

To Enhance Enterprise Resource Planning with Blockchain: Food Supply Chain

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Abstract: *Blockchain (BCT) is commonly referred to as a distributed ledger technology (DLT). Blockchain is the central generation in monetary markets applications. A Food Supply chain and logistics are complicated procedures in recent times because of their lacking merchandise in travelling. Using (DLT) represents each transition as they circulate via a logistics community that combine may include (ERP) that could carry out the low transition fee. The number of research on traceability applications based on Blockchain aimed to improve the quality and safety of food. This paper pursues to address the space and make a foundation for destiny studies endeavours. ERP assists contributors in documenting price, date, location, and different facts for greater efficaciously coping with the provision. ERP combined with Blockchain can boom the traceability of the business delivery chain, decrease losses from entrepreneurs, enhance visibility and compliance over outsourced settlement production, and doubtlessly decorate an organization's (like supply services). Vendors can combine blockchain and ERP structures in a highly secure and trackable way utilizing immutable data for commercial enterprise transitions. ERP with BCT removes those belief gaps among siloed ERPs even as offering visibility in the course of the system. It has more safety and facts integrity. We have reviewed six studies papers on BCT in logistics Supply Chain (LSC); Food Supply is determined to finish applying enterprise resource planning (ERP). The literature regards distributed ledger in transition, mainly targeted on missing groups, integration with customer relationship management fills the missing in methodology. We have proven current logistics and delivery designed a blockchain structure that enables (FLSM). In structure, we've got targeted food supply, protocols, modules, and challenges, street maps in LSC. This paper concludes with references to final decisions.*

Keywords: Enterprise resource planning, Blockchain technology, Food supply chain and logistics, Customer relationship management

1. Introduction

Blockchain technology (BCT) shows a rising rate, all for operations and request tests [1], [2]. In addition, the scientific community's interest has grown significantly [3], [37]. Still, at present, similar technology poses some pitfalls and pitfalls to its initial stage of development and novelty. The company has high prospects for blockchain operations as a relief for lowering middleware prices and offering a new price, esteeming trust and security [4], [5]. Multilevel, primarily disconnected, and geographically dispersed are some of the keystones of the moment's force chain. There, coupled with different government programs and mortal gust, makes it nearly insolvable to query incidents and track events in the force chain. An end-to-end force chain from the most straightforward raw material to the end product in the client's possession is opaque [4], [34], [27].

Force chains in the direction of the end of the ending renaissance had been battery-powered via way of means of internal databases with on-premise computing capacities are pushed specifically via way of means of Oracle databases and technologies [7]. With the appearance of the brand-new renaissance, a cover technology of allocated systems come delivered to run on a pall, allowing the outsourcing of many approaches and leading cost-effective garage centres and cost [1], [3]. BCT has helped offer chain approaches to be abundant worldwide to deliver and manufacture with the most effective frugality, have optimized quality, be nearest to the business and die lesser well worth to the client. Still, it's concluded up being plenitude of complexes [8]. Although those approaches are enabled via the system, the deals have inefficiencies, fraud, pilferages with decreasing legal guidelines and compliance, a more significant consider deficiency, and want lesser watching. In addition to

complexity, chains are also exposed to misgivings and pitfalls [8], [9], [10], similar to the involvement of business mates in opportunistic geste (e. g., malformed information, fraud) [11], [12], loss of data protection [13], fraud and cybercrime as well as the identification of fake products [14].

Enterprise Resource Planning (ERP) is an extensively used language for working with multiple departments on one platform, managing finance and account, payroll, and commercial compliance. Blockchain technology known as Distributed Ledger enables information to participate between multiple computers without a central platform for maximum security [15], [13], [14]. ERP software manages massive data transfer in the business process. It's a kind of database centre that enables an association to carry out back-office functions easily and in real-time with the help of integrated operations. Since the ERP system uses a database operation system, blockchain also uses a scalable real-time database that makes it easy to prove generalities, platforms, and operations [15], [16]. For illustration, if a marketing platoon is using software to induce checks and the account platoon needs the same checks to control deals, it's imperative to partake the tab information between the two, but this is frequently a negative for companies [17].

We seek advice from ERP started within the Nineteen Sixties with the invention of fabric needs coming up with (ERP) systems ERP and customer feedback software package to set up manufacturing schedules and ensure everything's required to provide for production runs, and track final product. Nowadays, technology suppliers developed producing resource planning systems. Whereas enterprise resource planning and customer feedback software still targeted production rules, it offered new

capabilities for improved production planning. Till the ERP war, it's currently detected as a monopoly business platform. This developing science brought the complete enterprise, from accounting to goods, enlarging the manufacturing and order fulfilment associated with the company's database. Corporations must shop for servers, rent an IT team with a satisfactory experience, and pay money for licensing and implementation. Then came massive bills for maintenance and upgrades.

