Proceedings of the International Conference on Industrial Engineering and Operations Management

Publisher: IEOM Society International, USA DOI: 10.46254/AN15.20250365
Published: February 18, 2025

Implementation of Blockchain Technology in Railway Industry of Bangladesh

Prof. Dr. Md. Nurul Absar Chowdhury
Professor, Department of Mechanical and Production Engineering
Ahsanullah University of Science and Technology, Dhaka
mdnurulabsar.ipe@aust.edu

MD Eusuf Jamil
Bsc. Graduated, Industrial and Production
Engineering Ahsanullah University of Science and
Technology, Dhaka
Jamil.ipe.200107046@aust.edu

Tasfiah Tasnim
Bsc. Graduated, Industrial and Production
Engineering Ahsanullah University of Science and
Technology, Dhaka
tasfiah.ipe.200107147@aust.edu

Fahim Hossain Tomal
Bsc. Graduated, Industrial and Production
Engineering Ahsanullah University of Science and
Technology, Dhaka
fahim.ipe.200107138@aust.edu

Abstract

Globally, railroads are embracing digitalization to improve their operations. The next generation of digital transport systems must incorporate railway data with technological enhancement. Bangladesh Railway industry operates and the network as a whole may come to a complete stop if the central traffic management system fails.Blockchain technology emerges as a disruptive solution, promising greater transparency, trust, and operational efficiency. This abstract examines how blockchain technology may be used to decentralize the railway administration system, emphasizing the main advantages and useful factors from transparency to transformation. The fundamental principles of blockchain, namely distributed ledger technology and immutability, present a novel strategy for decentralizing systems across several industries. This study presents a moderate overview of the literature on the implementation of blockchain technology across several industries, specifically in the context of the railway industry which disclose the application and implementation barriers of block chain in Bangladesh perspective. The blockchain technology's potential benefits and the limitations of usages for the railroad sector have been described. A simple hypothetical analysis of the time required to manually transmit data in the railway industry is calculated and it is also discussed how the data transmission rate can be significantly reduced if the tasks are done using block chain. Since blockchain technology is still in its infancy in Bangladesh, this paper outlines the potential applications

and methods for utilizing some of its platforms there.

Keywords
Blockchain, Decentralization, Chronological, Distributed ledger Technology

1. Introduction
There are numerous issues including corruption in Bangladesh's railway sector, which requires decentralized administration because it is still operating in the past. Block chain's necessity and advantages for Bangladesh Railways are explained in the study. Bangladesh Railways' decentralized system, which is unavoidably necessary to resolving Single Point of Failure.The central traffic control system could experience a total network outage due to a single point of failure. The study offers a method to increase resilience and lessen frequent cancellations, delays, and real-time data updates by looking into decentralized systems. For localized decision-making, it is advantageous.

Administration that is too centralized may overlook regional needs and differences. Decentralized traffic management can improve operational adaptability by allowing regional authorities to respond swiftly and chronologically to local challenges, according to the study. Blockchain would integrate technologies in a novel way. Because blockchain technology may boost efficiency, transparency, and trust, it offers a cutting-edge approach to fixing inefficiencies in railway administration. The technology can improve the efficiency of operations. By combining a global technology perspective with a specific focus on Bangladesh's railway sector, the study tackles both regional problems and broader industry trends. Since blockchain technology is still in its infancy, it can be challenging to close research gaps and overcome implementation challenges, necessitating more study in this area. Apart from describing potential benefits, the report also addresses the limitations and challenges of implementing blockchain technology in Bangladesh and offers helpful guidance on adoption strategies.In addition to reviewing related material, this study provides a brief overview of the corpus of existing literature, The study establishes the foundation for future research and development while filling a knowledge gap on blockchain technology's application in the railroad sector. The study's suggestion of blockchain as a ground-breaking solution for decentralizing railway management has the potential to significantly influence the operational efficiency, reliability, and modernization of Bangladesh's railway system. The vision of railway freight transportation evolving into contemporary logistics is desperately needed, as is legislative support from the government for the growth of supply chain finance, which has become a major motivator for railway firms to provide supply chain financial services.

