**INDIAN RAILWAYS**

**OMIS 697 – 1 DIGITAL TRANSFORMATION STRATEGY**

Text

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**Group - 8**

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**ABSTRACT**

Indian Railways (IR) is the state government owned monopoly railway company of India and is fourth largest and one of the busiest rail networks in the world, transporting six billion passengers and almost 750 million tons of freight annually more than 1.6 million employees. Our project’s goal is to investigate the operational and customer engagement challenges through research and then recommend digital strategies of Internet of Things (I.O.T) for Indian Railways to move up in the quadrant from conservative to digital.

**INDIA RAILWAYS**

Indian Railways, generally referred to as IR, is the department of the Indian government that belongs underneath the Ministry of Railways and is in charge of running the country's train system. The Indian Railways' administrative center is in Delhi, and the Railway Board oversees the Department while a cabinet-rank railways minister leads the Ministry. Despite recent attempts by Indian Railways, a government organization, to follow an organizational style of management, this country's train system is still a state monopoly and one of the busiest and largest in the world, carrying six billion people annually. The country is crossed by railways on both sides. With almost 1.36 million employees, IR is the second-largest commercial or utility employer in the world.

The IR was nationalized as one unit by the government in 1951, making it one of the biggest networks on the planet. Long-distance and local train networks are both operated by Indian Railways. The railroads have been essential to India's modernization and democratization since 1947.

**What and who?**

Now the world is entering into the Industrial Revolution of Fourth version, Digital transformation will be characterized as fusion of technologies with operations that is blurring the thin lines between the digital, physical, and biological spheres. The Indian Railways is continuously deploying cutting edge and emerging technologies. But there is a need of both freight and passenger railways to get innovate, improve, and enhance the customer and traveler experience continuously.

The creation of User friendly and smart mobility system is one of the top priorities in the evolution of transport globally. Railways is recognized as important part among ways of transport for this process. As a result of the drastic changes in the business environment made possible by IOT technology, train operators must update their current business models and plans. The success of Indian Railways depends critically on having a solid knowledge of the notion of digital transformation.

All stages of the supply chain will be disrupted by the digital industry's support for new industrial applications and business models. In order to design trains that are smarter and more environmentally friendly, Indian Railways and their suppliers will be able to employ real-time data, digital models, virtual tools, and testing environments. Streaming data from a train that is actually running will also be provided back to enhance the planning and construction process and allow greater predictive maintenance. Given the extreme complexity of the railway industry, which includes the requirement to manage a globally distributed workforce and track assets and cargoes at all times, digitization has the potential to have a huge influence on efficiency and flexibility.

The optimization of the current freight and passenger rail timetables and train sets is necessary to boost throughput on the current rail infrastructure, and digitization will effectively match capacity with demand in this situation. To keep processes running smoothly and keep the costs down, it will prevent bottlenecks. To address the capacity issue, Indian Railways is enhancing asset utilization and optimizing operations by making large investments in partnerships, infrastructure, and technology. The capability to embrace transition that goes beyond information technology and the continuing redesign of overall organizational activities and functions as new game-changing innovations emerge will be necessary for long-term substantive benefits. This will be more difficult and will call for a new level of collaboration between transportation providers and operators.

**Where? - The focus points**

Transportation is essential in a society that is becoming more urban and more international. Systems for traffic and transportation must be dependable, effective, safe, and environmentally friendly. The Agile networking, GSM-R, Internet of Things (IoT), eLTE may all be used to develop and build smart infrastructure for transportation, including smart airports, urban rail networks, and train lines. By enhancing transportation services, these technologies help make travel more practical, secure, and effective (Mcgill).

The outdated communication, safety, and signaling equipment, as well as the robotic signaling system to prevent crashes, are technical flaws that contribute to the problems with the Indian Railways and are addressed by Digital Railway Solution, which creates smart O&M, intelligent stations, and integrated mobility applications using a combo of network technologies.

Cost and Safety Optimization

The 21st century's requirements for railroad communications can be met via digitization, which can handle these issues while providing stability and reliability.

Connectivity

Since both passengers and operators expect excellent service, the railway sector's success depends on safety, dependability, and affordability. To meet these demands, however, the industry needs communications networks that operate at peak efficiency.

Over 150,000 km of railroad in Europe and 250,000 km worldwide including India are equipped with the current Global Technology for Mobile Communications-Railway (GSM-R) system. But despite its great popularity, it is currently suffering from obsolescence (Huawei). Rail automating, intelligent maintenance, remote monitoring systems, and other services will be demanded as more and more trains become digital, and GSM-R will be unable to meet these demands. Future trains will have greater bandwidth, functionality, and quality of service requirements.  LTE for Railways, aids in meeting these demands for trains. The network can handle mission-critical services including device monitoring, real-time video, and CBTC signaling.

