

1. Introduction
In the last few decades, with the decrease in the prices of technological equipment and internet services, the adoption of information and communication technologies (ICT) has increased drastically. The emergence of ICT causes a revolutionary impact on the transportation network and people's choice for performing daily activities. Telecommuting and E-shopping are possible just because of ICT (Keskinen et al. 2001, Inro 2002). The modern purchasing habits of consumers have altered the shopping and travel pattern significantly (Mans 2012). The E-commerce market has seen a steep growth in recent years, and it can be observed through the surge in online shopping (b2c e-commerce) (Rutter et al.,2017).

However, amid the covid-19 pandemic, restrictive measures taken to control coronavirus spread have given the E-commerce business manifold growth (Vitale et al., 2020). The research studies from different regions have reported that the customers who have adopted online shopping will not revert to offline shopping completely even after the pandemic (Pedro Ramos, 2020). To keep the customers attracted to online shopping even after the pandemic, businesses should utilize the concept of Industry 4.0 and IoT (Czifra and Molnár, Fatorachian & Kazemi, 2020).

Industry 4.0 is the Buzzword, which Germany first presented to the world and started the Industrial 4.0 revolution (Wagner et al. 2016, Hofmann and Rüsch 2017, Alcácer and Machado 2019). The industry 4.0 approach converts conventional factories into smart factories (Hofmann and Rüsch 2017, Alcácer and Machado 2019). Industry 4.0 approach consists Cyber-Physical Systems (CPS), Internet of Things (IoT), Cloud Computing (CC), Big Data (BD), Sensors, Intelligent Robotics, and Immersive Technology, etc., enabling the horizontal and vertical integration of companies (Lu et al. 2017, Alcácer and Machado 2019). Industry 4.0 aims to train machines in such a way that they can interact with each other and humans, share and understand the information to complete their tasks and provide real-time updates to the subsequent units.

Industries can make production, manufacturing, and logistics supply chains smarter, adaptive, faster, smoother, and efficient by adopting the industry 4.0 approach (Peruzzini et al. 2017). Connecting the physical world to the virtual world helps in understanding complex tasks (Peruzzini et al. 2017, Leyh et al., 2017). With the perks of industry 4.0 such as interoperability, digitization, visualization, and automation, companies can enjoy horizontal and vertical integration for collaboration and better utilization of resources.

Though Industry 4.0 has high implication potential on the logistics and supply chain by automation, real-time tracking, route optimization, risk management, horizontal & vertical integration, but impacts of Industry 4.0 & IoT on the logistics supply chain are scholarly less explored (Fatorachian & Kazemi 2020, Hofmann and Rüsch 2017). However, the central focus of the research community exploring Industry 4.0 is focused on making factories smart, or we can say on the manufacturing system (Lu et al. 2017, Alcácer and Machado 2019). Nevertheless, if E-commerce businesses want to attract more customers and retain their existing customers for online shopping, they must adapt the Industry 4.0 concept wholeheartedly and explore its every possible direction to capture the market share. Also, efficient and effective route optimization, parcel consolidation, resource sharing by horizontal and vertical integration can help in better mobility in over congested urban areas (Comi and Nuzzolo,2015). Furthermore, ICT & E-commerce have the potential to reduce the travel need for various activities such as shopping, leisure, traveling & work trips (Kumar et al. 2020, Mans 2012).

In this study, we develop a methodology framework to explore the Industry 4.0 concept from a logistics and supply chain point of view, how this concept can help in the growth of E-commerce business and how mobility can be improved in urban areas. This study will also shed light on the possibility of integrating passenger metro train infrastructure with E-commerce freight movement within the metropolitan region. The remaining paper is comprising of seven sections. The first section deals with the literature mining on ICT & E-commerce. The second section explores the Industry 4.0 concept and its components. The third section depicts the development of smart factory (SF). The fourth and fifth sections talks about the suitability and benefits of Industry 4.0 for the logistics and supply chain. The sixth section presents the proposal for integrating people and goods flow by utilizing the unused capacity of the transit metro rail network in the Nagpur urban area. The final section ends with concluding remarks, limitations of the study, and future scope for the research.

