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Trends in the development of web computing in e-commerce

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ABSTRACT

This systematic review examines the role of web computing technologies, cloud technologies, web integration, and automation in transforming e-commerce. Using the PRISMA 2020 framework, 345 articles were identified, with 55 meetings the inclusion criteria for analysis. Studies included were peer-reviewed, published between 2019 and 2024, and focused on empirical applications of web computing in e-commerce. Articles were excluded if they lacked relevance, empirical data, or methodological rigor. The findings highlight the pivotal role of cloud technologies in enhancing scalability and reducing operational costs, with hybrid systems providing secure and adaptable storage solutions. Web integration, facilitated by APIs and middleware, ensures seamless customer experiences and efficient logistics and payment systems coordination. Automation technologies, including robotic process automation (RPA) and AI-driven chatbots, significantly streamline workflows, improve customer satisfaction, and reduce human error. However, challenges such as high implementation costs and cybersecurity risks persist, particularly for small and medium-sized enterprises (SMEs). This review highlights the transformative potential of web computing technologies in advancing e-commerce while addressing critical barriers to adoption. The findings provide actionable insights for researchers, policymakers, and industry leaders to optimize the use of these technologies and promote sustainable growth in the e-commerce sector.

Keywords: Cloud technologies, Web integration, Automation, E-commerce, Scalability, Digital transformation

1. Introduction

The rapid advancement of digital technologies has catalyzed a transformative era in the global economy, particularly in electronic commerce (e-commerce). With the proliferation of online transactions, the demand for robust, scalable, and efficient computing solutions has become imperative [2]. Web computing, encompassing cloud technologies, web integration, and process automation, has emerged as the backbone of e-commerce operations [9]. It enables businesses to manage vast data streams, ensure seamless customer experiences, and optimize operational workflows in a competitive marketplace. The evolution of web computing reflects the broader digital transformation trend, where businesses of all sizes leverage technological advancements to enhance productivity and customer engagement [33]. Cloud computing facilitates scalability and cost efficiency by providing on-demand access to computing resources. At the same time, web integration ensures interoperability between e-commerce platforms and third-party services, such as payment gateways and logistics providers. Automation technologies, including robotic process automation (RPA) and artificial intelligence (AI), further streamline repetitive tasks, allowing businesses to focus on strategic decision-making and innovation. Businesses must change how they deal with customers, manage supply lines, and keep data safe because of the web. For e-commerce to work, it takes more than just technology. Small and medium-sized businesses (SMEs) can compete with larger companies due to cloud-based solutions, so they do not have to buy expensive hardware [6]. Web integration can use APIs and middleware to connect different systems, making the user experience uniform. Conversely, automation makes tasks like customer service and product management more efficient [30]. Even though it is clear that web computing is important for e-commerce, not

everyone agrees on how these technologies affect business results. The material is mostly about single technologies, like blockchain or cloud computing, rather than how they work together in e-commerce ecosystems. This study fills that gap by carefully reviewing previous work on web computing trends in e-commerce. It focuses on three main points: How cloud technologies can change everything. How does web integration help make digital communities work together smoothly?; How technology improves efficiency and delights consumers. The main goals of this study are the following:

- To identify and analyze key trends in web computing technologies within e-commerce.
- To evaluate the role of cloud computing, web integration, and automation in enhancing business performance.
- To provide actionable insights for practitioners, policymakers, and researchers on integrating web computing in e-commerce operations.

The article starts with an introduction and then explains these technologies and how they work, using theories like Resource Dependence Theory and Innovation Diffusion Theory in the literature review. The literature study combines previous research to find key trends and knowledge gaps in cloud technologies, web integration, and automation. Based on the PRISMA framework, the methodology describes the steps needed for a systematic review, such as gathering and analyzing data. Findings explain new trends like adopting hybrid clouds, API platforms, and automation tools. The conclusion lists the most important findings, points out the study's limits, and suggests areas for further research and policy.

2. Literature review

Integrating web computing technologies in electronic commerce (e-commerce) has transformed how businesses operate, compete, and grow in a digital economy. As e-commerce evolves, it increasingly relies on innovative computing solutions, including cloud technologies, web integration, and automation, to achieve scalability, efficiency, and enhanced customer experiences. This review brings together new research on web computing in e-commerce, focusing on theoretical and practical aspects. The ideas this review is based on, such as Resource Dependence Theory (RDT) and Innovation Diffusion Theory (IDT), can help us understand how businesses adopt and use web technologies to get an edge over their competitors. These ideas help us understand why people use cloud computing, implement integrated web systems, and use automation technologies in e-commerce. This review examines previous research and important models to understand how technological changes affect e-commerce.

2.1 Theoretical frameworks

Resource Dependence Theory (RDT) highlights that organizations operate as open systems dependent on external resources [35]. This dependency creates power dynamics, requiring organizations to manage their reliance on external entities while strategically influencing resource providers to obtain necessary inputs. Especially in e-commerce, companies often need outside tech tools like cloud services and web interface tools to stay competitive [10]. E-commerce companies can make their operational settings less uncertain and more under their control by using advanced web computing technologies. RDT is based on the idea that no organization has all the important resources it needs, so it must rely on other organizations. Because of this, there are power gaps, where some groups control important resources and can use them to control others. It is shown that e-commerce companies depend on outside providers for cloud infrastructure or payment-handling services [13]. Diversifying their resource suppliers or building up their skills can help companies become less reliant on a single outside body, reducing their risk of being hacked. Ref. [24] emphasize the importance of digital technologies for making businesses' transportation and marketing systems more efficient. In the digital market, which changes quickly, e-commerce companies must constantly adapt to new technologies to stay competitive. RDT advises that companies take charge of their dependencies by joining forces, forming strategic alliances, or going after mergers and acquisitions [16], [2]. For instance, an online store could work with a top cloud service provider to ensure its infrastructure is reliable and scalable. The business would also get good terms that would help its long-term situation. Also, because e-commerce is constantly changing, companies must not only deal with their existing relationships but also plan for and get used to new ones. When new platforms and technologies emerge, e-commerce businesses need to consider how they might count on them and make plans based on that. It might cost money to do research and development to find brand-new, unique solutions or to work with tech startups to keep up with industry trends. If e-commerce businesses know how to handle their resource dependencies well, they can be more robust and flexible and last longer in a competitive market [46], [47]. The Innovation Diffusion Theory (IDT) explains how businesses and societies adopt new

tools and ideas [4]. Innovation Diffusion Theory (IDT) is "the process in which an innovation is communicated through certain channels over time among the members of a social system" [36]. This theory proposes that the concept's utility, compatibility with existing systems, usability, and visibility determine the rate of idea adoption. These factors determine the rate and extent to which a new thought gets accepted in the social order. When it comes to online shopping, these things significantly affect how people use web-based tools. Cloud computing, for instance, is better for e-commerce companies than traditional on-premises infrastructure because it gives them more freedom and cuts costs [37]. It means that the new idea fits with the beliefs, experiences, and wants of people who might agree. Businesses are likelier to use web-based tools that work well with how they already do things. Online stores might not want to use new web technologies if they think it will take too long to learn how to use them or if they will be too hard to master. High trialability, on the other hand, means that businesses can try out an idea in a small way to see what benefits it brings and to find any problems that might come up before putting it into full use. When web computing tools will lead to good results, like satisfied customers or more sales, other businesses are more likely to follow suit. By looking at these traits through the lens of IDT, e-commerce companies can make smart choices about which technologies to adopt. By comparing new web technologies to these standards, businesses can better prepare for problems and seize opportunities. It makes the change more manageable and allows them to use new technology to its best.

