

# Digital Transformation of Transportation in the Age of COVID-19

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## Abstract

**Purpose:** To highlight the key trends in the transportation industry and the role of emerging technologies and digital transformation in acceleration of value creation. The conceptual framework suggests how such transformation could be implemented.

**Design/methodology/approach:** Research in a focus group was carried out where selected digital transformation frameworks were reviewed, and one was selected as the most applicable to the transportation industry. The selected framework was adopted for the transportation industry.

**Findings:** 1. Value creation should be positioned as the key objective of transformation. 2. Digital transformation is not so much about technology as it is about people. 3. The staged approach towards transformation allows it to be paced with account being taken of the maturity of technology as well as the maturity of competencies across the organization. For a successful digital transformation, the organization invests in development of digital capabilities. Moving towards digital means a mindset shift, cultural change and adoption of new methods of working.

**Research limitations/implications:** Transportation companies are at the early stage of transformation at such a scale. The case studies on successful transformations are limited. Therefore, experience is gathered mainly by the test and learn process. It is recommended that findings are validated with a wider group of experts when transformation matures. Comparing the same framework usage in other industries can also offer additional learnings to be considered by change leaders.

**Originality/value:** Transportation industry is in a process of transformation towards connected, electric and autonomous solutions, accelerated during the COVID-19 pandemic. The presented framework, adopted for the transportation industry, offers a practical tool for executives and change leaders to lead the transformation.

**Keywords:** digital transformation, transportation, leading change, connected world, electric transport, autonomous transport.

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## Transformacja cyfrowa branży transportowej w dobie COVID-19

### Streszczenie

**Cel:** wyodrębnienie kluczowych trendów w branży transportowej oraz roli przełomowych technologii i transformacji cyfrowej w tworzeniu wartości w branży. Przedstawiony model koncepcyjny transformacji cyfrowej stanowi praktyczne narzędzie, które mogą wykorzystać liderzy transformacji i agenci zmiany.

**Metodologia:** przeprowadzono badania z grupą fokusową, w której wzięło udział 8 ekspertów. Dokonano przeglądu wybranych modeli transformacji cyfrowej. Grupa wyselekcjonowała jeden model, który następnie został zaadaptowany do branży transportowej.

**Wyniki:** 1. Tworzenie wartości powinno być nadrzędnym celem transformacji. 2. O sukcesie transformacji cyfrowej decyduje nie tyle technologia, ile ludzie. 3. Etapowe podejście do transformacji pozwala nadać jej tempo z uwzględnieniem dojrzałości technologii oraz dojrzałości kompetencji w całej organizacji. Aby transformacja cyfrowa zakończyła się sukcesem, organizacja powinna inwestować w rozwój kompetencji cyfrowych. Przejście w kierunku cyfryzacji oznacza zmianę sposobu myślenia, zmianę kulturową i przyjęcie nowych metod pracy.

**Ograniczenia/implikacje badawcze:** firmy transportowe są na wczesnym etapie transformacji na niespotykaną dotąd skalę. Informacje dotyczące studium przypadków udanych transformacji w tym obszarze są ubogie, brakuje ugruntowanych wzorców. Dlatego doświadczenie jest gromadzone głównie w procesie testowania i uczenia się. Zaleca się, aby wyniki zostały zweryfikowane z szerszym gronem ekspertów wraz z postępowaniem transformacji. Porównanie wykorzystania tego samego modelu w innych branżach może również dostarczyć dodatkowych informacji, użytecznych dla liderów zmiany.

**Oryginalność/wartość:** branża transportowa przechodzi transformację na olbrzymią skalę, dążąc do rozwiązań zintegrowanych, elektrycznych i autonomicznych. Proces ten przyspieszył podczas pandemii COVID-19. Przedstawiony model, zaadaptowany do branży transportowej, stanowi praktyczne narzędzie dla liderów zmian do przeprowadzenia tejże transformacji.

**Słowa kluczowe:** transformacja cyfrowa, branża transportowa, zarządzanie zmianą, transport zintegrowany, elektryczny, autonomiczny.

## 1. Transportation Industry and Its Challenges

The transportation industry, responsible for moving people and goods, plays an important role in economic growth. In the EU only, the transport industry directly employs around 10 million people and accounts for about 5% of GDP (EU Science Hub, n.d.).