2. Literature Review

2.1 ICT & E-commerce

ICT has given many innovative techniques to simplify our day-to-day life activities ranging from office work to shopping. The origin of e-commerce is also given by ICT. Telecommuting and E-shopping are possible just because of ICT (Keskinen et al. 2001, Inro 2002). Researchers have seen ICT as a solution provider for many transportation-related problems. Taniguchi et al. (2016) found that the use of ICT, ITS & GPS will improve the goods delivery operation under the existing land use plan. They also emphasized that vehicle routing and scheduling models will help in reducing traffic flow during congested peak periods. Moeckel (2017), through a framework-based study, stated that ICT is disruptive in nature and will change travel behavior. Mans et al. (2012) also revealed that ICTs affect individuals' travel behavior in multiple and complex ways. Framework-based descriptive and empirical studies on ICT suggest that e-commerce may interact with travel patterns in four different ways: substitution, complementarity, modification, and neutrality (Cao et al., Mans et al., 2012).

Researchers are more interested in the substitution impact of e-commerce on trip-making (Mindali & Weltevreden 2013). Keskinen et al. (2001) also reported that ICT would reduce resource consumption by making physical flow to information flow or dematerialization. In their view, e-commerce could lead to a reduction in travel demand. Dematerialization of products, use of internet for information gathering, and efficient management of freight logistics were the main reasons to support their view. Comi & Nuzzolo (2015) found that demographic and socioeconomic characteristics changes have significant effects on the increasing use of e-commerce. According to Barbieri et al. (2021), the restrictions imposed due to the covid-19 pandemic have changed people's travel behavior around the world. The fear of coronavirus also leads people to adopt more online activities such as work from home and online shopping. This lead to the manifold growth of E-commerce businesses across the world.

The continued growth of online retail is shaking up long-standing business models and consumer shopping patterns. These consumers increasingly opt for shorter delivery cycles. In some cases, they choose to receive items within hours rather than days (Rutter et al., 2017). The demand for immediate delivery triggers the associated business to adopt the techniques which can fulfill the need of immediate delivery demand by customers (Rutter et al., 2017). As a result, E-commerce players can adopt the Industry 4.0 approach to update their associated logistics supply chain network to fulfill the immediate delivery demand of customers.

According to Lee et al. (2016), interdependencies between personal trips and freight trips have increased due to the digitization of services. Therefore, it became necessary for transport planners and policymakers to interlink both. For the integration of personal and freight trips, researchers are eying on the industry 4.0 concept. According to them, the Industry 4.0 concept has the potential to create a pathway for the integration of personal trips and freight trips (Fatorachian & Kazemi 2020, Hofmann and Rüsch 2017).

2.2 Industry 4.0 Concept & Components

Industry 4.0 has arrived due to the recent cutting-edge innovations and developments in computer science and information and communication technology (ICT). Industry 4.0 portrays a system network that is highly flexible, agile, resilient, automated, digital, and efficient. Industry 4.0 enables the human to machine interaction, machine to machine interaction and connects the physical world with the digital world (Fatorachian & Kazemi 2020, Alcácer and Machado 2019, Hofmann and Rüsch 2017). The following components (building blocks) are the basis for Industry 4.0 concept.

2.2.1 Cyber Physical System (CPS)

CPS systems are advanced technology systems in which the physical world interacts with the digital world through the internet or communicating devices. With the help of sensors, the CPS system fetches the data from the physical world, analyzes and processes the data with the help of computing techniques, and controls the physical devices with the help of actuators. The CPS embedded system performs the task of multicomputer and, with microcontrollers' help, controls the physical and virtual integration with or without wired connection (Alcácer and Machado 2019, Hofmann and Rüsch 2017, Bocciarelli et al. 2017, Jazdi 2014). CPS system is closely associated with the IoT (Alcácer and Machado 2019, Humayed et al. 2017). Humayed et al. (2017) identified three main components of CPS; communication, computation and control, and handling and monitoring.

2.2.2 Internet of Things (IoT)

IoT is the subsystem of CPS in which everything is connected through the internet. Porter & Hepperman (2014) predicted that IoT would bring a societal change in which all things will be connected through the internet and will communicate with each other via the internet. In IoT, human and physical things are integrated with each other via the internet resulting in thing to thing, thing to human, and human to human interaction (Alcácer and Machado 2019, Choi et al. 2017, Sadiku et al. 2017). Self-configuring, self-managing, and smart technology anytime, anywhere, will be new normal, enabling intelligent interaction and communication for better efficiency, functionality, reliability, and capacity utilization (Salkin et al. 2018).

