The Future of E-Commerce Systems: 2030 and Beyond

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Abstract The sophistication and efficiency of systems is undeniably advancing. As businesses evolve, questions on its past performance is beside the point but its anticipated functions and relevance in the future. With the use of software in commerce at the core of every business today, the overlook of how omnichannel transactions operates is an awe with the 4th industrial revolution and its societal impact. This chapter explains how commerce has currently evolved in the advent of technology elaborating on the current state and challenges of systems, its architecture, and the innovations of cyber physical systems in electronic commerce. It further expounds on the application of omnichannel systems in communication through the fifth-generation network, in transaction through blockchain and in composition through Social Internet of Things. We believe that this study will benefit all stakeholders in commerce from governments, supply chain organizations and consumers to understanding the forthcoming drivers of omnichannel systems in the 4th industrial revolution, its prospects, and its anticipated challenges.

Keywords E-commerce · Cyber physical systems · Industry 4.0 · Omnichannel · Technology acceptance model (TAM)

1 Introduction

The attributing factors of innovating commerce from its core trading such as the lack of specialization (coincidence of wants), storage, locality and medium of exchange [1–4] make the future of commerce as progressive as its evolution. Moldable through every innovative era, Commerce from its basics of barter to highly sophisticated global electronic transactions, soars in the generation in which it exists.
Today, the involvement of software applications in commerce is in every part of the human livelihood coupled with rapid changes, it impacts not only functions and activities of the commercial system but sways its values across societal, political, cultural and legal ways, hence being very significant.

This wave of high performance technology centric commerce does not only impact established physical commerce organizations, but thru all domains in the supply value chain where innovative omnichannel \([5]\) systems interoperate hardware and software solutions across brick and mortar channels, mobile technology and social media across the electronic commercial ecosystem. It involves entrants (startups) who want to break even to the market, technology solutions providers who need to understand the impact of different solutions integrating with organizations, end users who are interacting with the systems and government, network regulators who are setting policies on the application and usage of network technology for their day to day business functions.

Advancing with virtual consumers and businesses, it is evident that innovations in electronic commerce will take precedence in omnichannel systems demanding technologies in hardware and software interoperability.

E-commerce (EC) a fairly simple concept in explanation, where a commercial transaction of goods or services occurs electronically through systems application capabilities over an internet medium is now at the core of everyday businesses. As early as the 1960, when businesses exchanged information between each other through Electronic Data Interchange (EDI) \([6]\) to the late 80s where Graphical User Interface (GUI) coupled with commercial opportunities on the network sprouted online merchants, e-commerce has stimulated demand in advancement of innovative hardware and software applications.

Meeting this demand is the fourth industrial revolution also known as industry 4.0 \([7]\) which has grown e-commerce to real-time engagement. With its smart digital dynamics, industry 4.0 has eased consumer reach in applications and devices to their comfort. Industry 4.0 adoption in commerce has advanced the supply chain to diverse Cyber Physical System (CPS) \([8]\) capabilities that allow real time computations and convergence of multiple systems across network channels. This advancement allows the tight coupling of the CPS with organizations functional capabilities such as information management, monitoring and controls which provides organizations with essential attributes in operating, collecting consolidating as well sharing information across the chain.

CPS is described as a combination of distributed cyber and physical systems which are controlled and monitored as per the user requirements \([9,10]\). As a powerful source today for the most critical resources such as healthcare, energy, food, and transportation channels; CPS is a gateway to establishing a complete chain in omnichannel systems.

CPS innovations are currently integrated with Supply Chain services to innovate management of across its systems. Figure 1 shows the continuum of CPS as part of core technologies that have enabled organizations productivity in different time periods across the supply chain in organizations.
Figure 1  Industrial advancements

At a time when information interchange is programmed and electronic commerce takes precedence over brick and mortar in commercial exchange; attention is needed to understand the drivers to the development in e-commerce systems to cater and meet the requirements of the industrial revolution. An analysis of the advancement of e-commerce channel solutions is essential to defining the future connection, transaction, and usage of omnichannel systems. Section 2 of this chapter explains using Technology Acceptance Model (TAM) to understand the current state of e-commerce systems architecture and how it applies to users in customer engagement and businesses towards achieving progressive technology. Section 3 elaborates on the current challenges facing e-commerce systems especially in the wake of COVID19 Pandemic and addressing ways to mitigate them. Section 4 discusses the technology advancements anticipated to revolutionize e-commerce systems in on how they communicate through the fifth-generation networks, transact through blockchain and interact through Social Internet of Things among systems and with consumers. Section 5 discusses the anticipated challenges brought by the advancements of technology suggesting ways on how to mitigate them. Section 6 concludes the study on the evolution of e-commerce systems.