Experts from the Volvo Group, one of the leading companies in the industry, name the following factors that create strategic as well as operational challenges for the industry: global and regional economic, regulatory, digital, technological, climate and energy resource efficiency (Volvo Group, 2020). Furthermore, the industry is shaped by shifts in customers' and consumers' behaviors and expectations, accelerated access to information, new e-commerce trends and greater adoption of digital services (Charm et al., 2020; Wang & Sarkis, 2021, p. 4).

Besides all the positive impact, transportation also contributes to noise, air-pollution and climate change. The IDTechEx Report explains

that “despite medium and heavy duty trucks representing only 9% of the global vehicle stock, large inefficient diesel truck engines combined with high average annual mileage mean that the truck sector contributes 39% of the transport sectors’ greenhouse gas emissions, which equates to about 5% of all global fossil fuel derived CO<sub>2</sub> emission” (Wyatt, 2020). According to analysts from the World Economic Forum, if nothing was done, by 2030, the amount of CO<sub>2</sub> emissions would further increase by 6 tones; in addition, the number of parcels for delivery would increase by 36%, and traffic jams would be longer by 21 minutes on average (WEF, 2020). An increasing number of environmental and safety regulations puts significant pressure on the industry to change.

The biggest challenges that remain in the transportation business are the siloed, fragmented processes, including those related to collecting, processing, and driving business value from data (BlueJay, 2019).

Satya Nadella, the CEO of Microsoft, the company that is a strategic partner to many transportation organizations, stated that “digital technology is becoming core to both how we think about resilience in business continuity, as well as bringing about that next level of productivity change and efficiencies across industries” (Business Standard, 2021).

This paper investigates the academic and practitioners’ perspective in search of the response to the following:

- RQ1: What are the key trends and strategic priorities of the transportation industry?
- RQ2: How has COVID-19 impacted the transportation industry?
- RQ3: How to drive digital transformation in the transportation industry in acceleration of value creation?

Considering the amplified need for digitalization in the transportation industry, the paper also presents a conceptual framework for digitalization and digital transformation. The framework, based on the original concept presented by IBM, has been enhanced by the author based on the review of existing frameworks and evaluation with industry experts.

## 2. Key Trends and Strategic Priorities of the Transportation Industry

In 2017, the European Commission adopted the Strategic Transport Research and Innovation Agenda (European Commission, 2021), with the following strategic priorities:

- cooperative, connected, and automated transport,
- transport electrification,

- vehicle design and manufacturing,
- low-emission alternative energy for transport,
- network and traffic management systems,
- smart mobility and services,
- infrastructure.

According to the study by IBM “Truck 2030 – Digitally reinventing for the long haul” (IBM, 2011), the top trends that will influence the truck industry and the response to the above-mentioned challenges include: technology advancements, customer expectations, and the global workforce. Verhoef et al. (2021) also highlight the role of intensified competition in driving digital transformation. Heilig et al. (2017) emphasize the role of emerging technologies in increasing the productivity and efficiency they offer, as well as, with modern information technologies, provide better planning and management systems.

The leading truck manufacturers, per revenue, include Daimler, Volvo Group, Traton, Paccar.

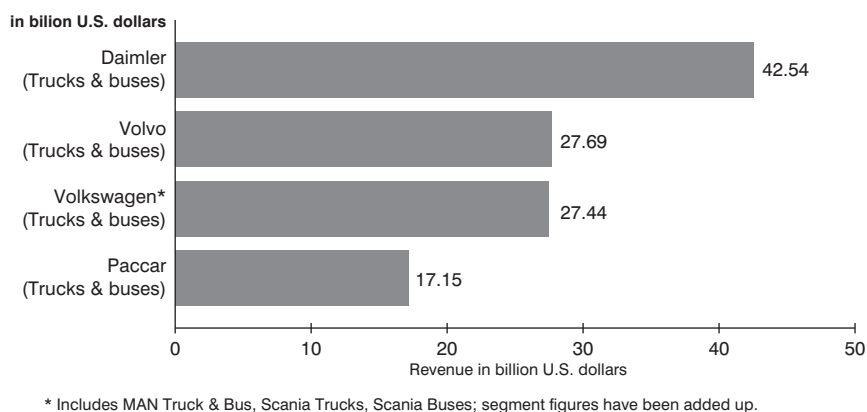


Fig. 1. Worldwide revenue of selected truck and bus manufacturers in 2020. Source: Statista, 2021.