In contrast, enterprise resource planning solutions are there for service suppliers before entering into cloud ERP, CRM, this technology cared for being costly and more manageable. Enterprise resource planning launched their primary cloud CRM, ERP. The model revolutionized this engine to reduce the direct funding and create the prices predictable. The purchase of foodservice logistics as a result of selling the product manages the infrastructure development and automatically upgrades the system. ERP is reachable for all smaller vendors in turn product growth, banding the product, and profitability. Storage for business innovation we've can see it in future. The system model allows small business vendors to combine every path of the business cycle, which is better for companies, lighting new insights that develop the businesses period of updating and automating the whole business cycle.

As blockchain technology gains additional and more attention, researchers began exploring blockchain applications in different areas and the transparent and traceable food supply chain. Customers nowadays are trying to find a quality, safety, and nutrition in food [38]. If a central half has all the info, he cannot produce interested customers with reliable information on time. Therefore, the applications of blockchain technology, all parties concerned will access and review the digitized information, are seen as how of resolution to the food supply chain [39].

Accordingly, we resolve the former exploration question into three sub-questions to address specific themes. also, we collected information on them in a comprehensive analysis:

RQ1: How can ERP and BCT integrate?

RQ2: What are the future scopes for blockchain with ERP integrated systems for the food supply chain?

RQ3: Can blockchain technology sustain the huge food transition performed on enterprise resource planning systems?

2. Discussion

This study presents exploratory research based on qualitative analysis. By applying ethnographic methods such as expert interviews, we have collected various data, visions, and opinions on integration with enterprise resource planning in the industry. We analysed the data collected with the basic theory approach.

2.1 Blockchain Integration Enterprise Resource Planning

Bitcoin has smelled via way of means of bit developed as a lousy specialized serving due to the spine for several large corporates. Perhaps the reason for recommending the combination of Blockchain era with organization valuable

resource designing (CRM) systems. Integration could extrude groups to their investments simultaneously as optimizing the cost [12], [17]. Blockchain may maintain a tune of offers and switch expenses among Bitcoin; the Food supply chain may also use its ERP. Accomplice diploma ERP software Centralizes all your business data of the commercial enterprise facts.

- Provides an unmarried factor of contact.
- Integrates different commercial enterprise technique programs as well.
- Shares depended on facts throughout numerous departments inside your organisation.

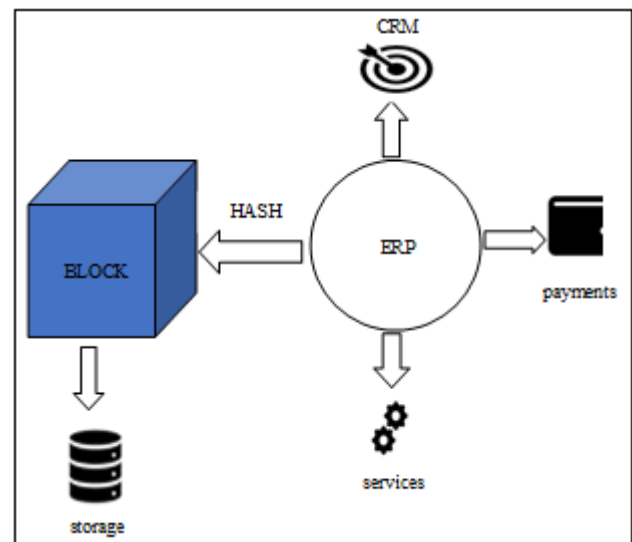


Figure (b):

Fig (a) shows. The integration allows knowledge ability for banks and monetary institutions. The advantages will be forwarded to company shoppers rapidly and economically thanks to mitigating risk-averse conditions. Blockchain-ERP integration includes services comparable to corporate banking services like payments, trade finance, and contract management [15], [9], [23]. ERP engine manages and streamlines all major business required in the food supply chain and logistics. it's a sort of info hub, that permits an organisation to hold out back-office functions swimmingly and in real-time with the assistance of integrated applications. As ERP system uses direction system, likewise Blockchain conjointly uses a period ascendable database that facilitates proof of concepts, platforms and applications [14], [18].