2 Current State of E-Commerce Systems

An innovative systems milestone has the ability to transform, re-invent or create new business model at the peak of demand. As an enhanced Information Systems (IS)
platform which is able to capture, process and distribute information [11], integrate systems [12, 13] to streamline data and support key functionalities so as to have an operational and workflow efficiency [14]; e-commerce platforms provide additional functions that are beyond IS capabilities such as integrated decision making capabilities that allow organizations to understand customer data for customization and personalization of products and services. In this section we present the state of e-commerce systems and essentially understanding on how its architecture is applied and how the systems are perceived as functional in everyday usage to appreciate the technology drivers behind commercial systems advancements.

2.1 TAM in E-Commerce Systems Architecture

In any system engineering, the software architecture is essential to the organizations growth. Software architectural requirements can be functional which develop from organizational objectives and are determined by functionality and services of the system user needs or non-functional which are the system qualities which describe how rather than what a system should do [10].

Before looking at progressing technologies in the e-commerce arena we first turn to the Technology Acceptance Model (TAM) to provide for a theoretical framework for explanation of the adoption of progressive innovations. The Technology Acceptance Model (TAM) will be explained to provide determining factors for ease of use in e-commerce. 

Over the years the adaptation of adopting new technologies has been studied in variety of fields [15]. In its originality the conceptualization of TAM [16] explains how the adoption of new Technology systems by users in context of their work. 

With the Perceived Usefulness (PU) and the Perceived Ease of Use (PEU) being the main drivers of TAM, the attitude towards usage and acceptance lead to behavioral intention and ultimately actually using e-commerce systems. In their study Mezhuyev et al. [17], reflect on how Software Engineering research has proved that TAM goes beyond the explanation of an information system or software acceptance but the processes that the systems are involved under them.

As complex the architecture of e-commerce systems, segmentation of services is essential to understanding the variance in use of technology. A typical e-commerce system architecture integrates numerous software systems. Figure 2 shows how in its simplicity as viewed on the front end, e-commerce back end architecture is technically complex involving several functions which are diverse in application components, processes, and seamless interaction for information flow in real time. They include:

(1) Consumer services that support the organizations pre-sales, sales and post-sale activities. Software systems providing these services enable organizations to capture, segment, analyze and manage customer information. Example: A Customer Relationship Management system (CRM) integration would handle
customer registration details, customizable preferences of goods and services, customer status and behavior and transaction history.

(2) *Supply Chain services* that support the organizations order fulfillment. Software systems providing these services enable organizations to monitor inventory, track the location and status of merchandise and manage orders in real-time. Examples include Merchandizing System, Order Management System, and Distribution Logistics System.

(3) *Business services* that support the organizations value proposition [18]. Software systems providing these services enable organizations to strategize important elements through various analytical techniques of their offerings whether it is a product or service to meet the needs of the end consumer. Example: A Payment Management System integration will not only allow payment of goods and services online but connect to various payment systems, calculate value added tax (VAT), various taxable deduction systems as per the goods/services or country specific regulations, shipping costs and discounts. E-commerce has soared with its electronic payment system solutions that process payment at the convenience of both business and customers, reduce transaction costs and enable business to broaden their market. Software solutions provide various payment systems [19] in use today such as the credit card, debit card, smart cards, e-wallets, net banking, mobile payment, digital currency e.g. bitcoin and other custom payment solutions e.g. amazon pay that organizations provide.

Other key business services systems include Knowledge Management Systems (KMS), Point of Sale management (POS) system, Catalogue Management System, and Employee Management System (EMS).

(4) *Enterprise services* that support the organization integration and workflow. Software systems providing these services enable organizations to connect and integrate platforms to work together in an efficient, secure and faster way for
seamless business processes. Examples include security applications, network connectivity applications and database management systems (DBMS).