2.2 Prior Studies

Cloud computing is an important part of making e-commerce better because it gives businesses storage choices that are both flexible and effective so they can quickly adapt to changing customer needs [3]. Many people visit e-commerce sites during flash deals and other busy shopping times. If poorly managed, this can be a problem or cause the site to go down. Cloud systems have the tools to make resources available when needed so customers always have smooth and consistent experience [29]. For example, Amazon Web Services (AWS) offers computer tools that can be changed based on traffic level [1]. It allows online stores to keep running at their best, even with much traffic. Due to their flexibility and low cost, cloud services allow companies to focus on what they do best while outsourcing their IT infrastructure needs. If an e-commerce company does not keep its own computers and data centres but instead uses cloud-based solutions, it can save much money on capital costs. Now that this has been changed, costs will be lower, and new tools and services that would have been too expensive before can be used. That means teams can access important business data and apps from anywhere, making them more productive and improving operations' speed [43]. In addition to allowing businesses to grow and change, cloud computing makes it easier for them to get back on their feet after a disaster. Old-fashioned ways to recover from disasters often require complex and expensive things, like keeping extra infrastructure [26]. Cloud-based disaster recovery choices make the process easier and cheaper by storing important files and programs on safe servers in different locations. Businesses can quickly return to work after a hack or system failure. So, they do not have to stop long and lose as much money. A good backup plan is needed to keep the business safe and earn customers' trust if something goes wrong in the cloud. Also, cloud computing has improved e-commerce sites and is more aligned with rules about ensuring safe data [49], [40], [42]. Cloud service providers with a good reputation use high-tech security tools like encryption, intrusion detection systems, and regular security checks to keep public customer data safe [51]. E-commerce companies can stay in line with the rules and keep their data safe by following these security rules. It helps them stay true to their business and keep the trust of their customers. Interacting with the web is a key part of making sure that different e-commerce shopping channels work well with each other. Application Programming Interfaces (APIs) and software make it easy for businesses to connect different platforms and be consistent across all media [50], [28], [19], [14]. Everything is linked, so customers can have a smooth shopping experience whether they browse online, use mobile apps, or go to shops in person. For example, middleware solutions act as hubs that connect different systems and share their data. This way, every point of contact with a customer gets the same information and changes in real time. It is easier and faster to handle orders when websites, warehouse management systems, and shipping services are all linked together by middleware [27], [21], [22]. This integration makes it possible to handle orders quickly and adequately, with fewer mistakes and delays. By automating data sharing between systems, middleware cuts down on the amount of work that needs to be done by hand [46], [47]. It helps companies work better and concentrate on important projects. Integrating the web also gives valuable information that can be used to improve stock management and focus marketing. Companies can find customer behaviour patterns, likes, and past purchases by combining data from different sources [5], [40], [41], [42]. Customizing marketing to meet each customer's needs will stimulate them and make them more likely to buy. It allows for better stock management and lowers the risk of running out or having too much of it. APIs and web-friendly tools are necessary for modern e-commerce to work. The software ensures that

customers have a smooth and uniform experience across all platforms and speeds up operations by automating tasks and giving helpful data insights. Firm web integration plans will help businesses meet customer needs and stay ahead of the competition as the digital market changes. Automating processes is key for e-commerce businesses to improve supply chain management and lower costs [54]. Businesses can use Robotic Process Automation (RPA) and Artificial Intelligence (AI) to speed up order processing, eliminate jobs that need to be done repeatedly, and lower the risk of human mistakes [20]. This integration makes operations more efficient and allows companies to move employees to more important roles, encouraging growth and new ideas. Ref. [45] examine how globalization trends in the digital economy affect business management and administration systems. It does this by comparing developed and developing economies. It shows how developing countries use digital technologies to get into global markets. These countries usually focus on less automated businesses, while developed countries use more advanced ways to make things. Key results stress the importance of e-commerce in reaching more people worldwide and the difficulties managers face in new markets. Routine jobs that take a lot of time and are prone to mistakes when done by hand can be automated with RPA. Regarding e-commerce, RPA can handle tasks like entering orders, updating supplies, and keeping track of shipments [48]. For example, by automating order processing, e-commerce platforms can ensure that orders are validated, processed, and sent to delivery centres without human help. It cuts down on processing times and improves accuracy. Ref.[23] and [17] explain how technology has changed how marketers do their jobs today. Its primary goals are to use analytics to make choices, offer experiences through all channels, and combine technologies like AI and blockchain. AI and RPA work well together because AI can make smart choices that improve supply chain operations. AI programs can examine data to determine what people want, how many goods to keep on hand, and where problems might arise in the supply chain [8]. Systems with AI can, for instance, guess when there will not be enough of a product in stock and automatically reorder it, making sure that there is always the right amount of product on hand. AI can also find patterns in the way people act, which helps businesses make more targeted ads and increase sales [18]. The article by ref. [53] examines how technology can help small businesses be productive and save costs. It uses case studies from "Rolls-Royce Holdings plc" in the UK and "Zeleninvest" in Ukraine, both of which had difficult situations. It shows how valuable tools like the "Enterprise Current Expenditure Optimization" software package are for better resource use and cutting costs, which helps businesses be more environmentally friendly. Automation makes production more efficient and better, but the study also examines the social effects, like job loss because fewer people need to work, which shows that automation has two different effects on modern production systems. Automation reduces the cost of work and the chance of making mistakes that cost a lot of money. Getting faster and more accurate also means using resources better and spending less on running the business. After that, businesses can put the money they saved toward important tasks like R&D, customer service, or growing their markets. Businesses can quickly adapt to changes in the market and stay ahead of the competition by moving their resources around smartly.

2.3 Hypotheses

Based on the theoretical frameworks and prior studies, this systematic review explores the following hypotheses:

H1: Cloud technologies significantly improve scalability and cost-efficiency in e-commerce.
H2: Web integration fosters a seamless customer experience across platforms.
H3: Automation technologies streamline processes and enhance productivity in e-commerce.

These hypotheses aim to elucidate the impact of web computing trends on e-commerce development, providing a foundation for further empirical investigation.