The following analysis of the post-COVID-19 strategies of the leading providers of transportation solutions has been conducted.

	<b>Daimler</b>	<b>Volvo Group</b>	<b>Traton SE</b>	<b>Paccar</b>
Strategy pillars	<ol style="list-style-type: none"> <li>1. Add value for customers</li> <li>2. Lead globally</li> <li>3. Grow services</li> <li>4. Differentiate by technologies</li> <li>5. Focus on core business</li> <li>6. Lean organization</li> <li>7. People &amp; culture</li> <li>8. Partnerships</li> </ol>	<ol style="list-style-type: none"> <li>1. Transform the Volvo Group to become a leading end-to-end integrator as well as offering easy to integrate products and services through strong brands</li> <li>2. Grow the service business</li> <li>3. Accelerate electromobility solutions</li> <li>4. Grow in Asia and the US</li> <li>5. Develop robust profitability throughout the decentralized regional value chains</li> <li>6. Selectively capture, accelerate and scale-up new businesses and develop competencies and capabilities needed</li> <li>7. Reinforce value-based leadership and ways of working where all colleagues are empowered to take action and are accountable for the results</li> </ol>	<ol style="list-style-type: none"> <li>1. Brand performance — profitable growth and increased performance of our brands</li> <li>2. Cooperation &amp; synergies</li> <li>3. Global expansion</li> <li>4. Customer</li> </ol>	<ol style="list-style-type: none"> <li>1. Reputation for superior operational excellence and premium-quality products and services</li> <li>2. Long-term growth in revenues and net income reflects increased market share in North America and Europe, excellent aftermarket parts performance and growth in financial services</li> <li>3. Maintain profitability throughout the cycle due to strong cost control discipline and experienced management team</li> </ol>
Tech driven trends	<ul style="list-style-type: none"> <li>– Electric transport, in particular focusing on two technologies: batteries and hydrogen-powered fuel cells</li> <li>– Technologies assisting accident-free driving</li> <li>– Autonomous vehicles and supporting platforms</li> </ul>	<ul style="list-style-type: none"> <li>– Autonomous,</li> <li>– Electric,</li> <li>– Connected vehicles</li> </ul> <p>The effect will be particularly strong at the convergence of these trends as it affects vehicles, assets as well as infrastructures, and opens the way for a paradigm shift.</p>	<ul style="list-style-type: none"> <li>– The company remains firmly committed to its pledge to invest €1 billion in electrification through 2025</li> <li>– Self-driving trucks have the potential to increase the efficiency of logistics</li> </ul>	<ul style="list-style-type: none"> <li>– Zero emission trucks</li> <li>– Battery charging solutions</li> <li>– Autonomous trucks</li> <li>– Connected services</li> </ul>

Tab. 1. Strategic pillars and priorities of transportation industry leaders. Source: Own study, based on the companies' strategic materials and documents: Daimler, 2021b; Volvo Group, 2020; Traton, 2020; Paccar, 2021.

It can be noticed that all companies emphasize strategic pillars being customer, profitability and partnerships. The key trends are: electromobility, autonomous driving, connectivity.

### 3. Electromobility

Connected and autonomous vehicles (CAVs) are expected to bring important environmental, social, and economic improvements in transportation systems (Sen et al., 2020, p. 153).

Leaders in transportation focus on increasing safety and reducing the environmental footprint to increase efficiency of the whole supply chain. Electromobility (eMobility) involves deploying Information and Communication Technologies (ICT) and electric technologies in vehicles to enable electric propulsion of vehicles referred to as Electric Vehicles (EVs) (Bokolo, 2020, p. 32).

A shift towards electric vehicles requires not only a change of vehicles but also investment and development of the supporting infrastructure, for example batteries production and utilization, charging stations, traffic optimization software. Most fleets will not rely on public charging but on private infrastructure, such as at their own fleet facilities (Geotab, 2020).

Recently, the Volvo Group has launched Volvo LIGHTS, a unique collaboration between the South Coast Air Quality Management District, Volvo Trucks and 14 other organizations to pioneer a range of vehicle, charging and workforce development innovations critical for the commercial success of battery electric trucks and equipment. To facilitate electric trucks development, Daimler Trucks launched the “ePowertrain”, an architecture for all-electric trucks, where innovative and “reliable drive system components are manufactured according to globally uniform quality standards” (Daimler, 2021a).