With the integration of segments in e-commerce systems an understanding of variables that mediate and those that influence behavioral intention and action is vital to technology acceptance. In the e-commerce segment TAM has been reviewed [20, 21] and models have been simplified, extended or combined in assessing perception in adoption [22, 23] of online shopping experiences, verifying user experiences, understanding consumer behavior [24] as well as analysing payment specific to mobile payment (m-payment) with an extended Unified Theory of Acceptance and Use of Technology (UTAUT) model where performance expectancy was seen as the best predictor in understanding the behavioral intention in m-payment systems [25].

As omnichannel systems evolve, external variables towards attitudes and behavioral intentions to be used with minor effort [16, 26] is a determining factor to reflect on perceived ease of use and perceived usefulness of technologies in the 4th industrial revolution to explicate acceptance with systems architecture.

2.2 Current E-Commerce Systems Application

Currently technologies such as Mobile Phones and wearables, Artificial Intelligence and Internet of Things have advanced design solutions of e-commerce systems and its applications to provide the supply chain with ultimate business integrations and end user experiences throughout the omnichannel systems at its time.

The use of mobile phone technology has made a big impact in commerce, this is due to the demand and comfort of users to interact with mobiles. E-commerce systems are ensuring that software applications are designed across multiple platforms prioritizing a mobile-first design [27, 28] approach to give end user an accessible, fast and responsive experience. Through wearables, such as smart watches and glasses, E-commerce organizations are able to autonomously synchronize data to not only attract customers but also have businesses identify customer needs and push products and services. Wearables provide a personal and intimate ability for businesses and customers which are highly advantageous depending on their specialized functions, anatomy and function [29].

As Artificial Intelligence (AI) and Internet of Things (IoT) dominates the CPS ecosystems autonomous services, e-commerce has seen transformations beyond changing the way commerce works by enabling a socio-technical [30, 31] approach to interaction, data analysis and information dissemination which are able to identify and solve problems beforehand.

E-commerce systems are universally operated hence, end-to-end delivery is fundamental [32]. IoT through location-based technology has intelligently enhanced delivery. Systems are not only able to identify customer location for a timely and intact delivery but are now responsive to customer expectations by communicating through connected devices, such as electronic chips and sensors in real time. Such
innovative technology has created transparency where stakeholders across the e-commerce supply chain can connect and communicate [33] effectively. Through chips and sensor technologies, IoT is making an impact in managing inventory in the supply chain. Software applications in mobile phones and computer systems cannot only track inventory but send notifications and detailed description of products, such as manufacture details of the product, expiration, depletion, and managing restocking e.g. the dash button [34]. Enabling technologies such as high speed internet connectivity, advancement of Global Positioning Systems (GPS) in area location accuracy and interoperability of devices such as IoTs, e-commerce systems are currently deploying systems integration and interoperability of drones [35, 36] and autonomous vehicles [37] for efficiency in delivery potential in the future of commercial supply chain system.

Consumer and business services are also currently being enriched by CPS innovations to enhance user experience and enable synchronization of information. Artificial Intelligence is seen to dominate this area through Augmented Reality (AR) [38, 39] where consumers are able to experience a realistic 3D shopping experience through visualization of products in real size. Intelligent agents are integrated in e-commerce systems to listen through the networks channels and hardware devices on various platforms to consumers brand sharing content giving organizations the ability to gather information and push products accordingly. Chatbots are also programmed to engage and guide visitors in an e-commerce platform to cater to the universal demand hence can be deployed to function around the clock [40].

Figure 3 outlines a typical e-commerce systems application through Artificial Intelligence. The systems can interact, learn, and understand chat conversation between persons Max and Lina. Natural language processing a domain of AI, is able to listen to conversation by identifying key words on brand products or services and market product based on the conversation and/or sentiment analyzed and search through its data or knowledge based systems for product identification which is then push marketed to the consumer.

Organizations are now seeing software systems playing multiple roles in e-commerce where a differentiating task or capability of legacy systems that are assigned to serve independently for specific purpose creates challenges to the organizations interoperability. Combined with CPS, through Internet of Things and Artificial Intelligence, the demand of systems engineering to design autonomous [37] systems that are societally significant, accepted and can integrate with not only hardware but differentiating software systems is a challenge.