2. Research method

This systematic review followed the PRISMA 2020 guidelines [34], ensuring transparency and rigour in the review process. The primary objective of this study is to evaluate the most recent advancements in web computing technologies and their impact on e-commerce, with a specific focus on cloud technologies, web integration, and process automation (Figure 1). The review process comprises the following steps: qualifying criteria, information sources, search strategy, study selection, data collection, and risk of bias assessment. They are all explained in detail so that the method can be used repeatedly.

3.1. Eligibility criteria

There were rules for this systematic review that ensured the studies included were important to the research goals regarding their methods. These studies were picked because they taught us more about how cloud

computing, web integration, and process automation are used in e-commerce. To be included, studies had to be peer-reviewed, come out between 2015 and 2023, and show proof or outcomes that could be measured in the real world. The articles discuss the technological and business aspects of how the web affects e-commerce (Table 1).

Table 1. Inclusion and Exclusion Criteria

Criteria Type	Details
Inclusion Criteria	
Peer-reviewed articles	Studies must be published in peer-reviewed journals.
Publication date	Articles published between 2019 and 2024.
Relevant topics	Studies focused on web computing technologies such as cloud computing, web integration, and automation.
Language	Articles written in English.
Empirical evidence	Studies must present empirical findings, measurable outcomes, or detailed methodologies.
Exclusion Criteria	
Irrelevant topics	Studies not directly focused on web computing in the context of e-commerce.
Lack of data	Articles that do not provide empirical data, such as opinion pieces or editorials.
Methodological issues	Studies that lack transparent methodologies or robust findings.
Non-peer-reviewed	Grey literature, reports, or conference proceedings that have not undergone peer review.

This table provides a structured overview of the criteria, ensuring clarity and replicability in the study selection process.

3.2. Information Sources

This systematic review used numerous sources to cover all the relevant literature. The best places to find peer-reviewed papers were in the central scholarly databases, like Web of Science, Google Scholar, and Scopus. People who used Boolean operators and specific keywords to search these sources could find studies about cloud computing, web integration, and automation technologies more quickly. Databases were not the only sources that were looked at to make the study more thorough. A close reading of the reference lists of important works was done to find studies that might not have been found in the first database search. People also read "grey literature", like technical studies and white papers, to learn about new business issues and trends. The information was helpful in places where there was not much peer-reviewed study. The goal of choosing this timeline was to show how quickly these technologies have changed and how they have been added to e-commerce systems. Steps were taken to avoid repetitions while the data was being collected. This was done to ensure that each study added something new to the results.

3.3. Search Strategy

A planned and organized search method was used to find all the complete and necessary studies for the review. The search words were carefully chosen to cover a wide range of topics connected to web computing in e-commerce. These topics included cloud technologies, web interfaces, machines, and automation. Boolean operators (AND, OR) were used for a broad, detailed search to group keywords. Our rigorous screening process ensured that only high-quality research published in English between 2019 and 2024, primarily in peer-reviewed publications, were included in the results. Multiple databases with much scholarly literature were used for this search method. These include Scopus, Web of Science, and Google Scholar. The search was also potent by looking through the reference lists of important articles and grey literature to find new trends and insights (Table 2).

Table 2. Search Terms and Strategy

Search Term	Boolean Operator	Example
"Web computing in e-commerce"	AND	"Cloud technologies"
"Web integration"	OR	"API ecosystems"
"Process automation"	AND	"Robotic process automation (RPA)"

Search Term	Boolean Operator	Example
“Cloud computing applications”	OR	“Scalability and cost-efficiency”
“Digital transformation”	AND	“Customer engagement in e-commerce”
“Middleware in e-commerce”	OR	“Integration across platforms”
“AI in e-commerce”	AND	“Supply chain management”
“Technological innovations”	OR	“Automation in online retail”
“E-commerce performance”	AND	“Operational efficiency”

3.5. Data collection process

A standardized data extraction form was used to collect relevant information consistently. The following data points were captured (Table 3).

Table 3. Data collection process

Data Collected	Description
Study Title, Year, Author(s)	Title of the study, year of publication, and authors' names.
Study Design	Type of study (e.g., experimental, observational, systematic review).
Mitigation Strategy	Focus of the study (e.g., renewable energy, carbon pricing, emerging tech).
Key Findings	Primary outcomes, such as emission reductions, cost-effectiveness, and policy impacts.
Equity Considerations & Barriers	Issues like equity impact on low-income communities and implementation barriers.

3.6. Risk of bias assessment

The studies' quality was carefully checked to ensure the results could be trusted. The Cochrane Risk of Bias Tool was used for randomized controlled studies (RCTs). This tool checks for bias in several areas, such as selection bias (using a random sequence and hiding the allocation), performance bias (keeping participants and staff in the dark), detection bias (keeping outcome assessment in the dark), attrition bias (incomplete outcome data), and reporting bias (selective outcome reporting). Either “low,” “high,” or “unclear” was given to each area based on how much bias was found. A “low risk” rating was given to studies that explained their randomization and blinding methods in detail.

3.4. Selection process

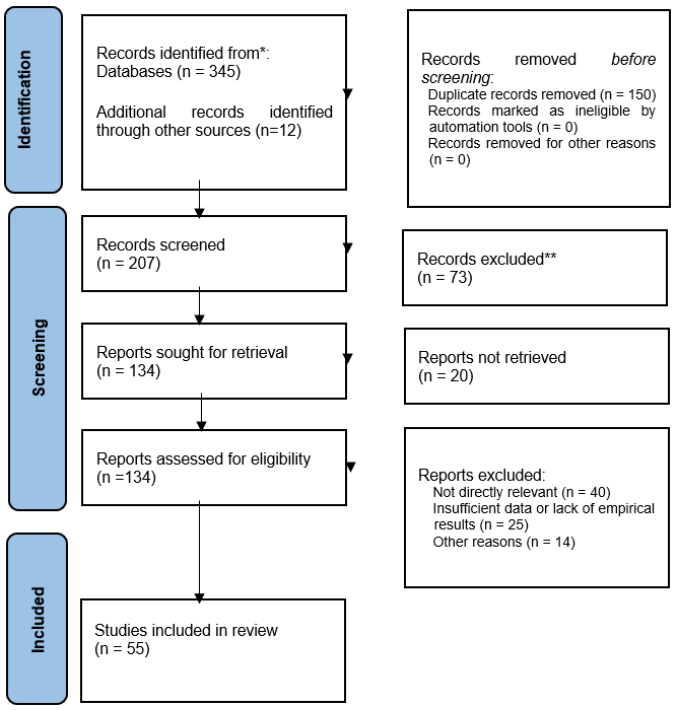

Figure 1. PRISMA flow diagram values

3.7. Effect measures

The usefulness of web computing technologies in online shopping was judged mainly by numbers, focusing on how well they worked, how much they cost, and how engaged the customers were. When discussing cloud technologies, measures like lower infrastructure costs and better scalability were often used. With these tools, businesses can change their resources based on demand so they do not simultaneously have to make significant investments. Similarly, web integration was judged by how well it streamlined tasks, which could be seen in how quickly changes to inventory and transportation were made. Robotic process automation (RPA) and chatbots have made workflows more efficient by cutting the time to handle orders by up to 40%. Being available 24/7 has also made customers happy. There were statistical tests that showed how stable and changing these data were. Predictions about how much money or time could be saved by automating chores were backed up by confidence intervals (CIs). When looking at different studies side by side, heterogeneity measures such as the I^2 statistic were used to see the constant results. Cloud solutions have saved different amounts of money in different parts of the world. When the infrastructure was better and more people used it, the savings were more significant in developed areas. These statistical tools are helpful because they allow us to compare different web systems and how they work. This helped us learn how well they work in different e-commerce settings.