According to most authors (Alcácer and Machado 2019, Li et al. 2015, Trappey et al., and Daya et al. 2017), IoT consists of four layers in its architecture: sensing layer, network layer, service layer, and interface layer. The sensing layer senses the information about things through sensors or RFID tags. The network layer transfers the information collected by sensors through a wired or wireless network to the service layer. The service layer processes the information and maintains the interoperability of various devices. Interface layers display useful information to the users for better understanding and comprehensive interaction with others.

2.2.3 Big Data (BD)

Big data is a field that deals with a large pool of data; it processes complex data and extracts valuable information by analyzing the data with the help of data processing application software. Any system which generates structured, semi-structured, and unstructured data which needs to be stored, processed, and analyzed for useful information needs the support of Big Data (Bortolini et al. 2017). The advanced analytics of BD is used for machine learning, forecasting, and understanding the various life cycle stages of products. As a result, the BD provides more rational, informative & responsive decision-making capabilities to the businesses (Qi and Tao 2018).

2.2.4 Cloud Computing (CC)
Cloud computing is the service available for those who want to outsource the IT infrastructure (Branco et al., 2017). It gives a resource pooling option to small and medium enterprises to enjoy the broad network, facilitating the on-demand services (Assante et al., 2016). CC offers a remote connection to various operating devices for any computing and communicating tasks. In CC, three types of service platform or layers such as Infrastructure as a Service (IaaS), Platform as a Service (PaaS), & Software as a Service (SaaS) are available (Alcácer and Machado 2019, Alqaryouti and Siyam 2018). In short, the CC is similar to the Internet of Service (IoS), which provides services such as storage space, servers, databases, software applications, data analytics, and intelligence.

2.2.5 Simulation
To understand the dynamics of businesses, simulation tools are getting popularity. Using simulation tools, businesses can visualize future scenarios. They can improve their planning and design methodologies based on the various feedbacks from simulation modeling (Rashid and Tjahjono, 2016). The complex and uncertain mechanisms can easily be dealt with in the simulation model; otherwise, solving them with the conventional mathematical modeling results in a herculean task. (Alcácer and Machado 2019). With the help of existing and imagined information, simulation tools allow gaining insights about a complex system before implementing the system in real (Fatorachian & Kazemi 2020).

2.2.6 Immersive Technology
Immersive technologies such as Augmented Reality (AR) and Virtual Reality (VR) are helping in the increment of human performances (Jain et al. 2017, Horˇejší, 2015). Immersive technologies AR & VR connect real information with virtual information to showcase an artificial reality beforehand to improve decision making. Immersive technologies improve the operator’s vision by putting artificial objects on a real platform to create an artificial environment (Alcácer and Machado 2019, Lamas et al. 2018).

2.2.7 Autonomous Robots
Autonomous robots are those smart machines which can interact with humans, can take orders from humans and systems, can perform the repetitive task with utmost precision and safety without tiring (Caggiano and Teti, 2018). Smart robots have computing, communicating, processing, and analytical power to interact with humans and other machines. With the help of smart robots, many businesses from production, manufacturing, and logistics are adopting automation in their operation (Fatorachian & Kazemi 2020, Alcácer and Machado 2019). These robots can help transport materials, sortation, loading and unloading activities, product making, product finalizing, packaging, etc.

2.2.8 Horizontal and Vertical System Integration
To develop a collaborative paradigm of system integration, engineering, production, marketing, suppliers, and supply chain operations must all work together based on the information flow and automation levels (Fatorachian & Kazemi 2020, Hofmann and Rüsch 2017). In general, there are two techniques to I4.0 system integration: horizontal and vertical integrations. These two types allow for real-time data sharing. The horizontal integration allows the inter companies’ operability by task sharing, data sharing, and resource sharing. This horizontal integration enriches the product life cycles and creates more value addition for the customers and the businesses. However, the second integration is for the intracompany operability in which all the hierarchal departments can agree to share their tasks, data, and resources (Alcácer and Machado 2019). In this digital era making collaboration for horizontal and vertical integration needs some standard basis so that the complete life cycle of a product gets benefited. Starting from the raw material to production house, manufacturing, and transportation to final customer, all must come together and make a standardized integration that adds value to the whole cycle (Stock and Seliger 2016).