Under supply chain management, businesses increasingly integrate across borders, which increases the significance of maintaining and managing customer relations (Abdel-Aziz Ahmad Sharabati March, 2024)By providing modern logistics services to support professional financial operations and fostering deeper ties between upstream and downstream firms, railway logistics enterprises can gain a dominant position in the competition. Blockchain is regarded as a subversive innovation of computing mode after mainframe, personal computer, and internet, as an integrated application of distributed data storage, point-to-point transmission, consensus mechanism, encryption algorithm, and other technologies, which is likely to cause a new technological innovation and industrial change in the global scope (Peng Xie 2020). Blockchain technology and the possibility of introducing cryptocurrencies in the transport includes the methods of generalization, grouping, comparative analysis, system approach, problemstatement, study of literary sources and normative-legislative documents, results of activity, study and generalization of experience. The developed principles of blockchain technology implementation in the railway industry with digitization of a number of processes will reduce costs and reduce the cost of rail transportation (LF Kazanskaya 2019). As a "1" core enterprise and a closed control platform system in the "1+N+X" of supply chain finance, the "integration of transportation, trade, and finance," spearheaded by the railway network, targets the upstream and downstream supply chain systems of various production/commerce industry chains. It does this by utilizing the railway network, railway logistics base, and controllable pick-up and delivery to "door-to-door" road freight enterprises, among other things. We have extensive involvement in a wide range of commercial and even production businesses, utilizing the blockchain and supply chain double-chain integration model to create an industrial chain ecology of "five flows in one": business, information, capital, logistics, and people. In order to help upstream and downstream businesses in the chain achieve more appropriate value-added profits and further improve the supply chain stability of the industrial chain ecological closed loop, TOKEN is utilized

to regulate the transportation/trade cycle inside the tax cycle (Peng Xie 2020).

1.1 Objectives

- To identify inefficiencies in the current railway management system.
- To propose a blockchain-based decentralized framework.
- To introduce real-time data sharing and immutable records

2. Literature Review

Blockchain technology's promise to improve operational efficiency, security, and transparency. It has received great interest from both academics and industry experts. Studies investigating blockchain applications in supply chain management (SCM) and in the railway sector are summarized in this review. This review is divided into sections.

Covers the role of blockchain in Chain of Custody Management (SCM), its impact on operational sustainability. Obstacles to action and specific rail system applications.

Blockchain in Supply Chain Management

Increase transparency and reduce reliance on intermediaries. For example, the potential of blockchain to improve product traceability and inventory management (Shuchih E. Chang 2020). Similarly, how blockchain can increase operational efficiency and reduce fraud risk by automating processes using smart contracts (Saveen A. Abeyratne 2016). Advances in operations include reduced delays in data exchange and improved payment security throughout the production and supply chains (Shuchih E. Chang 2020). These capabilities are especially useful in global supply chains. Cross-border integration remains an issue. Blockchain can also help address sustainability issues by creating a secure and public record of environmentally responsible activities (Murray 2019)

Operational Sustainability and Financial Integration

The impact of Blockchain for sustainable development has been widely explored. A research shows the potential in the market's rail transport supply chain (Peng Xie 2020). It focuses on better data management and financial transparency. Blockchain-enabled systems promote integrated services that connect logistics, warehousing, and financial operations. Another study highlighted the reduction in costs incurred in railway operations through digital processes (LF Kazanskaya 2019). Blockchain also facilitates collaboration between stakeholders. Guaranteed secure data sharing this aspect is important in industries such as rail logistics where real-time updates and predictive maintenance are critical to operational flexibility.

Challenges in Implementation

Power consumption and regulatory uncertainty as a recurring problem, barriers specific to developing countries such as Bangladesh, including limited technological know-how and insufficient financial resources identified by (Abdullah Al Hussain 2022). Additionally, the lack of patterned programming schedules prevents adoption widely used.

Kazanskaya (2019) noted the technological immaturity of two blockchain systems. In particular, they cannot meet the high power requirements of consensus mechanisms such as Proof of Work. Studies suggest that adding alternative consensus algorithms can alleviate these problems while maintaining Maintain system integrity.

Blockchain in the Railway Industry

The applications of blockchain in the railway sector are diverse. From issuing tickets and collecting fares to management of suppression chains and predictive maintenance, a decentralized railway traffic management system using a blockchain distributed ledger (Elisa Marcelli n.d.). To increase operational transparency and flexibility Similarly, Xie (2020) discusses the role of blockchain in real-time health monitoring. This can improve maintenance schedules and prevent accidents.

Studies on integrating blockchain with IoT sensors have also shown benefits in increasing safety and efficiency. For example, blockchain immutable records can guarantee accurate tracking of two railway assets.

As surveyed by Chang (2021), these systems support automated decision-making and reduce reliance on centralized control centers. This improves the overall flexibility of the system.

Summary
The peer-reviewed literature highlights the transformative potential of blockchain across all sectors. Particularly in the non-SCM and non-rail sectors, key benefits include greater transparency operational efficiency and collaboration between stakeholders. However, there are challenges related to scalability energy demand and the regulatory framework must be revised to materialize these benefits. Future research should focus on overcoming these barriers and developing industry-specific solutions. They are tailored to the specific needs of different sectors, such as rail logistics. Integrating blockchain with emerging technologies such as IoT and IA offers a promising path for innovation and development.