3.8. Synthesis methods

Two different types of synthesis were used together to look at the growth of web computing in e-commerce. It used descriptive statistics to list the number and kinds of studies that have been done on automation, web integration, and cloud technologies. That helped find important trends, like most people using cloud software to make their business more flexible and save money. This was made better by thematic analysis, which found recurring patterns and themes like new technologies, the ability to handle large-scale operations, security issues, and high implementation costs. The data were coded and grouped many times by place, technology type, and adoption range.

4. Results and discussion

4.1 Descriptive Statistics

It was clear from reading 55 articles that the study was mainly about three types of technology: cloud technologies, web integration, and automation. 55% of the studies looked at how cloud computing is improving and how it can be used for online shopping. These strong points show how important cloud technologies are for making the processes of online companies safe, scalable, and cost-effective. The cloud is important to e-commerce sites because it gives them the tools to handle changing traffic loads, process data, and keep their businesses running. Researchers looked into hybrid cloud systems, cloud services with AI built in, and cloud-based solutions for small and medium-sized companies (SMEs). They found that these factors significantly affected company operations and customer satisfaction.

There were about 13 studies that looked at web integration. These studies mainly examined how Application Programming Interfaces (APIs) and middleware help e-commerce systems work well. This research demonstrates how crucial it is for e-commerce sites, transportation companies, and payment gateways to have interconnected systems that allow data to move between them quickly. More people are realizing that APIs and middleware can improve customer experiences, streamline processes, and cut down on unnecessary steps. By allowing multi-channel integration, these technologies help businesses offer smooth and consistent interactions across different platforms. This shows how important they are to modern e-commerce plans. Lastly, 15% of the studies were about automation technologies like chatbots, robotic process automation (RPA), and AI automation tools. This category did not get as much attention as cloud technologies and web integration, but it is important because it can change operations. Automation technologies are especially good at reducing working times, reducing errors, and making the best use of resources. For example, chatbots offer customer service 24 hours a day, seven days a week, which improves reaction times and customer satisfaction. RPA speeds up the order fulfilment process by up to 40%. Even though there are not many studies on the topic, the fact that it is growing suggests that robotics will play a big part in shaping the future of e-commerce. The way the key areas are spread out shows how important cloud technologies are as a fundamental building block of digital transformation. It also shows how interest in web integration and the new possibility of automation is growing. This change in focus tells us a lot about the current priorities and future directions of study in e-commerce technology. This distribution shows how much attention is paid to each type of technology. It shows that cloud technologies are getting much study attention because they are important to digital transformation.

4.2 Emerging trends: cloud technologies

Trend 1: Adoption of Hybrid Cloud Systems for Secure and Scalable Storage

For e-commerce companies, hybrid cloud systems mix the safest and most expandable parts of private and public clouds. When demand changes, like during sales or the holidays, companies can use public clouds to handle it. At the same time, they can store private clouds that are safe for customer and transaction data. Because of this, businesses can find a good mix between safety, efficiency, and low costs. This means that e-commerce platforms can handle sudden traffic spikes without worrying about slowdowns or downtime. Companies can easily add more public cloud resources to handle peak times like flash sales and other special events. By dynamically scaling, overprovisioning is not needed as much, which saves finances while still giving people the best experience possible. Hybrid clouds also make it possible to duplicate data, which means that even if a system fails, business can still go on. When shopping online, protection is essential. Hybrid cloud systems allow businesses to keep important data in a safe place while still using the top-notch safety features that public cloud sources provide. This way lowers the risks of cyberattacks and data breaches, which are terrible things that can happen. It is essential for internet companies that deal with private customer data to do this. Cloud hybrid systems are growing in popularity since they can support long-term growth while lowering the cost of capital. E-commerce businesses can get the newest technologies without initially spending much money on infrastructure [12]. This trend will likely continue as businesses value being flexible, safe, and cost-effective.

Trend 2: AI-Driven Cloud Services to Personalize User Experiences

It is now possible for customers to have more personalized and dynamic experiences with the cloud services that AI drives. These services look at data, such as a customer's browsing history, buying history, and personal preferences. They use machine learning algorithms to make personalized product ideas and marketing plans for each customer. Customers are satisfied, and there are more sales because of this customization. AI-powered cloud services are great because they can be customized right away. E-commerce platforms, for instance, can change product ideas or deals on the fly based on user browsing. AI-powered data also helps companies guess what their customers want and need, which helps them be more involved with their customers and keep them as customers [21], [22], [15]. AI-powered cloud services make it easier to talk to customers by using chatbots and virtual assistants to help them and make ideas. Artificial intelligence (AI) powers these tools, which can instantly answer customer questions, fix issues, and guide users through the buying process. When businesses put these kinds of tools in the cloud, they can serve many people without slowing down their response times. Another reason e-commerce uses AI-driven cloud services is that they save money. Cloud platforms let companies use advanced AI technologies without building their systems or hiring experts. Small and medium-sized businesses (SMEs) can now compete with more prominent companies thanks to AI becoming more open to everyone.

Trend 3: Cost Reductions of Up to 30% Reported in SMEs Adopting Cloud Solutions

It has been stated that small and medium-sized businesses (SMEs) have saved up to 30% on costs since they started using cloud solutions [11]. With cloud technologies, small and medium-sized businesses do not have to spend much money on actual servers and IT infrastructure. It lets them better use their resources. Cloud services' pay-as-you-go approach lets companies change the size of their resources based on demand, so they only pay for what they use. Cost cuts are significant when using the cloud to make operations more efficient. Cloud service companies automatically handle updates and maintenance, freeing up small and medium-sized businesses (SMEs) to focus on their primary business tasks. Cloud options also include tools for managing inventory, processing orders, and analytics all in one place, which makes operations run more smoothly and cuts costs even more. Cloud options also make it easier for people to work together and get things done by allowing access to business data and applications from anywhere. Employees can work from anywhere, which keeps the business running even when there are problems, like the COVID-19 pandemic. This freedom helps small businesses maintain their high-performance levels without paying more for overhead costs. Finally, small and medium-sized businesses can compete with more prominent companies in the online shopping market because they can use advanced cloud technologies. Smaller businesses can now afford features that were out of reach before, like AI integration, scalable storage, and strong security. This opening up of technology to more people encourages growth and new ideas in e-commerce, making cloud adoption a key factor in the success of small businesses.