3 Current E-Commerce Systems Challenges & Constraints Revealed in the Covid 19 Pandemic

As the Pandemic hit, the choice of consumers restrained into lockdowns or restricted movements, lit on the attributing factors of shopping through e-commerce platforms.
As an only choice to many for basic household necessities, organizations needed to amp up their technology, this meant for integrating to operate omnichannel systems or implementing standalone systems to meet the consumer demand on e-commerce platforms. This section elaborates on the current e-commerce system challenges through its innovations in software architecture, development and compatibility of technologies and security that illuminated during the pandemic and how organizations can mitigate them.

As seamless as the process of buying and selling online, e-commerce platforms can be a crippling risk to organizations when it comes to design flexibility, adaptability, and security across all systems. As a complex architecture, ensuring that seamless interaction between system functions, had e-commerce organizations like Amazon [41] one of the most highly functioning e-commerce systems scrambling during the pandemic, whereby, adaptability to user demand was seen as a major constraints.

Software being the driver in e-commerce systems, its overall development and complexity pose a major risk especially in today’s interoperating environment. Legacy systems [42] whether of the shelf or custom built can handicap growth potential, hence the current state of omnichannel systems have to foresee potential challenges to be able to integrate, interoperate with other systems, infrastructure, industries, societies and economies. As the adoption of cyber physical systems increases with demand, policies, tools and practices of designing and building commercial software are changing. New entrants into electronic commerce have to consider long
term solutions to either replace their operational systems to cater for services or if applicable integrate to run the legacy systems in parallel with e-commerce platforms.

Development of usable and compatible systems considering human, social and organizational needs is a challenge in the current systems engineering. As demand grows in designing software in new dimensions of a social approach, Socio-technical systems [43, 44] design need to evolve. Engineers are currently facing various challenges in designing systems to meet this demand such include changes in alien terminologies not known to engineers, keeping with turnover demand of software applications to integrate for customer liking and designing systems to work with several hardware. To mitigate, engineers have to realize the autonomy of e-commerce systems goals through systems resources and constraints as well as the overall customer demand where each individual system can control and action upon requirements while understanding the interdependency of individual systems and their progression. Knowledge based systems [45] algorithms advancements on the architecture ensures learned behavior to progress the evolution of commerce systems.

As technology seeks to reach everyone in this era of Internet of Everything (IoE), societies are yet to have gained trust and confidence in EC software on global payment security, delivery, security and management of data and privacy of online activities [46, 47]. This include emerging security areas, such as IoT infrastructure security, securing storage facilities on cloud technology, privacy of analyzed data and information by AI/deep learning applications as well as collection and usage of big data applications on consumer information. The need to consider the technical development of systems and how to secure them is essential. Bodeau [48] in explaining the basic principles of security engineering, highlights that: Effective systems security should not be restricted to individual system vulnerability that could increase risks at systems level, Policy formats should not be inconsistent and enforcement should not be restrictive throughout systems, Design long term systems security plan to cater for evolving systems architecture.

E-commerce software systems today have conflicting operations, challenged laws and policies especially operating internationally and undefined governing software relationships. It is vital for organizations and countries to define systems structures and leadership of systems that carry information ranging from trademarks, finances, logistics as well as detailed user and customer information. This is vital for national security to ensure effective execution of commercial systems capabilities and requirements, security policies, processes, and practices on every application area especially in the wake of a Pandemic, where essential orders halt as e-commerce organizations meet with regulations. Localization of e-commerce systems and products have seen a faster delivery and satisfaction of customers than international shipping or systems bound by international laws which could not sell products across geographies as nations lockdown.

As a first on e-commerce platforms for many during the Pandemic, despite the system challenges, e-commerce is an essential pillar to cater to needs [49].

Studies on how TAM is applied to integration of systems and its compatibility in flexibility of design, adaptability, security and enhance actual system use to achieve ultimate functionality of systems is limited.
4 Future E-Commerce Systems

E-commerce systems architecture play a significant role in envisioning omnichannel systems of the future. As the basics of EC systems software architectural requirements, the current elements and quality of the systems are still prevalent. Interoperability and decentralization of systems will, however, require the relationships among systems to advance. As systems operations remain ubiquitous with unique innovative capabilities foreseeing advancements to supporting services developed to consumer, supply chain, business and enterprise systems is crucial.