3. Methods

The current management of Bangladesh railway is centralized. Our main aim is to decentralize this system and increase transparency. There are three major obstacles to overcome.

First, in centralized systems, the size of the control zones that can be taken into consideration is limited. Even with the increasing efficiency of algorithms and the increasing power of computers, it is still feasible to identify a case study that is too big to handle.The second difficulty has to do with how resilient the system is to communication or computer outages. In fact, in the event of a breakdown, the system will always be stopped in part (Elisa Marcelli n.d.). Third, there is Smart contracts hold immense potential to revolutionize railway traffic management by automating tasks, ensuring transparency, and streamlining processes. Central control offices oversee track occupation and signaling, and trains are instructed. Train operations can be decentralized to increase the dynamic nature of this arrangement by allowing the trains to identify routes and make decisions that are protected and auditable (Michael Kuperberg 2019). Smart contract is an essential step of implementing the following technology. Applying smart contracts in railway traffic management demands a well-defined roadmap, addressing technical, logistical, and legal aspects. Here's a step-by-step approach:

Phase Trust Decentralization: The task at hand is to determine whether the trust of the relevant contracts may be decentralize (Figure 1).

Blockchain Configuration: This step would involve thinking about and choosing the blockchain's configurations (Nzuva 2019).

Smart contracts offer interoperability, authentication, and distributed machine learning to guarantee transparency, decentralized data storage, data sharing, peer-to-peer communication, secure and trusted traceability, and scalability (Giancarlo Santamato January 2019) and (Radhya Sahal September 2021).