ERP systems are employed by multiple industries – banks, healthcare, food and beverage, e-commerce, retail, etcetera. It helps corporations manage their accounts finances provide chain, human resources, and alternative departments through a unified platform. Once multiple departments need to access shared data, verbal communication may result in the partial loss of data, ensuing in productivity loss and no or less profit booking. With an ERP system, multiple departments will be collaborated along to get data accessible by different groups in period from anywhere [16], [20], [19].

While Blockchain technology is comparatively new and ERP systems have been established for nearly three decades, several industries and firms are watching; however, this new

technology will be married together. Businesses are viewing this integration as a chance to create their business transactions additional robust, transparent, and binding [22], [12], [24], [26]. For instance, in the offer Chain, many transactions are recorded through the cycle of a product. Conceptually, these systems build, track, purchase, and ship products in an exceedingly offer Chain scenario. Group action with Blockchain can provide a replica of this data into the network that is immutable and ineradicable and might be tracked and used for any purpose. The following figure illustrates how this idea integrates with ERP in offer Chain transactions and how Blockchain records every event [21], [27].

2.2 Food Supply Chain Using Enterprise Systems

To extend knowledge security for deals, a brand-new system that enables these deals mechanically a lot of firmly and while not an intermediary has been conceived. (Distributed Ledger Technology) was developed within the 2008 recession to deliver transparency, security, and effectiveness in managing deals between multiple parties. This conception is currently being implemented or thought about in various business models worldwide [1], [18], [16].

What significantly is Blockchain? In its simplest form, Blockchain will be represented as a private, secure network that uses cryptography to keep exchanges secure a redistributed database, or digital tally, of deals that everybody on the network will see [27]. This network is essentially a series of computers that has to all authorize an exchange before it is cleared and recorded. For example, the following figure illustrates the Introductory food transfer with ERP Process in logistics and supply chain [18].

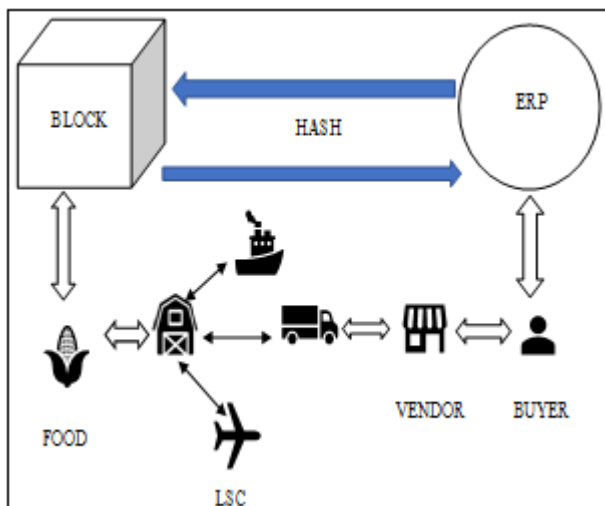


Figure 2: Food process Producer- Buyer

Diagram describes the basic overview of BCT and ERP logistics and supply chain:

- 1) The greater access to food source materials data to better inform material choice and enable Cycle design [19].
- 2) Increase opportunities for co-planning and forecast sharing between third party logistics and customers.
- 3) Decrease source and administrative costs by replacing paperwork with smart contracts and transactions

recorded on the blockchain, drive business initiatives by using enterprise resource planning [15], [17].

- 4) Increase visibility and compliance and outsource manufacturing [24].
- 5) Provide regulators and end consumers with a clear picture of all supply chain with integrated BCT and ERP [20].
- 6) Determine which batch to recall based on information availability, decentralize return merchandize authorization, and CRM [16], [25]. Blockchain can offer accelerated deliver chain transparency, in addition to decreased price and danger throughout the delivery chain [19].

Food source to consumer request challenges are driving food service providers to find ways to track and move force efficiently keep food safe enable hastily more accurate recalls and address Food source to consumer request challenges are driving food service providers to find ways to track and move force efficiently keep food safe enable hastily more accurate recalls and address consumer perception around food prominence and waste these solutions need to adaptable, flexible, sustainable and resilient fresh marks intelligent food industry solutions enhance food process flow management along the supply chain by offering an ecosystem suite of solutions that enable food provenance and traceability increase labour efficiency and food safety and promote sustainability all while helping to remove complexity from meeting government regulations and brand owner mandates the ability to trace from source to consumer is more important than it's ever been farmers and producers are being asked and in some cases required to provide traceability information they haven't had so in the past Avery first mile solutions help ensure food can be traced continuously from source to consumer by assisting producers in creating globally unique digital identities that include both product master and keys product attributes such as lot number harvest date and location a digital twin is created by using ERP and blockchain transition hash id and capture the information printed on the shipping label and transmit that information to the ERP making the information secure and accessible throughout the supply chain with ERP and bct outbound shipping is quickly supplied.