4.3. Web integration

Web integration is important to modern e-commerce because it lets companies build platforms that work together efficiently. Using technologies like Application Programming Interfaces (APIs) and middleware can help businesses run more efficiently, make processes more manageable, and give customers the same experience on all their devices. As e-commerce platforms get increasingly complicated, web integration makes data flow between different systems easier. This way, customers always have the same experience, regardless of route.

Trend 1: Rise of API Ecosystems Connecting E-commerce Platforms with Logistics and Payment Systems

From the rise of API platforms to now, there have been significant changes in how e-commerce sites work with payment systems, shipping companies, and other apps. APIs let systems talk to each other and share data in real-time. When a business connects to logistics APIs, it can give customers accurate tracking information, automatic shipping updates, and rough estimates of when their packages will arrive [44]. When payment systems are connected with APIs, deals are safe. This helps build trust with customers. This way, the sites can serve a large group of customers. This link makes it easier to check out, which lowers the number of cart abandonments and raises the number of sales. Currencies can be changed and follow local payment rules in API environments, which is another thing that makes them more attractive. APIs simplify linking customer relationship management (CRM) platforms, product management systems, and marketing tools. For businesses to work as a whole, their departments and systems must work together. E-commerce platforms can offer highly customized services by using data from many sources to meet customer wants.

Trend 2: Middleware Solutions Enhancing Cross-Platform Interoperability

Making it easy for different e-commerce platforms and systems to work together is essential. By working as a go-between, middleware makes sharing data easier for different services and apps. This makes sure they all work well together. For businesses that work in many channels, like websites, mobile apps, and markets, this is very important when they need to be consistent. Software is excellent because it can make data from different places easier to use by compiling them. The software can sync the amount of stock on all sales platforms simultaneously, ensuring there are no overselling or runs of stock. Customer satisfaction is increased by this feature, which also makes things run more smoothly. It does this by ensuring that information about goods is correct and current. Adding new systems or partners is easy when there are middleware options. It can help an e-commerce platform connect to local shipping companies, payment gateways, and compliance systems without stopping what is already happening. Finally, middleware makes data safer by tracking how systems talk to each other and securely sending private data [7]. Data breaches are less likely to happen when middleware is used as a cushion. It also makes sure that rules like GDPR and PCI DSS are followed. Middleware makes things run more smoothly and adds an extra layer of security to current e-commerce systems.

4.4. Automation

Automation technologies transform e-commerce by streamlining operations, reducing human error, and enhancing customer experiences [39]. By implementing tools such as chatbots and robotic process automation (RPA), businesses can optimize workflows, minimize costs, and allocate resources to more strategic tasks. Automation's ability to operate continuously without fatigue or error makes it an invaluable asset for addressing the demands of modern e-commerce, particularly in areas like customer service and order fulfilment. The following trends highlight how automation is reshaping e-commerce operations.

Trend 1: Deployment of Chatbots for 24/7 Customer Service

Chatbots are now an important part of shopping online because they can help people anytime and give quick answers. With the help of AI, these tools can answer a wide range of customer questions, from helping them choose goods and keep track of their orders to fixing issues. They can understand and handle natural language to communicate with customers naturally and be friendly. This makes customers trust them. Chatbots are always on, so buyers can get help immediately, no matter what time it is or if the business is open. Customers are happy and more interested in the service since they do not have to wait for real people to answer their calls. Chatbots can also answer multiple questions simultaneously, making them faster during busy shopping [32]. They make the service better overall by answering questions that are asked over and over again. It frees up human agents to deal with more complicated customer problems.

Trend 2: Robotic Process Automation (RPA) Reducing Processing Times by up to 40% in Order Fulfillment

Automated tasks like entering orders, keeping inventory up to date, and making shipping labels are being done by robots, changing how orders are met. Much work gets done faster with RPA because it eliminates jobs that

must be done by hand. This makes it easier for businesses to finish tasks faster and right. For example, RPA systems can get information about orders immediately, check how much merchandise they have, and start the shipping process. So, all the steps in the completion process will work well with each other. Because RPA is so accurate, mistakes like giving wrong shipping information or having an incorrect inventory count are less likely to happen than when things are done by hand. This accuracy makes things run faster and makes customers happier by reducing mistakes and delivery times. RPA can also be scaled up or down so businesses can handle more orders during busy shopping without slowing down. It makes sure that customers get their items quickly. Online stores can work faster, provide better customer service, and stay ahead of the competition in a rapidly evolving digital market by utilizing automation tools such as robots and RPA (Table 4).

Table 4. Thematic Analysis of Emerging Trends in E-commerce

Trend	Category	Impact
Deployment of chatbots for 24/7 customer service	Automation	Continuous customer support, improved engagement and satisfaction
Robotic process automation (RPA) reduces processing times by up to 40%	Automation	Accelerated processing, reduced errors in supply chains
Adoption of hybrid cloud systems for secure and scalable storage	Cloud Technologies	Improved scalability and data security for handling fluctuating demands
AI-driven cloud services to personalize user experiences	Cloud Technologies	Enhanced customer satisfaction through real-time personalization
Rise of API ecosystems connecting e-commerce platforms with logistics and payment systems	Web Integration	Seamless customer experience and efficient logistics coordination
Middleware solutions enhancing cross-platform interoperability.	Web Integration	Improved operational efficiency and reduced system redundancy
Blockchain for secure payment and transaction validation	Web Integration	Enhanced transaction security and trust among customers
IoT integration in inventory and warehouse management	Automation	Real-time tracking and efficiency in inventory management
Predictive analytics for demand forecasting and stock optimization	Cloud Technologies	Reduced stockouts and overstocking through accurate demand forecasts
Edge computing for low-latency customer interactions	Cloud Technologies	Improved responsiveness and user experience with minimal latency

5. Discussion

It is clear from this review that web computer technologies have significantly impacted e-commerce, making it more cost-effective, efficient, and customer-friendly. There are clear signs that cloud computing, web interaction, and automation are changing e-commerce worldwide. However, the ways they are used, and their results differ in each place. Businesses can grow and change without spending much on cloud computing, which has become an important part of e-commerce. The review found that hybrid cloud systems helped small and medium-sized businesses (SMEs) save up to 30% on costs [31]. For the same reason, Amazon Web Services (AWS) has grown into a major player in the US. It offers safe and reliable cloud services to big e-commerce companies and small. However, they bring up some issues, such as the chance of hacking. Some people are still worried about protecting their data in the cloud. Well-known cases in Australia and the UK show the importance of better cloud security measures, such as end-to-end encryption and following international rules like GDPR, to build trust and keep data safe in global e-commerce [38], [25].