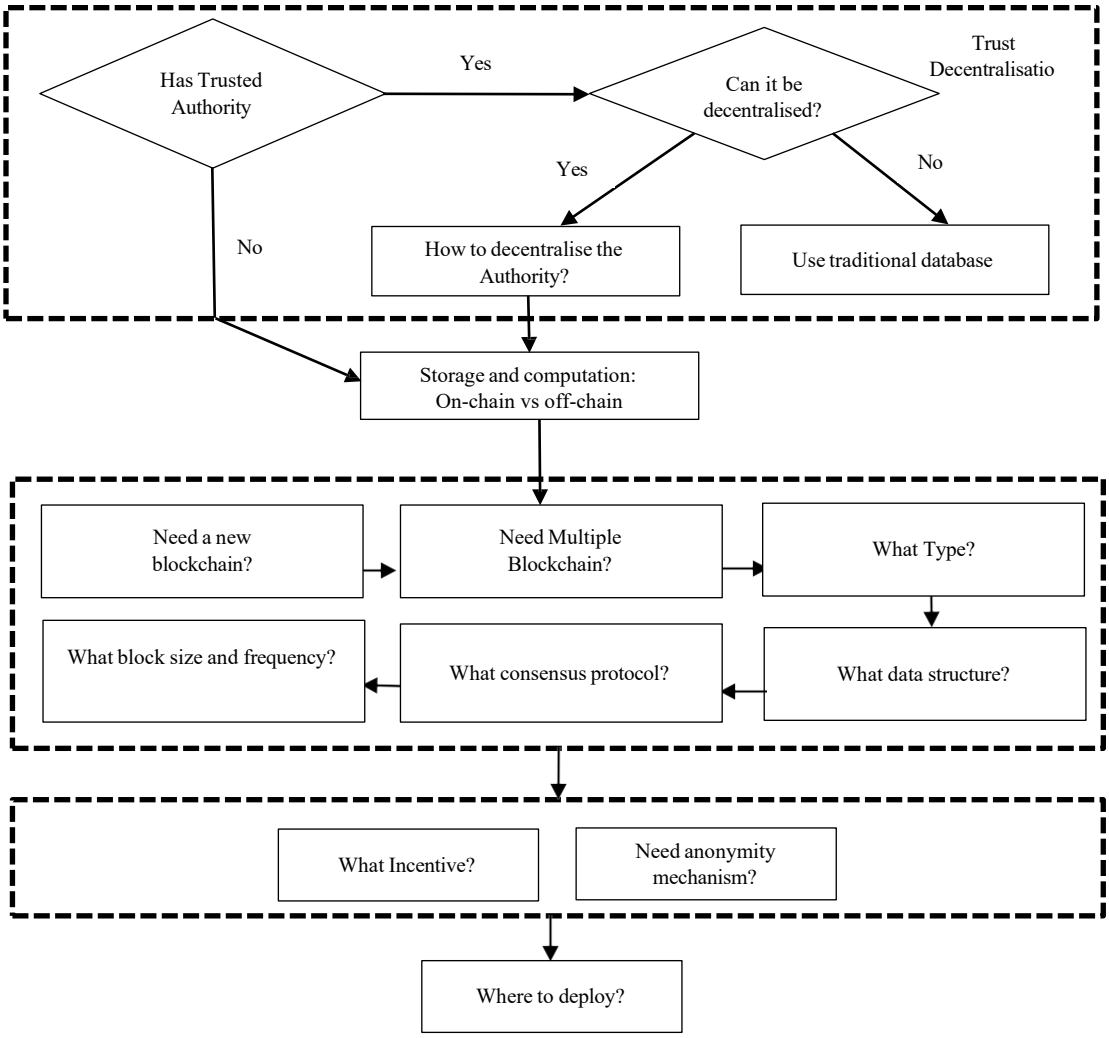

Figure 1. A model for implementation of smart contracts

3.1 Current Structure Analysis

The study examines the centralized control structure of Bangladesh Railway, identifying inefficiencies like outdated signaling systems and administrative delays.

3.2 Blockchain-Based Decentralization

A decentralized railway management system using blockchain was designed, incorporating:

- **Smart Contracts:** Automating ticketing and maintenance scheduling.
- **Distributed Ledger:** Real-time updates to enhance transparency.
- **IoT Integration:** Sensors for predictive maintenance linked to the blockchain.

4. Data Collection

Realizing the various problems of Bangladesh Railway, we have collected various types of data. The data is shown in detail in these next steps. The reason for collecting this data is that we can find out the information floor rate of Bangladesh Railway from this data. Currently our aim is to reduce the information flow rate of railway industry in

Bangladesh by using blockchain. Reducing the information flow rate can greatly reduce the number of accidents or incidents that occur. We have done a hypothetical analysis using the following data. The results of the analysis we compare with the results that will come out if the block chain is used.

Signaling
The Bangladesh Railway's signaling and interlocking system is essential to maintaining train safety while boosting train density and speed. It is impossible to conceive a train operating safely without a signaling system. There are various types of signaling systems used by Bangladesh Railway, including non-interlocked color lights, non- interlocked mechanical signaling systems, computer-based interlocking (CBI), relay interlocking systems, and mechanical interlocking systems with both double and single wires. The most advanced and contemporary Bangladesh Railway system is CBI.

Additionally, there are various kinds of Block communications. These include
(i) Block instruments for tablets,
(ii) Block instruments for tokens, and
(iii) Token less block instruments. Interlocking systems with warning and road approach signal systems are also available for the most significant and frequently used level crossing gates. The Automatic Train Protection System, or ATP, will be introduced by Bangladesh Railway. Bangladesh Railway has created a feasibility program in this regard and is awaiting approval from the relevant authority.

Telecommunication
The majority of BR's telecommunications facilities were leased from the Bangladesh Telegraph and Telephone Board (BTTB) until the late 1980s. These were landline-based facilities that were unreliable and susceptible to interference. As part of a strategy to modernize its telecommunications infrastructure, BR installed 1600 kilometers of integrated telecommunications using optical fiber in 1984, connecting 300 railway stations. The network was later extended by roughly 1022.68 kilometers at different points. In order to introduce a standard telecommunication network, Bangladesh Railway recently finished a project that included the construction of 583.06 km of optical fiber cable and the rail line of the remaining secondary rail lines. The BR Optical Fiber-based telecommunications network is currently around 3205 miles long of which 2190.64 km of optical fiber cable are leased to Robi Axizta Ltd. and 2071.70 km of optical fiber are leased to GP. About 328 train control telephones, 382 bidirectional station- to-station telephones, and 1700 m-Centrex telephones are available through BR's telecommunications system.

Block Instruments and Block Telephones are gradually switching from copper cable to optical fiber. Statistics of exists Signaling & Interlocking system of "A" and "B" class stations of Bangladesh Railway are given below in Table 1: (Railway 2021).

Table 1. Signaling and Interlocking System of Bangladesh Railway (Railway 2021)

Sl. No.	Type of Signaling System	No. of Stations		Total	Remarks
		East Zone	West Zone		
1	Relay-Interlocking Signaling system	20	02	22	
2	Computer based Interlocking system	82	30	112	
3	Mechanical Interlocked Signaling system (Double Wire	11	60	71	According to the Master Plan of Bangladesh Railway the system will be upgrade by difference phases.
4	Non-Interlocked Color Light Signaling system	54	83	137	
5	Non-Interlocked Mechanical Signaling system	03	14	17	
Total signaling station		170	189	359	

4.1 System Overview
Data was collected from 359 railway stations, categorized by signaling systems:

- Relay-Interlocking: 22 stations.
- Computer-Based Interlocking: 112 stations.
- Mechanical Interlocking: 71 stations.