As a matter of fact, Huawei technologies are already in use around the world, such as in Northern Africa, Central Asia, Europe, and Middle East they have continuously improved safety while lowering operating costs and boosting overall railroad performance. The three main components of railroad communications—mission-critical dispatch, system-wide backbone (system-wide connectivity), and broadband trackside devices—are covered by this innovation-driven end-to-end communications network. A network like this protects financial infrastructure investments and rolling stock while enhancing safety and dependability while lowering operating expenses (Huawei).

New dawn of Railway Industry with 5G:

Of course, the arrival of 5G heralds a new era for the railroad sector as well. Best suited for the large capacity, wide coverage, highly secure, and high reliability of the railway operator's future 5G network, the future new telecommunication system must be developed with industry leaders as a key enabler for rail transport digitalization, enabling the near real-time data availability that might otherwise be collected manually at the end of the day. As a result, it will enable railway operators to use networks data in real-time to accelerate decision-making, so enhancing safety, reliability, and operations.

Cloud

In the past, railroad operators divided up their activities into separate silos. Now, if such an operator has several lines, this leads to islands with inefficient architecture that are identical in design. The cloud platform enables the sharing and better usage of IT resources by combining the several operation service platforms into a single cloud platform. Railway operators may anticipate limited spending in regard to capital costs, hardware investments, and overall operating costs. Additionally, the platform provides a customizable system that is open and adaptable. Control is made simpler by the use of a single management system. Not to mention, different databases combine into a single data lake to provide service models and specialized capabilities for more efficient and seamless railway operations as a whole.

Intelligence center

The next stage is to derive the intelligence from the data after the railways operator has a consolidated pool of data. By integrating and combining information and processes, an Intelligent Operation Center (IOC) solution serves as the brain and nervous system of a railroad operation. Railway operators will have enhanced situational awareness thanks to IOC, which will improve asset management and hasten incident reaction times. A railway management with many routes will be able to evaluate the general condition of assets and machinery by consulting one map. However, the human brain may contribute to the safe and economical construction of a new line in addition to operation and maintenance. The IOC may take care of a new project instead of relying on human routine inspection, saving the railway operator a lot of time and money (Huawei).

**When? – For the Future of Indian Railways**

Railways have played a significant role in the transportation system for more than 200 years. They are also a vital part in the global supply chain which stretches from the conveyance of raw materials to the bulk shipping of completed goods. The movement of individuals and products still heavily relies on the rail sector in the modern world. In reality, given that the trucking business is constrained by growing fuel prices, more stringent government regulation, and the developing requirement for sustainability in logistics, demand for rail transportation should rise (railroad ways are known as one of the greenest modes of transportation in the world).

Rising demand is always nice, but to take advantage of this chance, a renewed dedication to agility, optimization, and performance is necessary. Future railroads that adopt technology advancements brought on by digitization will be the most prosperous. Indian Railways is hesitant to adopt new technologies and continues to employ outdated IT systems, which reduces resource efficiency, compromises dependability, and prevents businesses from swiftly adapting to changing customer demands.

In order to take advantage of changing needs and to increase returns in this capital- and asset-intensive business, more railways are anticipated to use artificial intelligence, data analytics, and digitalization to drastically decrease costs and enhance efficiency.

Digital Technology and Railways

The traditional functional requirements of the rail sector, such as station controls, traffic planning, maintenance and support,  communication networks, operations management, power supply, infrastructure management, and rail-facility information management, can all benefit from digitalization and artificial intelligence. Modern digital communications and on-train processing, in particular, will make it possible to track trains' speeds and locations with higher accuracy, which boosts productivity and performance. It's important to note that railways will become even more sustainable as a result of efficiency and performance enhancements, thus boosting their viability at a time when climate change is a pressing concern.

Technological Solutions for the prevailing challenges

Rise of a new unified Ecosystem:

New-generation apps and services will require a powerful rail communications network. Mission-critical smooth operating and economic onboard services will depend on greater fiber optic cables and radio technologies, LTE, and 5G. Strong domain knowledge in key aspects like Mobile and Data Communications will be necessary for the Design, Deployment, Operation, and Maintenance of a new ecosystem. Additionally, it will need to be able to anticipate and address the particular difficulties posed by train settings, such as reducing service disruption during complicated installations and meeting growing safety requirements, such as cybersecurity.