2.3 The Smart factory of Industry 4.0
The research fraternity believes that the framework of the Industry 4.0 revolution is to build a smart factory. According to them, the smart factory is the heart of Industry 4.0. However, CPS, IoT, BD, CC, AR, VR, Simulation, Autonomous robots, Horizontal and Vertical Integration are the building blocks for smart factory development. The integration or combination of these components in one or another form enables building a decentralized smart factory in which interaction or communication occurs through a cloud-based network. In the smart factory environment, machines can

interact with other machines, objects, humans, and sensors. The integration of the components in a smart factory allows to sense and generate data, store the data, process the data, analysis and interpretation and information sharing for correctively and efficiently handling the physical and digital world (Alcácer and Machado 2019, Wagner et al., Peruzzini, 2017, Weyer et al. 2015). The below figure 1 depicts the integration of the components of Industry 4.0 for the development of SF.

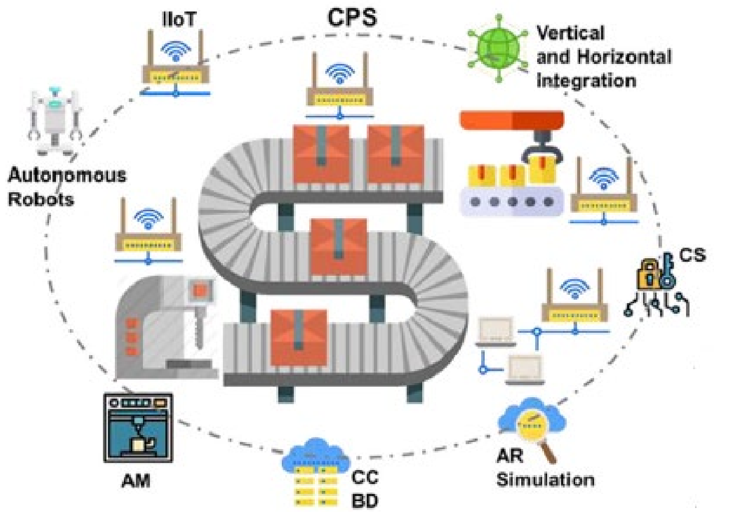

Figure 1. Development of the smart factory for the I4.0 implementation.
Source: Adapted from Alcácer and Machado, (2019).

2.4 Suitability of Industry 4.0 for Logistics and Supply Chain

Industry 4.0 concept has a vast potential to disturb the conventional logistics and supply chain. Though the primary focus was on the development of the smart factory to revolutionize the manufacturing industry, comparatively lesser attention was given to the logistics and supply chain (Fatorachian & Kazemi 2020, Hofmann and Rüsch 2017). Without the up-gradation of the logistics and supply chain, the vision of Industry 4.0 for the manufacturing sector will not fulfill. The concept of Industry 4.0 brings many implications for the logistics and supply chain. The smart factory concept can be utilized to upgrade various stages of the supply chain (Fatorachian & Kazemi 2020).

The combinations of CPS, IoT, BD, CC, AR, VR, Simulation, Autonomous Robots, and Horizontal and Vertical Integration can handle all the tasks of the logistics and supply chain such as product receiving, handling, sorting, boarding, deboarding, lifting, transferring, communicating, vehicle routing, location tracking, consolidating, distributing and many more in a smart, cost-effective and efficient way. Furthermore, industry 4.0 provides opportunities in terms of collaboration, decentralization, automation, resource optimization, digitization, and efficiency (Fatorachian & Kazemi 2020, Alcácer and Machado 2019, Hofmann and Rüsch 2017).

Factors such as increased competitiveness, shortened product life cycle, highly volatile business environment, and the specialized products bring a serious challenge for businesses and companies around the world. Therefore, the existing logistics and supply chain network need to be more adaptive, flexible, stable, cost-effective, and sustainable. (Hofmann and Rüsch 2017). Industry 4.0 has paved the way for highly flexible mass production, real-time coordination, value chain optimization, complexity cost reduction, or fully emerging new services and business models. As far as logistics and supply chain are concerned, Industry 4 is predicted to have a huge impact (Fatorachian & Kazemi 2020). Indeed, the logistics industry presents a suitable implication area for industry 4.0.