Current e-commerce systems design automation, through IoT and AI capabilities such as, AR, Intelligent agents, wearables, machine learning, cognitive and autonomous computing advance, enhancements in e-commerce customer experiences and supply chain visibility foresees expansions across businesses. At the top of every organization list is to solve the issue of last mile approach i.e. the seamless process of end-to-end delivery in the supply chain.

Progression of systems expect autonomous systems to play a crucial role in delivery integrate and interoperate to cater to the supply chain demand. Operating in the fourth industrial revolution, the evolution of commercial systems demand interconnection, information transparency, technical assisting systems and decentralized decision making for sustainability of electronic commercial systems. Hence, envisioning commercial innovative solutions requires seamless and interoperable solutions which are accepted throughout the commercial ecosystem. This intern demand high network connectivity speed, scalable communication between systems and devices in storage and architecture as well as decentralization of transaction process.

Figure 4 describes a typical progression of e-commerce systems interoperability. A sensory detection of wearbles (smart watch) would detect Person A's low heart rate and share information to a medical application on a mobile phone. The mobile phone communicates to check availability of medication on the SMART medical cabinet. On detection of none/low medication, the SMART medical cabinet requests medicine replenishment on blockchain platform from a health practitioner (medicine providers). The figure outlines how systems can share information without the inception of person A. Figure 4 further outlines how efficient digital transactions are, for systems are able to communicate and establish a commercial transaction through blockchain. Lastly, the communication of information from medicine providers to the delivery with autonomous delivery systems capable of locating person A geographically through sharing information with the smart watch once the transactions is verified and approved.

This section introduces and explains how crucial advancements in the platforms of exchange through blockchain, interoperability of systems through Social Internet of Things and medium of exchange through 5G networks envision how e-commerce systems will be engaging in the supply chain, its user acceptance and most importantly its interoperability.
With change in digital dynamics of the supply chain, technologies in transactions such as digital currencies have e-commerce industries search and invest in advance platforms to gain competitive advantage and cater to the demand. E-commerce blockchain systems is seen evolutionary technology for provisioning virtual transactions.

With expanded markets of the global trade and highly sophisticated e-commerce payment systems, ensuring value for quantity and quality of goods is essential to mitigate concerns of exchange globally. Specialization, medium of exchange and locality are key attributes to growth of EC systems. This is due to flexibility in payment, transparency and authenticity of goods and services.

Blockchain technology architecture provides a opportunities for and redesign of systems. A software platform of digital assets, blockchain connects and records everything of value for businesses in enhancing a sharing economy, governance through transparency and publicly accessible technology, supply chain auditing through certifying the authenticity and locality of products and services as well management and control of hardware devices within the network. The smart
contract, a software solution in blockchain, allows absolute record verification and security of all contracts and transactions.

Figure 5 outlines the transaction process in electronic commerce blockchain between the customer (Customer A) and the e-commerce organization (Store B). Customer A makes a request of purchase online. A block is generated on the request and broadcasted in the network. Information which serves as proof is added on the block at each stage an entity connects in the blockchain. The smart contract will then match the buyer and seller in the network. Store B receives order and sends the determined price of product to the contract. Customer A’s money is immediately transferred to a smart contract. Store B sends proof of ownership to the smart contract and links it to the delivery channel of the product. Customer A receives the goods. A block is then added to chain with information of the whole transaction process. Store B receives money.

As online transactions gain momentum, the fast-track of digital currencies such as bitcoin [55] has gained traction beyond gaming platforms and the dark web.

Cryptocurrencies are an essential component in transaction on blockchain, hence of greater importance to understand on e-commerce platforms. Acquiring digital currency is the first part of blockchain transaction which can be done through digital wallets such as e.g. Bitcoin wallet applications available on web/mobile computing devices. Businesses realize its significance in the transaction exchange for goods in platforms which has facilitated the consideration in e-commerce systems design to cater for blockchain usage. Depending on the platform for transaction exchange, specific digital wallets or currencies will be listed to complete a payment.

The process of blockchain in e-commerce involves all elements of the transaction whether it is a product or service exchange. With the facilitation of automation, instant

Fig. 5  E-commerce blockchain transaction process
transfer, the proof of work authentication, decentralization of transaction processes and the direct connection between the customer and the e-commerce organization; blockchain potentials electronic commerce systems to be secure, fast and an easy process.

Having a decentralized architectural approach, the progression of e-commerce’s with blockchain expects complete automation of processes throughout the supply chain, utilization of smart contracts for ease in securing transaction, eliminating the need for third party contractors and easing governments and businesses from fragmented systems to defined policies.