2.3 Food Traceable with Customer Relation Management

When it involves offering Chain Management (SCM), businesses got to move with varied suppliers and mates to get the raw accoutrements and coffers needed to bring the finished products to request [26], [28]. ERP plays a significant part in combating inefficiency, reducing unused materials and decreasing staff for manual supply and loading the food products [27], [28], [22], [29]. The integration of each system might produce some specific problems. It's in your company's stylish interest to confirm that you simply and your staff perceive the part of ERP at intervals in the SCM process [6], [29].

2.3.1 Utilize ERP Systems to Function of Logistics and Supply Chain

An offer Chain Management system is crucial for piercing period practical info across multiple departments and

businesses [22], [29]. Lacking clear insight into the assorted toil and dealing processes that represent your force chain will leave you unfit to supply procedures that supply a property competitive advantage. ERP systems play a polar half in many aspects of the creation and conservation of a superior Force Chain Management process, which can embody:

- 1) Logistics with Supply chain Planning: supply chain designing includes promoting channels elevations, determining the amounts of stock and force demanded and making certain refilling and product programs are ready to continue with demand. ERP systems give a neater and fresh protean thanks to establishing and altering the parameters that a force chain is needed to operate.
- 2) Execution: Point-rich ERP computer law operations offer a more practical way to handle procedural and give the goods, services and different coffers needed across the provision chain. ERP systems provide cross-platform visibility on all aspects of the provision chain, from producing and storehouse coffers to transportation and prosecution processes.
- 3) Monitoring and Maintenance: The flexibility to cover, review and alter force chain sweats and conditioning in a period is essential for doing a particular business in a position to take care of the malleability needed to remain competitive and ensure cost-effective operations.
- 4) Assessments: An examination of factual exertion against projected pretensions and targets is impossible for those who depend on a force chain that utilizes multiple complete systems and progress processes. ERP systems give superior word aggregation and association to ensure that any unwanted dissonances throughout the force chain are snappily known and effectively addressed.

2.3.2 ERP Implementation Strategy with Blockchain

Vendors that enforce the association with enterprise systems collected data and macro-view of the organization's existing advancement and methods to construct more practical and economical supply management and blockchain process. Businesses that utilize multiple complete provide chain management systems stand to learn from the combination, and executing these chains gives multiple-platform access to the product information, monetary and producing information required to style an SCM, BCT process that may offer superior performance. There aren't any exhausting and quick rules once it involves crucial that system to implement initial and also the specific desires and circumstances of your business should be weighed and thought of fastidiously before you reach a decision [30]. The inter-departmental and multi-organizational nature of provide chains makes effective management troublesome for businesses that lack the proper resources. ERP systems are an essential plus in creating and implementing an additional economical supply chain method. An associate degree efficiently managed, or superannuated supply chain process may be a liability that no business can afford to overlook. The of Supply Chain Management, Blockchain and customer relationship the final product reached and services to customer feedback, potency and overall quality [32], [29], [21].

2.3.3 CRM in used In ERP manages

Enterprise systems, described as customer relationship management, is software that manages the way of all customer connections with all activities performed in business [33]. CRM was developed for sales prediction development and sometimes to know the sales automation. Enterprise soon integrated systems with ERP to manage customer services with return and delivery of the product. Product vendors began to combine these CRM with ERP for customer contacts and feedback on products [34].

3. Protocols of Blockchain and Modules of Enterprise Systems

A BCT runs with a peer-to-peer network at intervals, which can redistribute. Therefore, each time a purchase takes place between the network members, it must be authorized and valid, thus ensuring that each sale between two individual accounts is without the risk of double-spending [29]—the verification by sales executives of the company's network. Miners use software and computers to corroborate the agreements; wages for their problems, funds, and skills. The circumstance of the offers is named block.