Indian Railways will need to collaborate with technology companies that have a track record of executing cutting-edge projects in high-traffic areas in order to save money, lower risk, and prepare efficiently for unforeseen obstacles.

Integration of Technology

Future rail networks will make use of a consolidated, entirely digital communication system. Onboard customer services as well as Ground-to-Train and Train-to-Train connections will be included. The Internet of Things (IoT), machine-to-machine and human-to-machine interfaces, sensors, cameras, emergency communications, and sophisticated access controls will all be used to improve safety and security. In order to compete, service providers would need to offer Indian Railways-lacking features like onboard entertainment, e-ticketing, Ubiquitous connectivity, travel information services, through a single application or website (Cyient).

It will need a mix of topic expertise, analytical aptitude, problem-solving skills and deep learning to enter this ecosystem of linked communications and apps. It will make use of considerable knowledge in fields including network and sub-system integration, installation, benchmarking, and radio frequency (RF) optimization (Cyient).

Indian Railways will need to collaborate closely with IT and network partners that have experience in the best end-to-end network planning, design, and implementation for the project to be successful. This entails the smooth conversion of current communications systems and related components as well as the incorporation of cutting-edge platforms, analytics, machine learning, and self-managed networks.

Scaling resources

The lack of technical expertise and human resources is becoming a hindrance for train operators' modernization plans as investment on rail infrastructure rises globally. When transferring its legacy networks, Indian Railways will need to consider a variety of outsourcing choices and chances to move quickly. Worldwide standards and laws differ; thus, operators will need suppliers with expertise in platform based research and development that can be customized to satisfy national standards. Rail services will require a variety of skill sets as well as the capacity to quickly scale up the necessary resources due to the necessity for rapid reaction.

Indian Railways will have to overcome the issue of modernizing and combining train communications systems into a single, app-driven ecosystem. To fulfill the demands of future rail operations while also delivering great safety, security, and a seamless passenger experience, strategic steps in the form of technological alliances and network process and enterprise solutions will be essential.

**How? – To adapt**

The fourth industrial revolution indicates that innovation in the transportation sector will continue to accelerate both on the demand and supply sides. The railway infrastructure can be improved by digitization, which can also increase availability and boost all assets' operating effectiveness. The introduction of new technology will result in completely different business models, from the production of rolling equipment to how Indian Railway operators service their consumers. The Indian Railways must keep pursuing these goals notwithstanding steady development. Railways may improve their effectiveness and efficiency as well as the responsiveness and agility of their operational environment by implementing an integrated rail ecosystem and emerging cognitive technologies to gather, associate, and use information.

Cognitive computing, Shared technology, and Consumption:

Railways must collaborate outside of their comfort zones by teaming up with nearby service providers, building an ecosystem of value, and using smart technologies, cognitive computing to harness data from both within and beyond their industries to drive revenue, cut costs, and gain market share in order to achieve the interconnectivity that will power the railway industries near future. Next-generation transport, which will increasingly be defined by a desire for access instead of technology-enabled, two-way communication, ownership, transparency, and shared consumption, may be expected to play a significant role for rails.

Improving Customer engagement:

With digitization, users may travel seamlessly from point A to point B. The door-to-door service provided by railroads satisfies all of the customer's transportation requirements. Railways benefit from stronger sales and marketing results and conversion rates. Through digitization, ticket pricing and changing will be improved, and consumers' access will be facilitated. The majority of the main train firms are promoting mobile ticketing options, which will be advantageous for clients if nations with complicated tariff systems embrace simpler or best-price fee schemes. The handling of client feedback is likely to see more advancements. Current procedures are not customer-focused, highly sluggish, or efficient. Railways anticipate and provide for changing consumer demands. They interact with clients using their chosen channels, particularly mobile devices, and provide pertinent, fast, and individualized service.

A growing number of goods will use the Internet directly on the freight side; linked train cars and container will offer their own broadcast updates on condition, location, and route. In the long run, autonomous vehicles will interact directly with terminals, trains, and dispatch centers to make sure that their goods and passengers arrive at the correct location and time. Real-time monitoring on systems, facilities, assets, and cargo is done by freight railways. Improvements are made in customer service, labor utilization, Productivity, network velocity, and on-time delivery, Delays and downtime are prevented. Railways make use of their lower operating costs to expand their services as the hub for door-to-door transportation, which is now made possible through agreements with supply chain providers and knowledge of their own operational performance (nasscom).