4.2 E-Commerce Social Internet of Things (SIoT)

The expectation of a social environment of hardware, software, data stowage between organizations and its customers is the future of e-commerce.

With systems interoperability, organizations are opting for less storage capabilities in-house and source for reachable quicker and faster approaches which would be less costly. This has led to the emergence of the social relationship between the businesses from manufacturing through end-to-end customer delivery. In so doing, organizations allow their service platforms and its customers to access their system resources on demand through the internet. This is done without the organizations need to solely manage resources which range from high power mechanical operations through to day-to-day business applications.

This Social Internet of Things (SIoT) as described by Atzori et al. [56] aims at being the base for autonomous interactions among objects (service discovery and composition) towards benefiting the human user. In e-commerce SIoT benefits businesses through scalability of systems but also in securing customers such include:

(1) **Delivery** which communication and movement of objects especially through autonomous channels such as drones from pickup to delivery will be enhanced to ease barriers such as geospatial and visibility issues as it communicates with other devices.

(2) **Efficiency** in customer service as devices will be able to quickly exchange information and provide what is needed to the customer expectation.

With services such as cloud computing [57–59], Social Internet of Things (SIoT) is aimed to reduce computing power in e-commerce organizations with scalable architecture, computational power, and performance in the service by engaging customers and enhancing faster customer reach regardless of customer communication device, hence essential for customer retention and reducing cost.
4.3 **E-Commerce 5G Connection System**

Commerce today is bleak without sustenance of a platform of exchange. As technology is demanding speed in every domain, connectivity is key. With diverse applications and devices online, massive data sharing and connectivity, increase in smart consumer demands, foresee congestion of networks, thus the core network technology operating systems must be looked into.

The notion of “always on” [60] connection demands for faster speed and faster performance of not only e-commerce systems but any hardware and software integration with it. With the upscale in software defined networks and increase in mobile technology usage, 5G (5th Generation wireless network) [61] connection is the future of high performance of electronic commerce systems.

Unlike its current predecessors of 4G and 4G LTE, 3G and 2G connections; 5G promises to offer higher frequencies which can transmit faster connections and low latency thereby, can process high volumes of data with slight delay. This is key to not only communication but the whole supply chain system ranging from online catalogue browsing to autonomous vehicles for e-commerce delivery such as drones and driverless cars to smart connectivity with 5G driven IoT use cases [62].

The expansion of e-commerce systems expect automated and programmable open interfaces of tasks, configurations and policies on network equipment with the usage of Software Defined Networks (SDN) [63–65] in 5G connectivity. SDN allows the behavior of network equipment to be logically controlled in a centralized manner.

With these capabilities, evolution of electronic commerce platforms foresee an innovative exposure to faster connectivity, smart display of its platforms, enhanced Augmented Reality viewing, faster efficiency in application of robotics in manufacturing and advance communication on mission critical delivery systems such as autonomous vehicles on every connectable application and hardware device giving businesses a leverage in the supply chain.

With the fast track of digital dynamics during the Covid 19 Pandemic, the future of advancements in e-commerce systems is imminent. As discussed in this chapter, the innovations success are determinant on acceptance and actual use of systems.

Consumers appetite in data service create demand and strain on the current network topology. Network expansion is essential in determining user trust as efficiency of systems ease up e-commerce delays such include payments, risk of losing funds for e-commerce systems and faster communication for delivery as services expound.

As the push to technology centric domain is in demand with people moving online, familiarity to e-commerce system where users gain trust is critical. Unlike shopping cart models where users experience hidden charges or unaware of the fiat currency exchange platforms, as well as the details on information sharing makes the use of blockchain systems attractive. Blockchain ensures an open transaction platform where consumers are able to see movement of transaction for and between platforms of exchanges.
Popularity of SIoT devices are gaining acceptance with smart homes and smart technologies, with this the ability to store user knowledge is still a determining factor in usage behavior whereby, consumers deem them trustworthy by allowing network discovery and degree of interaction between objects for information collection and sharing among systems and IoT devices.

Future studies are essential on the variance of behavioral changes on users be it between business to business or business to consumer on omnichannel systems integrating or adopting to the new technologies and whether the determinants of ease of use to include integration, maturity and simplicity of systems will enhance usability.