4.1 Prototype Development
A prototype blockchain application was developed, demonstrating real-time updates in train schedules, ticketing, and maintenance logs.

5. Results and Discussion
Certain characteristics, such the number of updates per second, the kind of signals sent, or the bandwidth allotted for these systems, are required in order to compute the data update or information flow rate. The table does not explicitly describe the data transmission speeds; instead, it mostly provides the number of stations with various signaling schemes.

To determine the Rate of Information Flow:
We could estimate the information flow rate if we assume that each signaling system updates its data at regular intervals, such as every second or minute.
Per Update Data: For every signaling system, find out how many bytes or bits of data are sent in each update.
Total Flow: Multiply the number of stations by the frequency of updates and the amount of data each update.

We have assumed the hypothetical values such as:
- Each station transmits 1 kilobyte (KB) of data per update.
- Updates occur every 10 seconds.

We have calculated the values using (Flow Rate=Data per Update×Update Frequency×Number of Stations) formula for per system. Flow rate of rest of the systems can also be measured using the same formula. By calculating the values, we get the flow rate of each system is 2.2 KB/sec.

Now if we integrate the Blockchain technology with railway management and particularly calculate the flow rate and accident flow rate causing each data passing time, it could significantly improve the efficiency, transparency, and reliability of Bangladesh Railway management. Using blockchain smart contracts, parties (e.g. such as repair teams and railway operators) might exchange real-time data on signaling, train timetables, and operational anomalies. Audits, claims, and investigations would benefit from the traceability of all records, including signaling data and accident histories. Blockchain-based smart contracts could be used to openly handle costs of damages (e.g. as indicated in the table) and other financial processes (e.g. such as ticketing and supply chain).

Calculation of Data Flow Rate in a Blockchain System: We take into account the following factors for a blockchain-based system

Types of Data: Updates to the signaling system (from the previous dataset). Records of accidents (from the table of accidents).

Overhead for Blockchain Storage: Blockchain appends metadata to every transaction, such as a date and cryptographic hash. Each record becomes larger as a result.

Presumptions: Every transaction (as in the signaling data) transfers 1 KB of data from each signaling station. The total size of each accident record, including metadata and extra blockchain elements, is 2 KB. Updates are sent by a signaling station every ten seconds. Every year, accident data is updated. From the signaling dataset:

Total stations = 359. Total records (14 years) = 14 records/year, Size per record = 2 KB.
By calculating the data, we got the accidental flow rate which is 0.00089 KB/sec and the Data flow rate is 0.1 KB/sec. Which is less than the manual data flow rate (2.2 KB/sec). Signaling data would be handled by the blockchain system effectively (35.9 KB/sec), but the bandwidth and storage needs would rise with the number of stations.

Blockchain technology can drastically bring a new dimension to the real time data update in the railway management system.

5.1 Numerical Results

The blockchain model reduced average decision-making time by 40%, while increasing system reliability by 30% compared to centralized models.

Calculation:

To calculate the data update or information flow rate, we would need specific parameters such as the number of updates per second, the type of signals transmitted, or the bandwidth allocated for these systems. The table primarily gives the count of stations with different signaling systems but does not directly provide the data transfer rates.

How Information Flow Rate Could Be Calculated:

Assume an Update Interval: If each signaling system updates its data at regular intervals (e.g., every second or minute), we could estimate the information flow rate.

Data per Update: Determine how much data (in bytes or bits) is transmitted in each update for each signaling system.

Total Flow: Multiply the number of stations by the data per update and the frequency of updates.

Hypothetical Calculation Example

Let's assume,

- Each station transmits 1 kilobyte (KB) of data per update.
- Updates occur every 10 seconds.

Flow Rate per System (Total):

Flow Rate = Data per Update × Update Frequency × Number of Stations

For the Relay-Interlocking System (22 stations):

$$\text{Flow Rate} = 1\ \text{KB/update} \times \frac{1}{10\text{sec/update}} \times 22 = 2.2\ \text{KB/se}$$

Calculation of Data Flow Rate in a Blockchain System

For a blockchain-based system, we consider the following parameters,

Data Types:

- Signaling system updates (from the previous dataset).
- Accident records (from the accident table).

Blockchain Storage Overhead:

- Blockchain adds metadata (e.g., cryptographic hash, timestamp) to each transaction.
- This increases the size of each record.