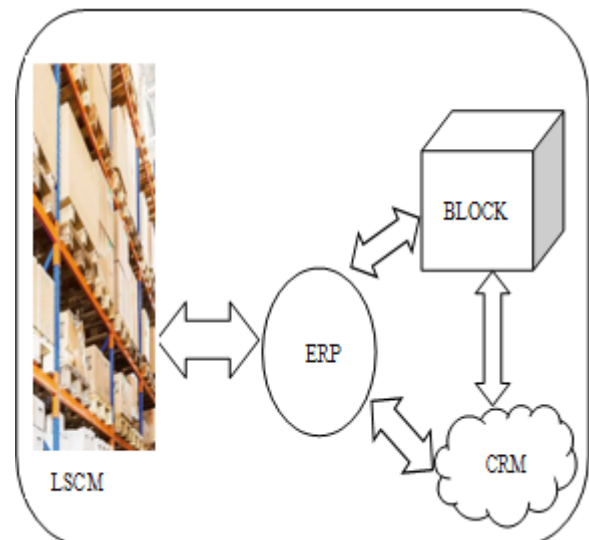


Figure (c): Protocols for BCT ad ERP

The main module includes:

Finance: The finance and accounting module is that the spine of maximum ERP structures additionally, handling the general ledger and automating essential economic tasks, facilitates companies to tune bills payable (AP) and receivable (AR), near the books efficiently, generate financial reports, observe sales popularity standards, mitigate economic risk, and more significant [31], [23].

Human assets management: Most ERP structures encompass an HR module that provides middle abilities, including time and attendance and payroll. Add-ons, or even whole human capital management (HCM) suites, can attach with the ERP and provide more excellent sturdy HR capability – from a group of workers analytics to worker enjoy management [32].

Sales respective: The income module maintains a tune of communications with potentialities and clients and facilitates reps to use data-pushed insights to grow income and goal leads with the right promotions and upsell opportunities [21]. It consists of the order-to-coins process capability, including order management, contracts, billing, income overall performance management, and income pressure support [32]. Manufacturing: the assembly module may be an essential planning and execution issue of ERP software. It facilitates organizations to simplify complicated production methods and check that manufacturing is in step with demand. This module generally consists of capability for material necessities planning (MRP), manufacturing scheduling, production execution, high-satisfactory management, and more significant [30].

Logistics and delivery chain management: Another critical issue of ERP structures, the deliver chain module tracks the motion of products and substances during an organization's delivery chain. The module gives equipment for real-time stock management, warehousing operations, transportation, and logistics – and might assist growth to delivery chain visibility and resilience [13], [32], [18], [24], [29].

Service offering: In software, the modules facilitate organizations to supply scale, personalized carrier clients have companies' agents on feedback or customer care. The module can encompass equipment for in-residence repairs, spare parts, subject carrier management, and carrier-primarily based sales streams [14], [37]. It additionally gives analytics to help carrier reps and technicians unexpectedly resolve client troubles and enhance loyalty.

Engineering department: Feature-wealthy ERP structures encompass an Engineering module. This module gives product layout and development equipment, product lifecycle management (PLM), product compliance, and more significant – so organizations can quickly and cost-correctly create innovations [32].

Enterprise assets management: Robust ERP structures can encompass an EAM module, enabling asset-extensive companies to limit downtime and hold their machines and system jogging at top efficiency. This module consists of capability for predictive maintenance, scheduling, asset operations and preparing, environment, fitness and safety (EHS), and more significant [17], [32].

4. Challenges

As we generally tend to journey sparkling into our know-how of blockchain and dive deep into it from multitudinous aspects, we find out an exceptionally egregious trend. Blockchain era has massive implicit to advantage organization operations, nonetheless like each invention, it ultimately finally ends up in specialization [35], [36]. the reason is, there's a massive hazard for more than one merchandiser to vault into the fray, giving editions and precise commercial enterprise use cases, hosting up the opposition and discerning out from others. consequently, on separate, anyone comes up with a specialization. This finally ends up in more than one blockchains being in parallel. it's

assumed at that time of time, there are a few twenty different ERP merchandisers that we generally tend to wear erected. nonetheless sluggishly, a few products extemporized, amended, bettered, and ultimately survived as all of us capture them currently. Also, in blockchain, there are multitudes of them being second with extraordinarily precise operations [37], [26]. Blockchains will collect features and talents on the way to modify establishments to discern or ameliorate their commercial enterprise processes [38], [39]. Among all the challenges mentioned above, interoperability, standardization, controllable and technological limitation are the four biggest challenges for the accelerated abandonment rate of blockchain in the study business, as in the well-known case of Ethereum, Litecoin, Dogecoin and Hyperledger. Which includes varietiesoftware like Bot-tree, Factom, Algorythmix, Hijro and Skuchain.