## 5 Anticipated Challenges in E-Commerce Systems Progression

With the increase in complexity of systems and new areas of systems and systems engineering, evaluating the emerging innovative approaches of software architecture must be realized against the challenges it poses to e-commerce.

Willingness to share information and interconnectivity of devices is dissolving issues of discretion. As trust is established in accepting and using systems, privacy is the least of everyday e-commerce system usage concern but, the complexity of the future systems, its impact on critical infrastructure as well as engineers’ knowhow and of systems.

As demand grows, critical infrastructure resources such as power/energy/electricity, transportation, systems security, and the overall societal impact will bear the burden of expansion of hardware and software complexity in systems. Utilization of energy resources to accommodate complex systems such as blockchain technology for e-commerce will significantly impact the power grid systems. With every communication established in the blockchain process to reach an agreement, utilization of computing and network power process is utilized. This will in the future burden the energy system as more and more organizations enter this marketplace. Alternate initiatives on the utilization of smart energy grids using solar and wind energy to accommodate for the increase in computing system processes need to be understood and implemented within individual governments and countries across the globe.

As e-commerce innovation develops, the transportation system whether it is through water channels, road systems or air channels would have to accommodate massive connectivity and delivery channels. It is essential that this critical infrastructure of communication have regulations and security protocols for efficiency across the supply chain. The expectation of 5G enabled autonomous delivery vehicles driverless drones, smart cars and smart airplane systems taking over delivery and distribution channels safeguarding each application layer in systems, security
protocols will have to be considered to safeguard breaching of systems and loss of data through malicious activities.

The ability of AI enabled e-commerce systems platforms to securely work with mass volumes of data which is a crucial component connecting consumers with organizations [66] without redundancy, incomplete capturing and failure in processing creates a challenge in EC. With AI capabilities such as machine learning advantaging businesses with technologies such as Conversation commerce; where virtual agents listen through the communication on networks and devices on brand sharing content of users on different platforms questions not only data security which allows for organizations to push for content based on agents’ information gathering but also congestion of networks. This challenge broadly addresses governments and organizations alike at large who envision to have smart technologies in place running heavy data transmissions. E-commerce being data intense will be dependent on high network throughput in technologies such as 5G to sustain.

As systems evolve, a unified communication between SIoTs is expected to be autonomous hence raises concerns on whether the ability of machines collaborating with each other autonomously will dominate operations or override systems programmed functions. This anticipated challenge of autonomous systems making over-riding decisions for efficiency of the system which might lead to human endangerment is a critical area of concern. Hence advancements in knowledge on integration and interoperation of systems engineering is an essential to management of systems interaction.

Advancement of systems solutions will always raise the question on impact of working roles where systems dominate the market. Societies in high adoption of technology countries will have to educate people on systems operations to avoid being economically impacted when system interoperability will render unskilled workers redundant in their jobs, such include customer care careers which are replaced with automated AI bots, retail associates replaced with Augmented reality to assist consumers in choosing and purchasing products online, warehouse boxing and packaging replaced with robots. Adapting in different software and hardware dimensions, the future will also scramble to define the roles of system engineers. The domain of systems and systems engineering (SoSE) demand experts in cyber physical systems to include robotics and integration capabilities to keep up with the complex software approaches and the changing requirements on every architectural tier of development in e-commerce.

6 Conclusion

E-commerce systems solutions offers a promising paradigm in delivering commercial solutions as it evolves. As a software-intensive system, taking into consideration the design principles of the fourth industrial revolution i.e. interconnection, information transparency, technical assisting systems and decentralized decision making,
e-commerce systems are integral in evolution of the way humans work as well as enhances global trading services.

E-commerce systems are the driver to the future software development, therefore, a broader view of how software applications will impact the everyday life adhering to legal frameworks, environmental protocols, infrastructure advancements, information management, societal concerns, technology knowhow and the shrinking geographical boundaries has to be realized.

With the world visioning for smart cities, efficiency of commercial technology is vital. Smart cities services and operations require sophistication of technologies from connectivity, storage to management across complex urban settings that meet the requirements of systems interoperability and functionality. Defined Technology Acceptance Models that cater to users in determining the value and acceptance of omnichannel systems and the technologies beyond online standalone stores is essential to ease electronic systems into our day to day commerce.

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