Integration of enabling technologies of Industry 4.0 such as CPS, IoT, CC, BD, Autonomous Robots, and simulation can facilitate real-time tracking, monitoring, sensing, product handling, lifting, transportation, routing, security, distribution, and risk management. The concept of Industry 4.0 seeks to break the old systems and boundaries and create new rules and standards. The more promising the idea of Industry 4.0, the greater are the problems associated with its implementation. According to Hoffmann 2017, the vision of Industry 4.0 fulfills only when the logistics and supply chain becomes capable of providing requisite input factors at the right time, in the right sequence, right quantity and quality, and at the right place.

In the era of information and communication technology, the demand for online business and shopping has increased manifold. Also, the covid-19 pandemic encourages people to look after online business and online shopping (Barbieri et al., 2021). The major drawback of online business is that the user did not get immediate possession of the products. The higher delivery time means more dissatisfied users. Hence, the industry 4.0 approach is a must for all the logistic players associated with E-commerce businesses to supply the products to end-users as early as possible with a cost-efficient method.

2.5 Benefits of Industry 4.0 Enabling Technologies on Logistics & Supply Chain

The success of manufacturing industries depends on how efficiently they get their supplies and deliver their final products to end customers (Fatorachian & Kazemi 2020). In order to successfully implement the vision of industry 4.0 for smart manufacturing, companies also need to look after the up-gradation of logistics and supply chain processes. Industry 4.0 technologies can help in uninterrupted supply and operations with effective communication and information sharing. This section will discover the potential benefits of industry 4.0 technologies on logistics and supply chains. The possibility of interaction between machines, humans, and objects through a wired or wireless network in a smart factory environment can help build an automated supply chain network. The highly automated system will definitely enhance production and operational efficiency (Fatorachian and Kazemi 2018).

Technology such as BD, AR, VR, and simulation can help in improving product design, demand analysis, production planning, and control (Rashid and Tjahjono 2016). The possibility of transparency and data sharing with the help of CPS, IoT, and CC enables the horizontal and vertical integration of business across manufacturing and supply chain processes. That will offer versatile resources, quicker innovation, and economies of scale (Alcácer and Machado 2019). These technologies provide greater visibility and connectivity, enabling responsiveness and real-time customization for partners to ensure quality products (Park et al. 2016, Brettel et al. 2014). Moreover, smart machines can detect variations and unforeseen defects and can apply corrective measures on their own to ensure product quality (Chung 2015, Brousell et al. 2014).

Robotics, CC, and BD can help in effective and efficient sortation and fulfillment management by effectively sharing real-time information (Fatorachian & Kazemi 2020). A communication system sends the collected data to BD and becomes accessible via CC (Alqaryouti and Siyam, 2018). Big data gives advantages to businesses by value addition (Cheng et al. 2018). The CC helps in data mining and analyzing (Fatorachian & Kazemi 2020, Alcácer and Machado 2019). These technologies can enable real time information access for various stakeholders to take responsive action at any stage of the supply chain process (Harris, Wang, and Wang 2015). Autonomous robots and machines can perform repetitive tasks without tiring with utmost accuracy enabling quicker processes with minimal wastages.

CPS, IoT, BD, CC with the help of sensors can provide traceability, monitoring, and controlling of logistics. These technologies will be crucial for logistics in tracking, route optimization, diversion, security, and risk management (Hassan et al. 2015; Chung 2015). This capability will add value to the business by enhancing dependability, trust, and speed of delivery. The integration of smart robotics in logistics along with CPS, IoT, BD, and CC can help in developing an autonomous system for parcels packaging, sorting, handling, boarding, deboarding, tracking, monitoring, and delivery.

Furthermore, these technologies offer horizontal and vertical integration, enabling opportunities for innovation, efficiency, resource and work optimization. For example, if e-commerce companies come together for collaboration for the last-mile delivery of their parcels. In that case, they can save a lot of resources and can enhance the speed of delivery. That, in turn, reduces the delivery cost, delivery time, congestion, and pollutants. A research study by Pimentel & Alvelos (2015) suggests that integrating public bus transport with freight flow will help in bus capacity utilization, lesser pollutant emission, and efficient freight flow.

From the literature review, we can say Industry 4.0 enabling technologies has a potential to make a paradigm shift in conventional logistic and supply chain process. Encouraged by literature findings and the power of Industry 4.0 technologies, we proposed the integration of passenger metro trains with e-commerce freight flow for the last mile in the Nagpur urban region. That can reduce congestion, delivery time, delivery cost, fuel consumption, and pollutants in the urban region.