5. Conclusions

Based on the analysis therefore far, it will simply be finished that tons of analysis have already been done on the blockchain with versatile applications. However, the sector remains wide open. the event of blockchain from the bitcoin network is examined with an in-depth study of protocols for validation and address hashing in a very distributed network with the publicly offered information, thus creating the data secured, which is transparent for business and legitimacy. The paper examines what is most common in many onfood supply and logistics services implemented in enterprise resource planning that are developing food product, inclusive, tested, and ready for growth in the transparency of food management. The challenges open up areas of focused research and new products. The use of blockchain in financial transactions has always been at the fore, but this paper looks at the broader applications of the supply chain as seen in various ERP protocols and modules. From a food supply chain perspective, blockchain will become enterprise systems and will be examined in detail alongside future growth areas. This research makes it clear that there are three evolutionary areas for blockchain and erp protocols and modules in the food supply chain for the integration of ERP blockchain, the middleware to connect blockchain with ERP. These are areas that are developing very quickly and opening up great opportunities. Ultimately, it's about the future where companies will only be able to trade if they are blockchain certified.

Acknowledgements

The Review Work has been carried out utilizing previous research paper in IEEE.

6. Review of Literature

- [1] *"Blockchain in Logistics and Supply Chain" in 2018 at the IEEE by G. pobeli. In this article, the blockchain era is part of the monetary issue of the offers offered to customers. Also, this article discusses the logistics of the meal, delivery, and shipping chain. The blockchain era (BCT) had faith in the integration of stopovers, and the evolution of statistics accompanied the drift within the maritime chain. We explained that BCT could be*

covered by incorporating resource planning, as companies use ERP software to set up their activities such as supply chain accounting, while non-public BCT combined with ERP is easier to govern and manage security confidentiality.