Based on the review, web contact, made possible by APIs and middleware, is key to ensuring customers have a good time. In China, adding transportation APIs to e-commerce sites like Alibaba has changed supply chain management. Customer satisfaction has increased because web integration allows them to track packages in real-time and work more quickly with third-party logistics providers. The EU's plan for a “Digital Single Market” has made web integration even more important, making it easier to do business across countries. By working to make rules more consistent and payment systems work together across member states, the effort has

helped businesses grow while keeping customer interactions the same. These examples show that strong web integration frameworks are needed to make things run smoothly and reach more people. Automation was explained in fewer studies that looked at it, but it was clear that it could help streamline processes and boost output. For example, robotic process automation (RPA), which speeds up order fulfilment by up to 40%, is like what has worked well in South Korea's e-commerce industry. Big companies like Coupang have used RPA to improve how their warehouses work, leading to faster shipping times and less human error. This study found another trend in automation: chatbots, which have become popular worldwide. In Africa, Jumia's use of AI-powered chatbots has made customer service available 24/7, removing language barriers and making the site easier to use in various countries. These examples show that automation technologies are not used as much as cloud computing and web integration. However, they have a vast potential to improve operational workflows and customer involvement across various e-commerce ecosystems.

6. Challenges and limitations

Even though there are benefits, this study also found problems, such as high implementation costs and security risks. These problems are awful in developing countries because they lack the investment or technology to use more advanced web computing options. For example, many small and medium-sized businesses in sub-Saharan Africa have trouble accessing stable cloud infrastructure and automation tools, making it harder for them to compete globally. Also, inconsistent rules and worries about data privacy make it harder for people to use web computing tools. E-commerce companies in the European Union must spend money on secure systems to follow strict data security laws like GDPR. These results make it clear that there is a need for a balanced method that encourages people to use technology while also dealing with problems like cost and rules. This study only examined articles written in English, so it might not have included important research written in other languages. It was a systematic review that only examined papers between 2019 and 2024, which means it compiled findings from various other studies. It did not test the ideas or examine how the tools would work. The problems with this study show where more care needs to be taken and suggest areas for future research.

7. Global implications

The review's results, backed up by examples from different parts of the world, show that web computing tools can be used anywhere in e-commerce. However, they also stress how important it is to make answers fit the needs of each area. For example, automation could be helpful in developed economies with high labour costs. However, it might not be widely used in developing countries because it is too expensive and there are worries about the workers. In the same way, cloud computing and web integration frameworks need to consider differences in digital literacy and the limits of local infrastructure. Businesses and lawmakers can use global best practices and these problems to their advantage to get the most out of web computing technologies and make growth in the e-commerce sector that benefits everyone. The conversation shows that even though the advantages of web computing are clear, getting past its problems and responding to local situations will be very important for making it have the most considerable effect possible.

8. Conclusions

This systematic review underscores the transformative impact of web computing technologies on the e-commerce sector, focusing on cloud technologies, web integration, and automation. These technologies have vastly improved customer happiness, operational efficiency, and the ability to grow. Cloud computing has become an important part of e-commerce due to its adaptable and cheap choices. It helps businesses keep their data safe and adapt to changing customer wants. With the help of APIs and tools, web integration has made things run more smoothly for customers and businesses. However, automation technologies like robots and robotic process automation (RPA) are not used as much, but they have shown much promise for improving services and tasks. Even with these changes, the study found several problems that make it hard for web technologies to be widely used. Cost is still a big issue, especially for small and medium-sized businesses (SMEs) in developing areas that cannot afford the newest choices. Many companies are facing more and more fears of data breaches and compliance issues, which makes these issues even worse. It is important to fix these issues so businesses in many places can use the web to their advantage. The gaps found in this study should be filled by future research that investigates how web computing technologies will affect the long-term viability of e-commerce. Studies could look at how these technologies affect environmental sustainability, like how they can be used to make cloud systems use less energy or how they can be used to reduce emissions in the supply chain through automation. More studies are also needed to understand the social and economic effects of automation, especially on jobs in the e-commerce sector, and to find ways to balance new technologies with

workforce development. Policymakers might want more people to use web-based tools, especially small and medium-sized businesses. This could mean giving people money, like handouts or tax breaks, to help them pay for the costs of getting new technology up and running. Businesses should also spend money on digital infrastructure and safety standards to use these technologies without risking customer trust or data security. Governments, tech companies, and business people will need to work together for the digital economy to be open to everyone and last. To sum up, web computer technologies have already changed e-commerce, but they are still not as good as they could be. People with a stake in the global e-commerce scene can use new technologies to help the economy grow, improve customer experience, and support sustainability. To do this, they need to eliminate things by blocking new technologies and making the world more open to them.

Declaration of competing interest

The authors declare that they have no known financial or non-financial competing interests in any material discussed in this paper.

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Author contribution

N. Chaplynska: study conception and design; S. Ivanov, S. Onishchenko: data collection; A. Chukhlib: analysis and interpretation of results; I. Tkach: draft preparation. All authors approved the final version of the manuscript.

References

[1] T. Abu-Jassar, H. Attar, A. Amer, V. Lyashenko, V. Yevsieiev, and A. Solyman, "Remote monitoring system of patient status in social IoT environments using Amazon Web Services (AWS) technologies and smart health care," *International Journal of Crowd Science*, vol. 8, no. X, pp. 1–16, 2024. [Online]. Available: https://www.sciopen.com/article/pdf/10.26599/IJCS.2023.9100019.pdf?ifPreview=0

[2] M. Ahmed and S. Pratap, "Constraint absorption in emerging economies: The role of business groups," *International Journal of Organizational Analysis*, vol. 30, no. 6, pp. 1253–1270, 2022. doi: 10.1108/ijoa-11-2019-1927

[3] Z. Akrami and G. S. Bhathal, "Cloud computing empowering e-commerce innovation," in *Applied Data Science and Smart Systems*, CRC Press, pp. 393–401, 2024. [Online]. Available: https://www.taylorfrancis.com/chapters/oa-edit/10.1201/9781003471059-51/cloud-computing-empowering-commerce-innovation-zinatullah-akrami-gurjit-singh-bhathal

[4] W. M. Al-Rahmi, N. Yahaya, M. M. Alamri, I. Y. Alyoussef, A. M. Al-Rahmi, and Y. B. Kamin, "Integrating innovation diffusion theory with technology acceptance model: Supporting students' attitude towards using a massive open online course (MOOCs) systems," *Interactive Learning Environments*, vol. 29, no. 8, pp. 1380–1392, 2021. doi: 10.1080/10494820.2019.1629599

[5] P. Anitha and M. M. Patil, "RFM model for customer purchase behavior using K-Means algorithm," *Journal of King Saud University - Computer and Information Sciences*, vol. 34, no. 5, pp. 1785–1792, 2022. doi: 10.1016/j.jksuci.2019.12.011

[6] M. Attaran and J. Woods, "Cloud computing technology: Improving small business performance using the Internet," *Journal of Small Business & Entrepreneurship*, vol. 31, no. 6, pp. 495–519, 2019. doi: 10.1080/08276331.2018.1466850

[7] S. Bansal and D. Kumar, "IoT ecosystem: A survey on devices, gateways, operating systems, middleware and communication," *International Journal of Wireless Information Networks*, vol. 27, no. 3, pp. 340–364, 2020. doi: 10.1007/s10776-020-00483-7