**Why?**

After the US, Russia, and China India has the larger worldwide rail networks.  Indian railway system consists of a total of 123,542 km of tracks over a 67,415 km route, along with about 7,300 stations (Techmahindra). In terms of lowering operational costs, maximizing the use of rail infrastructure, complying with safety and security regulations, and integrating the systems, it is now facing significant problems. Although significant efforts have been made to address these issues, Indian Railways still need improved decision support systems and information management in order to achieve operational excellence by making the appropriate judgments at the appropriate time.

One of the top goals in the global transportation upgrade is creating user-friendly mobility an innovative environment system. It is accepted that a crucial part of this process is rail transportation. The business ideas and strategies now employed by train operators need to be updated due to a dramatic progress in the business environment caused by technology.

The ongoing cycle of digitalization, which links cyber-physical systems to the real and virtual worlds, is responsible for innovation and change in many economic areas. cloud computing and the internet of things, mechanization, in-depth data analytics, mechanization, and robots are the top technologies and solutions that have sped up digitalization in the railway industry.

The advent of the concept of industry 4.0 as well as more recently, Digital railway and Railway 4.0 are clearly indicative of the adjustment to the present requirements of the digital economy. The Indian Railways has identified several key areas for digital transformation, including partnerships with logistics and technology companies to advance technology, user-friendly applications for passengers, application integration for a collaborative platform, consumer convenience for freight, cashless commerce, alerts and dashboards, data analytics, and mobile applications.

Notable recent technological inclusions (InvestIndia):

* The Indian Railways began implementing digitalization throughout all of its operational areas, including passenger data systems, automated passenger car factories, preventive maintenance, train signaling, unreserved ticketing, ground control systems, and procurement, techniques.
* The Indian Railways are implementing the Real-Time Train Information System (RTIS) linked to ISRO for computerized chart creation and passenger train data.
* Automated unreserved tickets are made accessible to passengers at rest stations using Unreserved Ticketing System (UTS) terminals. The signal system of Indian Railways is being updated. In order to boost production, the railway installed Industry 4.0 in contemporary passenger car plants.
* In order to inspect bridges in 2019, Indian Railways also used 3D scanning and drone cameras for riverbeds. In the future, they want to use drones for train maintenance.
* By implementing cutting-edge technology and mechanisms that adhere to international standards and laws, Indian Railways has completed the end-to-end digitization of procurement processes and has consistently improved its methodologies. Its long-term objective is to increase consumer happiness and functional implementation.

Recent technological innovation suggestions for Indian Railways:

* Traffic flow can be improved, and technical mistakes can be decreased via automatic train control systems.
* The procedure of loading and unloading as well as freight management in general will be improved by autonomous trucks.
* Condition-based monitoring, made possible by Internet of Things (IoT) technology, reduces delays brought on by rail and train breakdowns.
* Control, Traffic planning, and optimization of train operations can be improved by artificial intelligence.
* Some train firms use robotic equipment for cleaning and upkeep of infrastructure and drones for remote inspection.
* Additionally, the revolution of the rail sector will be greatly accelerated by 5G networking technologies. In addition to enabling "smart trains" with more effective safety and signaling systems, it may preventative maintenance and automate predictive when used in conjunction with IoT technology. This increases service dependability and increases the productivity and usable life of high-value assets.
* Machine vision based rail freight inspection and obstacle detection systems, which considerably reduce the requirement for human attention.
* The problems of derailment, rail breakage, and fasteners may be solved by railways with the use of digital twin technology.
* Data analytics and digitization can also provide railways with fresh approaches to enhance passenger experiences and comprehend delays.

Conclusion

The laws of business will ultimately change as a result of digitalization and be guided by a model of being shared, accessible, trustworthy, and able to operate at marginal cost. Companies will need to connect their suppliers and consumers more extensively and deeply while while being integrated and decentralized. The conventional rail business is under danger because technology makes it easier for new rivals and entrants to swiftly produce value. Indian Railways should embrace disruption in order to create a linked train ecosystem. By implementing cognitive technology, trains will be able to function more quickly and agilely while also being more effective and efficient. Railroads have a long history of operating as networks; the fourth industrial age will expand these networks in ways that we are just now starting to fully understand. This funding will hasten the development of new railway intelligence, allowing improved industry-wide expertise, and business model innovations as the rail sector adopts connectivity and cognitive technology.

The Indian Railways' sluggish adoption of digital technology presents an opportunity in and of itself. Adopting digital technology will promote an atmosphere that is open and transparent and assist in the transition to a quicker, more process-centric approach. The solution is in implementing digital technology to address corporate issues. By adopting digital to improve their infrastructure, ongoing operations, and the experience of both freight clients and passenger customers, Indian Railways may achieve a true competitive edge.

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