- [2] "Notice of Removal Blockchain combine ERP for Supply Chain" by Hader Research published in IEEE 2020. This Research Paper provides encourages the removal of blockchain environments with ERP systems. Furthermore, the researcher provides the reasons for removing blockchain. When integrated with the ERP, we have considered the blockchain. It creates and brings new information in DCT and designs monitors; a smart contract is a protocol encoded in the blockchain that automates the enterprise resource system's business transition and existing system data.
- [3] The analysis paper "A Proxy cryptography Approach to Secure knowledge Sharing withinside the web of Things supported Blockchain" revealed in IEEE 2019 by OpuniBoachie describes blockchain technology which may shield facts sharing with the encryption agreement set of pointers proxy won't lead to method nodes in block encryption. In addition, we've got taken the mixture of blockchain with ERP that permits businesses to tightly manage facts sharing, transparency, protection with the availability chain facts to be held on representing an idea of block and node withinside the ERP.
- [4] "Peer-to-Peer Energy Trading, " published in 2021 in IEEE by JuharAbdella, provides an overview of peer-to-peer (P2P) trading with blockchain technology applications that used bitcoin as a currency to show trading. In P2P, get better security, transparency of confidentiality, costs, and faster payment settlement. In addition, we considered the peer-to-peer network in ERP systems for faster settlement and privacy, making vendors inexpensive to implement p2p in the ERP system.
- [5] "User Interface of Blockchain in Traceability Applications, " published in 2021 in IEEE by Atima, in its big quest to solve traditional problems in the agri-food supply chain, data visualization, efficiency, livestock identification, and system of traceability. When BCT has used traceability implementations, it aims to improve quality and safety. Moreover, traceability is critical in logistics and the supply chain with blockchain and enterprise resource planning products such as clothing, which electronics manufacturing vendors can track and visualize.
- [6] "Authentication Technology for E-Commerce Platforms withinside the Blockchain Era, " denoted in 2021 in IEEE via the approach of Guangming Li, studies some e-trade systems that have centred on adopting BCT in monopoly and duopoly markets. We've considered authentication value and era to boost the delivery chain platform in ERP.
- [2] Ramachandran and D. Kantarcioglu, "Using blockchain and smart contracts for secure data provenance management, " 2017, arXiv: 1709.10000.
- [3] S. E. Chang and Y. Chen, "When blockchain meets supply chain: A systematic literature review on current development and potential applications, " IEEE Access, vol.8, pp.62478–62494, 2020.
- [4] M. M. Queiroz, R. Telles, and S. H. Bonilla, "Blockchain and supply chain management integration: A systematic review of the literature, " Supply Chain Manage., Int. J., vol.25, no.2, pp.241–254, Aug.2019.
- [5] H. Treiblmaier, "The impact of the blockchain on the supply chain: A theory-based research framework and a call for action, " Supply Chain Manage., Int. J., vol.23, no.6, pp.545–559, Sep.2018.
- [6] Zheng, Z., Xie, S., Dai, H., Chen, X. and Wang, H. (2017) 'An overview of blockchain technology: Architecture, consensus, and future trends', Proceedings of the 2017 IEEE BigData Congress, Honolulu, Hawaii, USA, pp.557–564.
- [7] S. Wang, Y. Zhang, and Y. Zhang, "A blockchain-based framework for data sharing with fine-grained access control in decentralized storage systems, " IEEE Access, vol.6, pp.38437–38450, 2018.
- [8] O. Alkadi, N. Moustafa, B. Turnbull, and K.-K. R. Choo, "A deep blockchain framework-enabled collaborative intrusion detection for protecting IoT and cloud networks, " IEEE Internet Things J., to be published, doi: 10.1109/IIOT.2020.2996590.
- [9] Hald, K. S.; Kinra, A. How the Blockchain Enables and Constrains Supply Chain Performance. *Int. J. Phys. Distrib. Logist. Manag.* 2019, 49, 376–397.
- [10] X. Wang et al., "Survey on blockchain for Internet of Things, " *Comput. Commun.*, vol.136, pp.10–29, 2019.
- [11] Bettis, R. A.; Mahajan, V. Risk/Return Performance of Diversified Firms. *Manag. Sci.* 1985, 31, 785–799.
- [12] Kshetri, N.1 Blockchain's Roles in Meeting Key Supply Chain Management Objectives. *Int. J. Inf. Manag.* 2018, 39, 80–89.
- [13] Zhang, H.; Nakamura, T.; Sakurai, K. Security and Trust Issues on Digital Supply Chain. In Proceedings of the 2019 IEEE Intl Conf on Dependable, Autonomic and Secure Computing, Intl Conf on Pervasive Intelligence and Computing, Intl Conf on Cloud and Big Data Computing, Intl Conf on Cyber Science and Technology Congress (DASC/PiCom/CBDCCom/CyberSciTech), Fukuoka, Japan, 5–8 August 2019; Institute of Electrical and Electronics Engineers Inc.: Piscataway, NJ, USA, 2019; pp.338–343.
- [14] Baralla, G.; Pinna, A.; Corrias, G. Ensure Traceability in European Food Supply Chain by Using a Blockchain System. In Proceedings of the 2019 IEEE/ACM 2nd International Workshop on Emerging Trends in Software Engineering for Blockchain, WETSEB, Montreal, QC, Canada, 27 May 2019; Institute of Electrical and Electronics Engineers Inc.: Piscataway, NJ, USA, 2019; pp.40–47.
- [15] M. U. Hassan, M. H. Rehmani, and J. Chen, "DEAL: Differentially private auction for blockchain based microgrids energy trading, " IEEE Trans. Serv. Comput., vol.13, no.2, pp.263–275, Mar. /Apr.2020.

References

- [1] Z. Zheng, S. Xie, H.-N. Dai, X. Chen, and H. Wang, "Blockchain challenges and opportunities: A survey, " *Int. J. Web Grid Services*, vol.14, no.4, pp.352–375, 2018.