[8] G. Baryannis, S. Validi, S. Dani, and G. Antoniou, "Supply chain risk management and artificial intelligence: State of the art and future research directions," *International Journal of Production Research*, vol. 57, no. 7, pp. 2179–2202, 2019. doi: 10.1080/00207543.2018.1530476

[9] Bernovskis, D. Sceulovs, and A. Stibe, "Society 5.0: Shaping the future of e-commerce," *Journal of Open Innovation: Technology, Market, and Complexity*, vol. 10, no. 4, p. 100391, 2024. doi: 10.1016/j.joitmc.2024.100391

[10] P. Costa and H. Rodrigues, "The ever-changing business of e-commerce: Net benefits while designing a new platform for small companies," *Review of Managerial Science*, vol. 18, no. 9, pp. 2507–2545, 2024. doi: 10.1007/s11846-023-00681-6

[11] Cotrino, M. A. Sebastián, and C. González-Gaya, "Industry 4.0 roadmap: Implementation for small and medium-sized enterprises," *Applied Sciences (Basel, Switzerland)*, vol. 10, no. 23, p. 8566, 2020. doi: 10.3390/app10238566

[12] M. Deb and A. Choudhury, "Hybrid cloud: A new paradigm in cloud computing," in *Machine Learning Techniques and Analytics for Cloud Security*, Wiley, pp. 1–23, 2021. doi: 10.1002/9781119764113.ch1

[13] Faccia, C. L. Le Roux, and V. Pandey, "Innovation and e-commerce models: The technology catalysts for sustainable development: The Emirate of Dubai case study," *Sustainability*, vol. 15, no. 4, p. 3419, 2023. doi: 10.3390/su15043419

[14] G. S. D. Farrow, "An application programming interface model for open banking ecosystems," *Journal of Payments Strategy & Systems*, vol. 14, no. 1, p. 75, 2020. doi: 10.69554/lbqj4694

[15] T. Fountaine, B. McCarthy, and T. Saleh, "Building the AI-powered organization," *Harvard Business Review*, vol. 97, no. 4, pp. 62–73, 2019. [Online]. Available: https://wuyuansheng.com/doc/Databricks-AI-Powered-Org__Article-Licensing-July21-1.pdf

[16] K. Gala and B. A. Mueller, "Acquihires by SMEs as a strategic response to industry digitalization," *Journal of Small Business Management*, vol. 62, no. 3, pp. 1430–1468, 2024. doi: 10.1080/00472778.2022.2140161

[17] G. N. Gubal', "On the existence of weak local in time solutions in the form of a cumulant expansion for a chain of Bogolyubov's equations of a one-dimensional symmetric particle system," *Journal of Mathematical Sciences*, vol. 199, no. 6, pp. 654–666, 2014. doi: 10.1007/s10958-014-1892-1

[18] Haleem, M. Javaid, M. A. Qadri, R. P. Singh, and R. Suman, "Artificial intelligence (AI) applications for marketing: A literature-based study," *International Journal of Intelligent Networks*, vol. 3, pp. 119–132, 2022. doi: 10.1016/j.ijin.2022.08.005

[19] S. M. Hari Krishna and R. Sharma, "Survey on application programming interfaces in software defined networks and network function virtualization," *Global Transitions Proceedings*, vol. 2, no. 2, pp. 199–204, 2021. doi: 10.1016/j.gltp.2021.08.018

[20] Jha, N., Prashar, D., and Nagpal, A., "Combining artificial intelligence with robotic process automation—an intelligent automation approach," in *Studies in Computational Intelligence*, Springer International Publishing, pp. 245–264, 2021. doi: 10.1007/978-3-030-65661-4_12

[21] Khan, S., and Iqbal, M., "AI-powered customer service: Does it optimize customer experience?" in *2020 8th International Conference on Reliability, Infocom Technologies and Optimization (Trends and Future Directions) (ICRITO)*, IEEE, pp. 590–594, 2020. [Online]. Available: https://ieeexplore.ieee.org/abstract/document/9198004

[22] Khan, Y., Su'ud, M. B. M., Alam, M. M., Ahmad, S. F., Ahmad (Ayassrah), A. Y. A. B., and Khan, N., "Application of Internet of Things (IoT) in sustainable supply chain management," *Sustainability*, vol. 15, no. 1, p. 694, 2022. doi: 10.3390/su15010694

[23] Kobets, D., "Digitalization and its impact on the development of contemporary marketing strategies," *Economics Affairs (Calcutta)*, vol. 69, no. 2, pp. 1021–1040, 2024. doi: 10.46852/0424-2513.3.2024.26

[24] Lagodiienko, V., Perevozova, I., Bakhchivanzhi, L., Ozarko, K., Milcheva, V., and Orlova, O., "The role of digital technologies in optimizing the functioning of the marketing and logistics system of the enterprise," *Review of Economics and Finance*, vol. 21, pp. 2019–2026, 2019. [Online]. Available: https://refpress.org/wp-content/uploads/2023/12/Lagodiienko_REF.pdf

[25] Lehmacher, W., "Digitizing and automating processes in logistics," in *Disrupting Logistics*, Springer International Publishing, pp. 9–27, 2021. doi: 10.1007/978-3-030-61093-7_2

[26] Lewin, C., Rossi, M., Soultani, E., and Raj, K. S., "Managing infrastructure resilience and adaptation," *Sustainable and Resilient Infrastructure*, vol. 9, no. 2, pp. 107–123, 2024. doi: 10.1080/23789689.2023.2241728

[27] Li, M., Shen, L., and Huang, G. Q., "Blockchain-enabled workflow operating system for logistics resources sharing in E-commerce logistics real estate service," *Computers & Industrial Engineering*, vol. 135, pp. 950–969, 2019. doi: 10.1016/j.cie.2019.07.003

[28] Mackenzie, A., "From API to AI: Platforms and their opacities," *Information, Communication and Society*, vol. 22, no. 13, pp. 1989–2006, 2019. doi: 10.1080/1369118x.2018.1476569

[29] Menon, N. M., and Sujatha, I., "Influence of Rogers' theory of innovation of diffusion on customer's purchase intention – A case study of solar photovoltaic panels," *IOP Conference Series: Materials Science and Engineering*, vol. 1114, no. 1, p. 012059, 2021. doi: 10.1088/1757-899x/1114/1/012059

[30] Meyer, C., Cohen, D., and Nair, S., "From automats to algorithms: The automation of services using artificial intelligence," *Journal of Service Management*, vol. 31, no. 2, pp. 145–161, 2020. doi: 10.1108/josm-05-2019-0161

[31] Narwane, V. S., Raut, R. D., Gardas, B. B., Kavre, M. S., and Narkhede, B. E., "Factors affecting the adoption of cloud of things: The case study of Indian small and medium enterprises," *Journal of Systems and Information Technology*, vol. 21, no. 4, pp. 397–418, 2019. doi: 10.1108/jsit-10-2018-0137

