



## **DIGITALIZATION IN RAILWAY TRANSPORT A LEVER TO IMPROVE RAIL COMPETITIVENESS**

**Dimitar Garchev**

[mgarchev@gmail.com](mailto:mgarchev@gmail.com)

*University of National and World Economy  
Bul. "8 Dekemvri" Sofia, 1700  
Bulgaria*

**Keywords:** *transport, railway, digitalization*

**Abstract:** *Since the 1990s, digitalization has been advancing at speed across all industrial sectors, public entities, and society at large; and railways are no exception. Digital technologies already govern rail customer's expectations, ticket reservation and purchasing habits, operator's information, and payments systems, but experts believe these technologies have much more to offer the sector. Digitalization is key to industry competitiveness and has therefore become an EU priority. Rail companies have already implemented a vast array of new services and applications using digital technologies, be it for providing more information and leisure services on board, improving the monitoring of their assets, or automating more operations. The changes introduced by digitalization in rail transport are perceived by many stakeholders as an opportunity – owing to the benefits it can offer – but also as a challenge. Indeed, it will require a change of mindsets and business models. Rail digitalization will also require financial investment and a strategy to tackle cyber threats. Addressing these challenges will allow digitalization to improve the efficiency and competitiveness of the railway sector.*

Digitalization began in the 1990s, in the first instance affecting industries based on the provision of information, such as encyclopedia or business directory publishers. Subsequently, it touched network industries, for instance in the energy, postal and transport sectors, and continued to develop at a previously unforeseen pace: it now concerns all business areas and society at large. Digitalization encompasses the processes by which digital technologies and information are used by business sectors and public administrations to modify their organizational models, improve their performance, and create new value. According to the World Economic Forum, by 2025 the combined value of digitalization to industry and society could exceed US\$100 trillion. For companies, digitalization requires a customer-driven business strategy and major organizational change. Based on research carried out in key sectors of the German and European economies, strategy consultancy Roland Berger has identified four levers of digital transformation for an industry:

- digital data, which, once collected and analyzed, provide for better predictions and decisions.
- automation systems, which increase speed, and reduce error rates and operating costs.

- connectivity, which synchronizes supply chains and shortens innovation cycles; and
- digital customer access, which enables companies to offer customers transparency and new services.

Digitalization has not touched all industrial sectors, EU Member States and regions equally. According to European Commission data for 2017, transport had a modest index of digital intensity, 1 lower than 15 %. In the 19th century, when railways were first set up and developed, they were a major actor in the industrial revolution and one of the most innovative sectors of the world economy. With the subsequent development of automotive and air transport, railways relinquished their leading position in technological and technical innovation. When digitalization developed across industrial and economic sectors, rail transport embraced it unevenly and thus, according to stakeholders, digitalization is still at an early stage in rail transport. Today, numerous experts consider digitalization as a necessary step in the development of rail transport to maturity. As it can improve manufacturing, operations and maintenance, rail companies and infrastructure managers view digitalization as a lever to improve their efficiency and management, lower their operating costs, and enhance their competitiveness with other transport modes. Rail companies and their suppliers have launched investments, start-up incubators and research to develop new digital solutions to run their businesses. It is more than likely that digitalization will further offer new opportunities to rail transport actors, for instance in asset management, operations, or the role of users, and contribute to the emergence of new players in the rail market. Digitalization is a new element of competitiveness for companies in all sectors and an important condition for economies to perform well. Therefore, it has become one of the EU's main priorities.

Over the last five decades, Rail transport has faced major headwinds. The transformation of global supply chains has made the logistics business more challenging than ever, with increasing pressure to deliver fast and flexible services at a lower cost. In that quickly-evolving context, freight rail is grappling with fierce competition from road transport—a trend that will only intensify under the effect of disruptive technologies like autonomous trucks and on-demand mobility services. In addition, railways around the world have been hit by significant government budget cuts, limiting their ability to invest in infrastructure or maintain high service standards. Stiff competition from roads, which have the door-to-door delivery advantage have offered added pain.

At the same time, railways are in the midst of a profound transformation, driven by emerging digital technologies like 5G, big data, the Internet of Things, automation, artificial intelligence, and blockchain.

It is hard to overstate the impact of digitization on the railway sector. In fact, digital technology is disrupting pretty much every component of railway operation:

- Rolling stock. Advances in automation, self-diagnosing, or real-time geolocation tracking mean that trains are becoming considerably smarter and safer.
- Control and signaling systems: digital systems can radically enhance the reliability and performance of operations. From an infrastructure/asset management standpoint, they also eliminate the need for outdated railway signal boxes and heavy copper wires.
- Railway infrastructure. Internet of things sensors and devices are opening new possibilities for obstacle and damage detection, preventive maintenance, linkages with other systems, Government agencies, logistics providers, and transport modes.
- Revolutionary communications (5G, LTE), and cloud infrastructure (backend) will offer attractive solutions for handling large volumes of data and avoiding bulky rail-side infrastructure

- Faster self-learning algorithms in Enterprise Asset Management (EAM) systems make for more efficient dispatching, routing, and maintenance scheduling.
- Smart monitoring and surveillance systems are changing the way operators manage hazards, intrusions, railway crossings, and driver behavior.