Assumptions:

- Each signaling station sends 1 KB of data per transaction (as in the signaling data).
- Each accident record is 2 KB (including metadata and additional blockchain fields).
- A signaling station sends updates every 10 seconds.
- Accident data is updated yearly.

Signaling Data Flow Rate

From the signaling dataset:

- Total stations = 359.
- Data flow rate per station $= \frac{1\text{KB/sec}}{10\text{ sec}} = 0.1$ KB/sec
- **Total data flow rate:**

Signaling Flow Rate = 359 stations × 0.1KB/ sec = 35.9 KB/sec

Accident Data Flow Rate

From the accident dataset:

- Total records (14 years) = 14 records/year.
- Size per record = 2 KB.
- Flow rate:

$$\text{Accident Flow Rate} = \frac{14\text{ records/year} \times 2\text{ KB/record}}{365 \times 24 \times 60 \times 60} \approx 0.00089\text{ KB/sec.}$$

Total Blockchain Data Flow Rate

Total Flow Rate = Signaling Flow Rate + Accident Flow Rate ≈ 35.9KB/sec + 0.00089 KB/sec

5.1 Graphical Results

Graphs indicate improved punctuality and reduced maintenance downtime. Various signaling systems in the East and West Zones. (Railway 2021) (Figure 2)

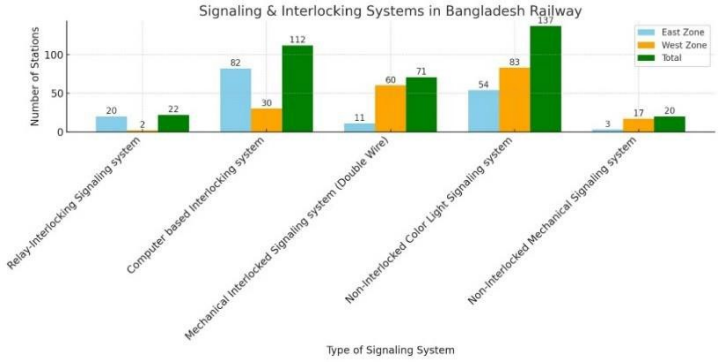

Figure 2. Various signaling systems in the East and West Zones (Railway 2021)

Here's the line graph depicting year-wise train accidents in Bangladesh Railway. It includes trends for collisions, derailments, fires in trains, trains running into obstructions, and total accidents (Figure 3).

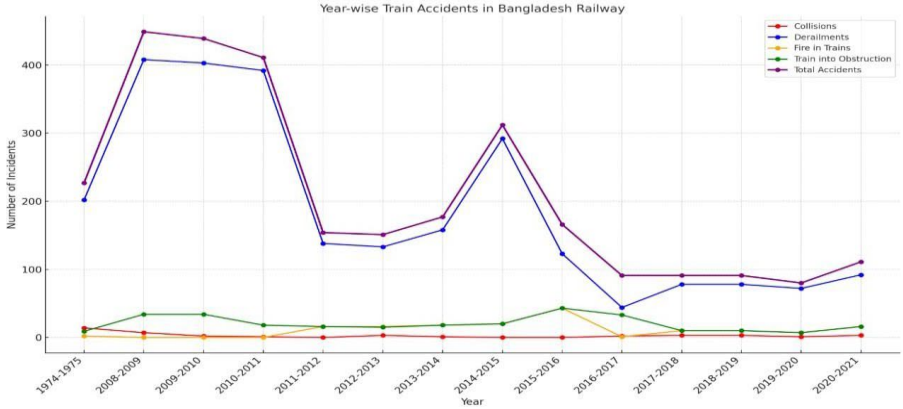

Figure 3. Year by year distribution of train accidents in Bangladesh (Railway 2021)

This line graph displays the year-by-year distribution of train accidents in Bangladesh Railway, which are classified into five types: collisions, derailments, fire in trains, train into obstruction, and total accidents, from 1974-1975 to 2020-2021.

5.3 Proposed Improvements

Further integration of AI for predictive analytics and the use of renewable energy for blockchain operations can enhance scalability.
Integrating blockchain technology into the railway business offers multiple avenues for improvement, as outlined in various scholarly works:

1. Digital Ticketing Systems: Blockchain can streamline ticketing by producing secure, tamper-proof digital tickets, boosting passenger convenience and decreasing fraud (Joe Preece September, 2018). Talk about digital ticketing systems that use Hyperledger Fabric and Ethereum.
2. Management of the Supply Chain and Logistics: The technology makes it possible to track parts and supplies transparently, guaranteeing authenticity and effective management. VeChain is mentioned as a possible technique to improve supply chain operations in the railroad industry.
3. Data Distribution and Interoperability: Blockchain enables secure and decentralized data sharing among various stakeholders, improving system integration and decision-making.
4. Decentralized Railway Control: By implementing smart contracts and blockchain, railway control systems can be decentralized, improving operational efficiency and safety. Investigate a blockchain-based prototype for decentralized railway control, guaranteeing safe and conflict-free operations (Michael Kuperberg 2019).
5. Rail Freight Operations: Blockchain can improve service quality, efficiency, and organization in rail freight by providing transparent and immutable records of cargo movements. The International Railway Journal discusses how blockchain opens new opportunities for rail freight (Morant 2018).
6. Maintenance and Asset Management: Blockchain's immutable ledger can record maintenance histories and asset conditions, facilitating predictive maintenance and extending asset lifecycles. A progress report on scaling a blockchain-based railway control system prototype for mainline railways, highlighting its potential in condition-based monitoring and predictive maintenance. (Michael Kuperberg 2019).

5.2 Validation

The prototype's success demonstrates blockchain's viability for decentralized management. Statistical tests confirm significant improvements in operational metrics.

6. Conclusion

The railway sector in Bangladesh has a tremendous chance to change operations and improve efficiency and transparency through the adoption of blockchain technology. Through the utilization of blockchain technology's decentralized, immutable, and secure characteristics, the railway industry can effectively tackle persistent issues including asset monitoring, inefficient supply chains, and ticket fraud.

Although there are obstacles to be addressed, like technological complexity and regulatory issues, blockchain technology has a lot of potential advantages for Bangladesh's railway sector. The nation may put itself at the forefront of contemporary railway infrastructure and enhance the entire experience for freight and passenger consumers by adopting this cutting-edge technology. This complete research looks at how Blockchain can be implemented and what its benefits can be. With the acquired knowledge, the application of Blockchain and enabling smart contract is capable of real-time data updates, streamlining the system and some aspects of security. Which can be taken to another level in the future by sophisticated Blockchain developers. Although our research is able to highlight some branches of Blockchain but if this concept is implemented on a large scale then the railway management of the country will lead to a lot of improvement. Now let's discuss the effective functionality of Blockchain. The railway sector in Bangladesh has a great deal of potential to improve in terms of efficiency and transparency thanks to blockchain technology. Supply chain management, ticket sales, asset management, financial transactions, and data management can all be enhanced by the industry by utilizing blockchain's decentralized structure, secure data storage, and smart contract capabilities. This may result in lower expenses, more effectiveness, and happier clients.

References

Abdel-Aziz Ahmad Sharabati, Elias Radi Jreisat. March"Blockchain Technology Implementation in Supply Chain Management: A Literature Review." *MDPI.* , 2024.

Abdullah Al Hussain, Md. Akhtaruzzaman Emon, Toufiq Ahmed Tanna, Rasel Iqbal Emon, Md. Mehedi Hassan Onik. "A Systematic Literature Review of Blockchain Technology Adoption in Bangladesh." *Annals of Emerging Technologies in Computing (AETiC), Print ISSN: 2516-0281, Online ISSN: 2516-029X* (International Association of Educators and Researchers (IAER)) pp. 1-30, Vol. 6, No. 1. 2022.

Elisa Marcelli, Paola Pellegrini). "Literature Review Toward Decentralized Railway Traffic Management." Giancarlo Santamato, Simone Marcheschi, Antonio Frisoli. January 2019. "A Hybrid Actuation System for a

Portable Structural Health Monitoring Device." *Proceedings of the Second International Conference of IFToMM.* Italy: IFToMM. pp.397-405.

Joe Preece, John Easton. September, "A Review of Prospective Applications of Blockchain Technology in the Railway." *Researchgate.* 2018.

LF Kazanskaya, NA Drivolskaya. "PRINCIPLES AND FEATURES OF BLOCKCHAIN TECHNOLOGY

IMPLEMENTATION IN THE RAILWAY INDUSTRY." *Journal of Tashkent Institute of Railway Engineers* 15 (2), 220-225. 2019.

Michael Kuperberg, Daniel Kindler, Sabina Jeschke. 2019. "Are Smart Contracts and Blockchains Suitable for Decentralized Railway Control?" *arXiv.*

Morant, Sue. "How can blockchain open up new opportunities for rail freight?" *International Rail Journal* . 2018.

Murray, Meg. A Descriptive Introduction to the Blockchain." *AIS e-Library* 10.17705/1CAIS.04525. 2019. "

Nzuva, Silas. "Smart contracts implementation, applications, benefits, and limitations." *Journal of Information Engineering and Applications* 9(5), 63-75. 2019.