- [16] M. Vukolić, "The quest for scalable blockchain fabric: Proof-of-work vs. BFT replication," in Proc. Int. Workshop Open Problems Netw. Secur., Zurich, Switzerland, 2016, pp.112–125.
- [17] J. Kang, Z. Xiong, D. Niyato, P. Wang, D. Ye, and D. I. Kim, "Incentivizing consensus propagation in proof-of-stake based consortium blockchain networks," IEEE Wireless Commun. Lett., vol.8, no.1, pp.157–160, Feb.2019.
- [18] Z. Tian, M. Li, M. Qiu, Y. Sun, and S. Su, "Block-DEF: A secure digital evidence framework using blockchain," Inf. Sci., vol.491, pp.151–165, 2019.
- [19] M. El-Hindi, C. Binnig, A. Arasu, D. Kossmann, and R. Ramamurthy, "BlockchainDB: A shared database on blockchains," Proc. VLDB Endowment, vol.12, no.11, pp.1597–1609, 2019.
- [20] J. Al-Jaroodi and N. Mohamed, "Blockchain in industries: A survey," IEEE Access, vol.7, pp.36500–36515, 2019.
- [21] A. Singh, K. Click, R. M. Parizi, Q. Zhang, A. Dehghantaha, and K.-K. R. Choo, "Sidechain technologies in blockchain networks: An examination and state-of-the-art review," J. Netw. Comput. Appl., vol.149, 2020, Art. no.102471.
- [22] B. Wang, M. Dabbaghjamesh, A. Kavousi-Fard, and S. Mehraeen, "Cybersecurity enhancement of power trading within the networked microgrids based on blockchain and directed acyclic graph approach," IEEE Trans. Ind. Appl., vol.55, no.6, pp.7300–7309, Nov./Dec.2019.
- [23] X. Feng et al., "Pruneable sharding-based blockchain protocol," Peer-toPeerNetw. Appl., vol.12, no.4, pp.934–950, 2019.
- [24] N. Hackius and M. Petersen, "Translating high hopes into tangible benefits: How incumbents in supply chain and logistics approach blockchain," IEEE Access, vol.8, pp.34993–35003, 2020
- [25] L. Luu, V. Narayanan, C. Zheng, K. Baweja, S. L. Gilbert, and P. Saxena, "A secure sharding protocol for open blockchains," in Proc. ACM Conf. Comput. Commun. Secur., 2016, pp.17–30.
- [26] H. Chen and Y. Wang, "SSChain: A full sharding protocol for public blockchain without data migration overhead," Pervasive Mobile Comput., vol.59, 2019, Art. no.101055.
- [27] G. Wang, Z. J. Shi, M. Nixon, and S. Han, "SoK: Sharding on blockchain," in Proc.1st ACM Conf. Adv. Financial Technol., New York, NY, USA, 2019, pp.41–61.
- [28] N. Hackius and M. Petersen, "Translating high hopes into tangible benefits: How incumbents in supply chain and logistics approach blockchain," IEEE Access, vol.8, pp.34993–35003, 2020.
- [29] J. Yun, Y. Goh, and J.-M. Chung, "Trust-based shard distribution scheme for fault-tolerant shard blockchain networks," IEEE Access, vol.7, pp.135164–135175, 2019.
- [30] Zyskind, G., Nathan, O. et al. (2015) 'Decentralizing privacy: Using blockchain to protect personal data', Security and Privacy Workshops (SPW), 2015 IEEE, IEEE, pp.180–184.
- [31] M. Andoni et al., "Blockchain technology in the energy sector: A systematic review of challenges and opportunities," Renew. Sustain. Energy Rev., vol.100, pp.143–174, Feb.2019.
- [32] S. Wang, D. Li, Y. Zhang, and J. Chen, "Smart contract-based product traceability system in the supply chain scenario," IEEE Access, vol.7, pp.115122–115133, 2019.
- [33] A. Arya, C. Löffler, B. Mittendorf, and T. Pfeiffer, "The middleman as a panacea for supply chain coordination problems," Eur. J. Oper. Res., vol.240, no.2, pp.393–400, 2015.
- [34] TejasviAlladi, Vinay Chamola, Reza M. Parizi, Kim-Kwang Raymond Choo, "Blockchain Applications for Industry 4.0 and Industrial IoT: A Review", Access IEEE, vol.7, pp.176935-176951, 2019.
- [35] Mohamad Kassab, Giuseppe Destefanis, Joanna DeFranco, Prince Pranav, "Blockchain-Engineers Wanted: an Empirical Analysis on Required Skills Education and Experience", Emerging Trends in Software Engineering for Blockchain (WETSEB) 2021 IEEE/ACM 4th International Workshop on, pp.49-55, 2021.
- [36] Mohamad Hassan Kassab, Valdemar Vicente Graciano Neto, Giuseppe Destefanis, Tarek Malas, "Could Blockchain Help With COVID-19 Crisis?", IT Professional, vol.23, no.4, pp.44-50, 2021.
- [37] Z. Li, H. Wu, B. King, Z. B. Miled, J. Wassick, and J. Tazelaar, "On the integration of event-based and transaction-based architectures for supply chains," in Proc. IEEE 37th Int. Conf. Distrib. Comput. Syst. Workshops (ICDCSW), Jun.2017, pp.376–382.
- [38] M. Iansiti and K. R. Lakhani. (2017). The Truth About Blockchain. [Online]. Available: <https://hbr.org/2017/01/the-truth-about-blockchain>
- [39] O. Ahumada and J. R. Villalobos, "Application of planning models in the agri-food supply chain: A review," Eur. J. Oper. Res., vol.196, no.1, pp.1–20, Jul.2009. [Online]. Available: <https://www.sciencedirect.com/science/article/pii/S037722170800198>