3. Integration Possibility for Passenger Metro Train to Deliver E-Commerce Parcels in Nagpur City

The majority of E-commerce players in the Nagpur urban area use heavy trucks, light trucks, vans, motorcycles, cycles & E-rickshaw for the last mile delivery of parcels. Most of the warehouses of E-commerce players are situated in the outer periphery of Nagpur city. The parcels are being sent to the sub-distribution points using heavy & light trucks as a mode of transportation from these warehouses. Furthermore, parcels reach the final customers using mini trucks, vans, motorcycles, & E-rickshaw from the sub-distribution points. Though the e-commerce industry can reduce the travel need for different activities, it still needs more advancement in its approach to reduce traffic congestion on roads.

With the ever-growing population, the congestion on urban roads is also increasing exponentially. City authorities give limited access to commercial vehicles to reduce the traffic congestion on the roads, which increases the last mile delivery time of parcels. On the other hand, customers want their parcels as early as possible, and the delay in the delivery of parcels results in dissatisfaction of customers. So the complete dependence of E-commerce players on road transport for freight movement within the city hinders their anticipated growth. Also, fossil fuel-based smaller vehicles for delivery of parcels reduce their profit margin and increase the carbon footprint.

Currently, Nagpur city is experiencing road traffic congestion problems like other major cities in India, which might cause hindrance to its anticipated development rate. By keeping that in mind, the city authorities have introduced the Nagpur Metro rail transit service to overcome the road traffic congestion problem in the city. However, though the transit metro rail provides a cheaper, convenient, & faster mode of transportation for passengers within the city, it fails to utilize its total capacity due to varying ridership demand throughout the day. Again the ridership will be limited, citing the unavailability of a metro station within walking distance for all users (Roy, 2021). So this will create a massive challenge for the management to utilize the capacity of drivers, fleet & infrastructure fully.

Industry 4.0 approach has the potential to overcome the problem of delivery delay and fuel efficiency of the E-commerce industry on one hand and capacity utilization of transit metro rail on the other hand by integrating passenger metro train infrastructure with E-commerce freight movement. The integration of passenger metro train infrastructure with E-commerce freight movement allows using the unutilized capacity of a metro train by parcels delivery service during off-peak hours.

The integration of passenger flow with the freight flow already exists for the long haul end; it proved to be very effective. However, this type of integration for the last mile is nonexistent. We believe that the industry 4.0 approach can integrate both types of flow for the last mile. Coupling this integration with the energy-efficient fleet of smaller vehicles such as E-rickshaw, E-Van, and drones can improve mobility in the city. Also, the concept of industry 4.0 is not new for all the e-commerce players and transit metro rail services. They are already using the components of Industry 4.0 in one or another form. They have the resources and knowledge for the requisite integration but at the same time lacks the concept and willpower to integrate both flows.

Pimentel & Alvelos, in 2015, already proposed an integrated business model for the integration of Bus rapid transit infrastructure for the distribution of parcels in urban areas and labeled this integration as Integrated Urban Logistic Services (IULS). However, we would like to label the integration of passenger transit metro rail with e-commerce freight delivery for last-mile as Integrated Passenger Freight Services (IPFS), inspired by industry 4.0 approach. The cyber-physical system, IoT, ICT, sensors, BD, CC, Autonomous Robots, & Immersive technology all will come into play for the smooth operation of the IPFS model. Through the IPFS model, the smart metro trains can interact with each other. Based on the previous and current ridership data, they can pass a message of available capacity for the parcel flow on the next train beforehand. Sensors can detect the capacity available and will load the parcels accordingly. Smart robots can take loading and unloading care. If the number of parcels increases beyond the available capacity, extra trains can run during off-hours to fulfill the demand.

As the metro stations are limited, home delivery through the metro is not possible. So for further flow, Metro Delivery Hub (MDH) points can be created at every metro station to board and deboard parcels at each metro station. The flow of parcels will be from the warehouse of the e-commerce players to the MDH of the nearest metro station via truck. Then at the MDH point, robots will unload the parcels from the truck and loads the parcels on the metro train according to the available capacity. Robots will scan the barcode on the parcel and arrange them for a particular route and train according to the available capacity. Then at the destination MDH, the robots will deboard the parcels from the train. Then, the parcels will be sent to the customer's house via energy-efficient vehicles such as E-rickshaw, E-van & drones from the destination MDH. The return parcels will be collected from the houses and bring back to the destination MDH, and from there, the robots will send them back via the returning train. In order to make the operation of integrated service smooth, parcels should be appropriately packed in the predefined standard size. In addition, they must be barcoded so that mishandling of the parcels will not happen.