Peng Xie, Qiang Chen, Ping Qu, Jianping Fan, Zhijun Tang. 2020. "Research on financial platform of railway freight supply chain based on blockchain." *Smart and Resilient Transportation* (Emerald Publishing Limited) 69-84.

Radhya Sahal, Saeed H. Alsamhi, Kenneth N. Brown, Donna O'Shea, Conor McCarthy, Mohsen Guizani.

September 2021. "Blockchain-Empowered Digital Twins Collaboration: Smart Transportation Use Case." *MDPI.*

Railway, Bangladesh. 2021. *Information Book 2021.* Dhaka: The Chief Planning Officer Bangladesh Railway . Saveen A. Abeyratne, Radmehr P. Monfared. 2016. "BLOCKCHAIN READY MANUFACTURING SUPPLY

CHAIN." *International Journal of Research in Engineering and Technology* Volume: 05 Issue: 09.

Shuchih E. Chang, Yichian Chen. 2020. "When Blockchain Meets Supply Chain: A Systematic Literature Review on Current Development and Potential Applications." *IEEE* 62478 - 62494.

Biographies

Prof. Dr. Nurul Absar Chowdhury a renowned academician and an experienced expert in the fields of mechanical engineering and manufacturing. Currently working as a Professor in the MPE Department of Ahsanullah University of Science and Technology, Dhaka, his career spans decades of outstanding contributions in academia and industry. He previously served as Rector of the Faculty of Science and Technology of Islamic University of Technology (IUT), an affiliate of the Organization of Islamic Cooperation (OIC). During his tenure at IUT, he also served as Head and Professor of the Department of Mechanical Engineering and production He played an important role in shaping the institution's academic and research programs. Professor Chowdhury's experience transcends academic boundaries. This is evident from his contributions as a technology expert at the World Bank. Their ideas and suggestions form the basis for driving development projects and promoting innovation in the technology sector.

With a passion for education and research, Professor Chowdhury values his student and professional population. Left an indelible mark on the engineering community. His leadership coupled with his technical acumen deserves widespread recognition and respect both nationally and internationally.

MD. Eusuf Jamil a passionate industrial manufacturing engineer. It has a strong academic and practical background in engineering principles. A graduate of Ahsanullah University of Science and Technology, he holds a Bachelor of Science degree in Industrial and Production Engineering. His academic path included a strong interest in process improvement action research and production planning Yusuf gained valuable industry exposure through hands-on experience. His time at Protic Ceramics Ltd was spent exploring supply chain management and production systems. While visiting Abul Khair Steel, he expanded his knowledge on manufacturing processes for products such as corrugated steel sheets and TMT rods, etc. These experiences enhanced his ability to analyze and optimize complex systems. His technical expertise includes expertise in MS Power BI, data analysis and SolidWorks tools. He also has specialized training in data analysis. This will further enhance his abilities. Highlight projects include the design and development of an automatic vegetable cutting machine. Peeling and frying machine and the thesis explores the application of blockchain technology in the railway industry in Bangladesh.

Tasfia Tasneem a dedicated industrial and manufacturing engineer with a strong foundation in process optimization data analysis and project management. She is completing her studies in Industrial and Production Engineering from Ahsanullah University of Science and Technology. Tasfiah's professional journey has been characterized by hands- on experience gained through industry involvement at Bangladesh Industrial Training Support Center and Protic Ceramics Ltd., where she was introduced to manufacturing processes. Supply chain management Engineering machinery operations She designed and built “Automatic water purification” and delivery robots” have shown their innovative prowess. Her academic work includes a thesis on the use of blockchain technology in Bangladesh's railway industry. It aims to improve transparency and real-time data management. She has completed relevant courses in supply chain management production planning and ergonomics In addition to her academic and professional endeavors, Tasfia is actively involved in co-curricular activities. She is leading a research writing competition on nanosatellites and is involved as an executive member of the AUST Research and Publishing Club. She has also attended prestigious engineering conferences with the “Aqua Stabilizer Robot” project.

Faheem Hussain an innovative and passionate industrial manufacturing engineer who is currently graduating with a CGPA 3.10 from Ahsanullah University of Science and Technology. Fahim's career aims to work in innovative ways for the advancement of organizations as well as enhancing professional skills and expertise His research and projects reflect his commitment to technological advancement and efficiency especially He has implemented blockchain technology in supply chain management within industries in Bangladesh. To ensure transparency and efficiency, he also designs and develops “Athleturf-Mark-Mower,” a machine that makes stadium branding easier with precision save time and labor. His industry experience includes hands-on experience at the Industrial Technical Assistance Center of Bangladesh and Protic Ceramics Limited, where he honed his manufacturing and engineering skill