[32] Nirala, K. K., Singh, N. K., and Purani, V. S., "A survey on providing customer and public administration-based services using AI: Chatbot," *Multimedia Tools and Applications*, vol. 81, no. 16, pp. 22215–22246, 2022. doi: 10.1007/s11042-021-11458-y

[33] Omol, E. J., "Organizational digital transformation: From evolution to future trends," *Digital Transformation and Society*, vol. 3, no. 3, pp. 240–256, 2024. doi: 10.1108/dts-08-2023-0061

[34] Page, M. J., McKenzie, J. E., Bossuyt, P. M., Boutron, I., Hoffmann, T. C., Mulrow, C. D., Shamseer, L., Tetzlaff, J. M., Akl, E. A., Brennan, S. E., Chou, R., Glanville, J., Grimshaw, J. M., Hróbjartsson, A., Lalu, M. M., Li, T., Loder, E. W., Mayo-Wilson, E., McDonald, S., … Moher, D., "The PRISMA 2020 statement: An updated guideline for reporting systematic reviews," *BMJ (Clinical Research Ed.)*, vol. 372, p. n71, 2021. doi: 10.1136/bmj.n71

[35] Pfeffer, J., and Salancik, G., "External control of organizations—Resource dependence perspective," in *Organizational Behavior 2*, Routledge, pp. 355–370, 2015. [Online]. Available: https://www.taylorfrancis.com/chapters/edit/10.4324/9781315702001-24/external-control-organizations%E2%80%94resource-dependence-perspective-jeffrey-pfeffer-gerald-salancik

[36] Pinho, C., Franco, M., and Mendes, L., "Application of innovation diffusion theory to the E-learning process: Higher education context," *Education and Information Technologies*, vol. 26, no. 1, pp. 421–440, 2021. doi: 10.1007/s10639-020-10269-2

[37] Podile, V., Suresh Kumar, K., Cavaliere, L. P. L., Annapureddy, S. R. R., Siva Praneeth, K. V., Sabareesh, K. P. S., and Sambasiva Rao, D. B., "Advances in E-commerce through the integration of distributed

computing approaches," in *Meta Heuristic Algorithms for Advanced Distributed Systems*, Wiley, pp. 229–244, 2024. doi: 10.1002/9781394188093.ch14

[38] Radanliev, P., "Digital security by design," *Security Journal*, 2024. doi: 10.1057/s41284-024-00435-3

[39] Rajeshwari, S., Praveenadevi, D., Revathy, S., and Sreekala, S. P., "Utilizing AI technologies to enhance e-commerce business operations," in *Toward Artificial General Intelligence*, De Gruyter, pp. 309–330, 2023. [Online]. Available: https://www.degruyter.com/document/doi/10.1515/9783111323749-015/pdf?licenseType=restricted

[40] Shah, S. S., and Asghar, Z., "Dynamics of social influence on consumption choices: A social network representation," *Heliyon*, vol. 9, no. 6, p. e17146, 2023. doi: 10.1016/j.heliyon.2023.e17146

[41] Shah, S. S., and Shah, S. A. H., "Trust as a determinant of social welfare in the digital economy," *Social Network Analysis and Mining*, vol. 14, no. 1, 2024. doi: 10.1007/s13278-024-01238-5

[42] Shah, S. S., and Shah, T., "Responsible consumption choices and individual values: An algebraic interactive approach," *Mind & Society*, vol. 22, no. 1–2, pp. 1–32, 2023. doi: 10.1007/s11299-023-00294-2

[43] Sookoo, A., Garg, L., and Chakraborty, C., "Improvement of system performance in an IT production support environment," *International Journal of System Assurance Engineering and Management*, vol. 12, no. 3, pp. 461–479, 2021. doi: 10.1007/s13198-021-01092-0

[44] Sullivan, M., and Kern, J., Eds., *The Digital Transformation of Logistics: Demystifying Impacts of the Fourth Industrial Revolution*, Wiley, 2021. doi: 10.1002/9781119646495

[45] Suprunenko, S., Pishenina, T., Pitel, N., Voronkova, A., and Riabovolyk, T., "Analysis of the impact of globalization trends in the digital economy on business management and administration systems of enterprises," *Futurity Economics & Law*, vol. 4, no. 2, pp. 131–147, 2024. doi: 10.57125/FEL.2024.06.25.08

[46] Tan, F. T. C., Pan, S. L., and Zuo, M., "Realizing platform operational agility through information technology–enabled capabilities: A resource-interdependence perspective," *Information Systems Journal*, vol. 29, no. 3, pp. 582–608, 2019. doi: 10.1111/isj.12221

[47] Tan, W. C., and Sidhu, M. S., "Review of RFID and IoT integration in supply chain management," *Operations Research Perspectives*, vol. 9, p. 100229, 2022. doi: 10.1016/j.orp.2022.100229

[48] Tayab, A., and Li, Y., "The contribution of the RPA technology in enhancing better business performance in warehouse management," *IEEE Access: Practical Innovations, Open Solutions*, vol. 12, pp. 142419–142426, 2024. doi: 10.1109/access.2024.3470221

[49] Vinoth, S., Vemula, H. L., Haralayya, B., Mamgain, P., Hasan, M. F., and Naved, M., "Application of cloud computing in banking and e-commerce and related security threats," *Materials Today: Proceedings*, vol. 51, pp. 2172–2175, 2022. doi: 10.1016/j.matpr.2021.11.121

[50] Wulf, J., and Blohm, I., "Fostering value creation with digital platforms: A unified theory of the application programming interface design," *Journal of Management Information Systems*, vol. 37, no. 1, pp. 251–281, 2020. doi: 10.1080/07421222.2019.1705514

[51] Yaacoub, J.-P. A., Noura, H. N., Salman, O., and Chehab, A., "Robotics cyber security: Vulnerabilities, attacks, countermeasures, and recommendations," *International Journal of Information Security*, vol. 21, no. 1, pp. 115–158, 2022. doi: 10.1007/s10207-021-00545-8

[52] Zafir, E. I., Akter, A., Islam, M. N., Hasib, S. A., Islam, T., Sarker, S. K., and Muyeen, S. M., "Enhancing security of Internet of Robotic Things: A review of recent trends, practices, and recommendations with

encryption and blockchain techniques," *Internet of Things*, vol. 28, p. 101357, 2024. doi: 10.1016/j.iot.2024.101357

[53] Zaitsev, S., "Automation as a factor of sustainable development: Analysis of its impact on productivity and cost optimization in small businesses," *Law, Business and Sustainability Herald*, vol. 2, no. 3, pp. 4–26, 2022. [Online]. Available: https://lbsherald.org/index.php/journal/article/view/44

[54] Zhu, L., "Optimization and simulation for E-commerce supply chain in the Internet of Things environment," *Complexity*, vol. 2020, pp. 1–11, 2020. doi: 10.1155/2020/8821128