The whole integrated network is consists of a set of e-commerce suppliers, a transit metro train network, metro delivery hub points, micro logistic operators, and a set of customers. E-commerce suppliers are the ones who want to send & receive their parcels from their warehouses to the final customers' houses. A transit metro train network consists of multiple trains, rail routes, and platforms to connect multiple points in urban and suburban regions. Metro Delivery Hub points can be created at each metro station for receiving, sorting, boarding & deboarding parcels. Micro logistics operators can pick the parcels from the metro delivery hub points and delivers them to final customers using e-rickshaw, e-van, and drones. Finally, micro logistic partners can bring back the returned parcels from customers to metro delivery hub points.

4. Conclusion

This study is intended to identify the changes in the behavior of people due to ICT & E-commerce, how the users will behave in the future, and what type of solution is needed for their changing behavior. The literature study revealed that ICT and E-commerce are changing the shopping and travel behavior of people. Through framework-based descriptive and empirical studies, researchers have identified that ICT & E-commerce interact with conventional shopping and travel behavior in four different ways, namely substitution, complementarity, modification & neutral. Moreover, the implications of ICT & E-commerce on conventional shopping & travel behavior are complex in nature. However, researchers are more interested in the substitution impact because substitution impact indicates that these technologies can reduce travel demand in an urban area, which can help in improving mobility and reducing congestion.

The e-commerce business has seen rapid growth in the last decade, and recent restrictions on mobility in the wake of the covid-19 pandemic resulted in the manifold growth of the e-commerce business in a very short span of time. The boom in the e-commerce industry due to covid-19 will continue even after the pandemic is uncertain. So there will be a sure sort of challenge for the e-commerce players to retain the existing customers and attracting new customers.

E-commerce offers many benefits such as convenience, better pricing, time-saving, trip-saving, fuel-saving, and many more. Nevertheless, at the same time, it has a major drawback the delivery time for parcels and products. Customers are not willing to wait for their parcels/products, and they want their parcels/products as early as possible. A longer delivery time means a high number of disappointed customers. So to keep the customers, happy E-commerce players need to reduce the delivery time of parcels. Modern problems needed modern solutions. That is why the concept of Industry 4.0 was explored in detail to understand its components and nitty-gritty to provide solutions for the modern e-commerce business and mobility.

The literature mining suggested that the eagerness of customers to get their parcels/products as early as possible demands the up-gradation in the conventional logistics and supply chain. The up-gradation of the conventional logistics and supply chain can be achieved by adopting the industry 4.0 approach. The components of industry 4.0 such as CPS, IoT, BD, CC, AR, VR, simulation, autonomous robots, and horizontal and vertical integration, seems capable of transforming the conventional logistics and supply chain.

The time restrictions for freight-carrying trucks in the city area to reduce congestion increases the delivery time for parcels, and opting for smaller vehicles for freight flow is not a cost-effective solution for logistics players. Hence a solution through the integration of metro rail transit system with freight flow is proposed. In this integration flow of people and fright altogether with the same mode of transport can happen. Through this integration, the transit metro rail of Nagpur city will get the solution for its ridership problem during non-peak hours, and its capacity utilization will improve. On the other hand, the fright flow of e-commerce players can be handled in a more cost & energy-efficient way with greater mobility in the city area. This integration will make the freight flow within the city area faster, convenient, and more sustainable. This integration needs a positive attitude and willpower from stakeholders such as city authorities, city metro authorities, e-commerce players, logistics service providers, and urban residents.

Regardless of the important theoretical contributions for improving the conventional logistics and supply chain and mobility, this paper lacks the practical application of IPFS. This is the limitation of the study. In this paper, we have just presented the idea for integrating people and fright flow by utilizing the unused capacity of the transit metro rail network. This work can be carryforward by a pilot study. Furthermore, the type of infrastructure improvement required, planning needed, resources needed, technicality involved, and operational constraints must be researched thoroughly before implementation.

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