With these breakthroughs, digital development provides a unique opportunity for railways not just to stay relevant, but also to increase their share in the overall logistics market, and to become an integral part of the transition toward greener, more sustainable freight transport. The potential benefits of digitization include:

- Performance. Automated and predictive systems will lead to fewer delays and breakdowns, optimized dispatching, routing and scheduling, increased capacity with trains running closer together, lower costs, and more.
- Competitiveness. Digital solutions can substantially improve journey times, reliability, cost recovery, traceability, and coordination with other modes—all of which will increase the competitive edge and the modal share of freight rail.
- Increased efficiency, less red tape, and lower transaction costs, especially with the integration of blockchain into rail operations. Russian and Kazakh railways are already looking into blockchain to streamline operations and reduce paperwork. IBM and Maersk have implemented successful pilots as well, and major universities around the world are conducting research on blockchain applications in the railway sector.
- Improvements in safety and security thanks to track obstacle detection, intrusion detection, and other similar systems that are allowing railways to address various types of risks in a smarter, more systematic way.
- Smaller environmental footprint. By optimizing train operations and giving rail a competitive edge over both road and air transport, digitization is poised to lower the climate impact of logistics.

**Table 1: Digitalization Opportunities in the Passenger Rail Value Chain—Consumer Interface Example**

| CLUSTER  | BENEFITS FOR PASSENGERS  | EXAMPLES OF OFFERS NOT YET ESTABLISHED  | ACTIVE EXAMPLES   |
|--|--|---|---|
| <b>Integrated tools for planning</b>                 | <ul style="list-style-type: none"> <li>• Simplicity</li> <li>• Information</li> </ul>                                  | <ul style="list-style-type: none"> <li>• Cross-transportation mode planning tool</li> <li>• Mobility check – identification of “sturdy” connections</li> <li>• Commuter advisory, including traffic forecasts</li> </ul>  | <ul style="list-style-type: none"> <li>Kayak</li> <li>Tripiit</li> <li>Google</li> </ul>                                      |
| <b>Information bundles complementing the journey</b> | <ul style="list-style-type: none"> <li>• Information</li> <li>• Improved comfort</li> <li>• Personalization</li> </ul> | <ul style="list-style-type: none"> <li>• Up-to-date news about the weather, events, activities at the destination</li> <li>• Point of interest finder (museums, tours, etc.)</li> <li>• Orientation and navigation for boarding, changing, and alighting</li> </ul> | <ul style="list-style-type: none"> <li>TripAdvisor</li> <li>Gate Guru</li> <li>Flight View</li> <li>HRS</li> </ul>            |
| <b>Service and comfort</b>                           | <ul style="list-style-type: none"> <li>• Information</li> <li>• Improved comfort</li> <li>• Personalization</li> </ul> | <ul style="list-style-type: none"> <li>• Alarm/reminder SMS prior to departure (based on current traffic situation)</li> <li>• Dining offers</li> <li>• Parking spot finder</li> <li>• Car sharing</li> </ul>   | <ul style="list-style-type: none"> <li>Groupon</li> <li>Car2Go</li> <li>DriveNow</li> <li>BlablaCar</li> <li>Apple</li> </ul> |
| <b>Social factors and entertainment</b>              | <ul style="list-style-type: none"> <li>• Improved comfort</li> </ul>   | <ul style="list-style-type: none"> <li>• Overview of friends’ journeys/follow commuters</li> <li>• “Friend finder” and chat</li> <li>• Games and audiobooks for children</li> </ul>   | <ul style="list-style-type: none"> <li>Audible</li> <li>TripTrace</li> <li>Facebook</li> </ul>                                |

Source Oliver Wyman

Despite its many promises, the digitization of rail also comes with a number of challenges, ranging from concerns over privacy and security to regulation, issues related to the ownership of data and proprietary systems, public acceptability, the impact on jobs, and the fear of investing in stranded assets.

**REFERENCES:**

- [1] European Parliament, <https://www.europarl.europa.eu>
- [2] The world is going digital, World Bank Blogs. Stephen Muzira and Martha Lawrence
- [3] Taking rail virtual through Digital Industry <https://www.brinknews.com/taking-rail-virtual-through-digital-industry/>
- [4] Digital transformation of Railways, Siemens AG