General Motors has developed a suite of software tools to offer an EV ecosystem for the commercial marketplace. The cloud-based software platform suggests the best delivery routes and other fleet management features, location monitoring or battery status (TechCrunch, 2021).

### 4. Autonomous Driving

During the pandemic, consumer preferences changed as they shifted towards e-commerce. Logistics and shipping operators have been provided with a strong case to include self-driving trucks in their fleet as the means of a response to shortage of drivers or other emergencies and unforeseen circumstances (Research and Markets, 2020b). Autonomous vehicles could help to increase the delivery network capacity, reduce costs and comply with social distancing measures (Euromonitor International, 2020).

Therefore, solutions are emerging among OEMs and start-ups. Waymo, Aurora, TuSimple, Plus.ai are some such examples (Ackerman, 2021).

Scania developed Autonomous Transport Solutions, which is a complete system that encompasses handling logistics, the assignment of tasks to

vehicles, and information sharing between vehicles and infrastructure. Volvo developed the Vera autonomous tractor, which is tested to move containers from a logistics center in Gothenburg, Sweden, to the nearby port.

One example of the truck autonomous driving trend is platooning, where the human-driven truck is followed by a few autonomous trucks imitating the driving maneuvers of the lead truck (Wang & Sarkis, 2021, p. 7). The solution is powered with a set of technologies, including sensors, platooning control unit, driver controls, lidar, sonar, GPS, and radar-based collision mitigation system. Platooning remains one of the top trends in autonomous driving and companies like Daimler, Scania, Iveco, Volvo, DAF, Peloton, Huawei, TuSimple and Hyundai are testing the solutions.

## 5. Connectivity

Connectivity is also an enabler for automation and electromobility. By leveraging a set of technologies, data is collected and provided in real time, allowing a truck to communicate almost instantly with other vehicles and infrastructure around it. Development of Vehicle-to-Everything (V2X) is observed, which refers to Vehicle-to-Vehicle (V2V) and Vehicle-to-Infrastructure (V2I) communication: “wireless technology that enables data exchange between vehicles and their surroundings” (Castellano, 2020).

Volvo Trucks claims to reduce diagnostic time by 70% and truck repair time by 25% by using IoT and artificial intelligence, which allowed for embedding telematics for over-the-air updates to engine software, and processing millions of data records instantaneously by using the on-board technology, combined with a back-end analytics platform (Violino, 2020).

Claes Erixon, Head of R&D at Scania explained: “The volume of operational data from on-road Scania vehicles is doubled every 20 months. Engineers benefit from all this information when designing new features or improving existing functions” (Bulktransporter, 2019). Another truck manufacturing giant Daimler claims their trucks are equipped with as many as 400 sensors for collecting valuable information and their software contains 100 million lines of code — more than in that of a jet plane. This data can clearly help to develop better services and enhance the performance of road freight traffic and increase its efficiency (Daimler, 2021a). Joyce Tam, PM at Peloton, stresses the lack of capabilities in data intelligence as the obstacle to the development of connectivity solutions and argues that it should remain the focus of the ecosystem (Roeth, 2019).

## 6. Impact of COVID-19 on the Transportation Industry

The COVID-19 pandemic, leading to social and economic lockdown, put further significant pressure on the industry. The European Automobile Manufacturers' Association (ACEA, 2021) reports that in 2020, the EU

commercial vehicle market shrank by 18.9% to reach 1.7 million units. The global truck transport market is estimated to have declined from \$1,609.2 billion in 2019 to \$1,591.8 billion in 2020, and then to recover and grow at a CAGR of 9% from 2021 and reach \$1,984.9 billion in 2023 (Research and Markets, 2020a). Near-shoring manufacturing and material sourcing grew in importance and led to the need to revamp the supply chains and goods trucking companies and how they operate (Pyzyk, 2020). At first, the industry responded to the times of uncertainty by keeping cost in check. Many vehicle factories shut down for more than 30 days (ACEA, 2021) and put their employees on furlough, reducing resources and production of vehicles. With time, it became clear that the climate change challenge and pandemic are great catalysts for the accelerated technological adoption by an order of magnitude.

The impact of the pandemic on vehicles production, on logistics and the whole supply chain prompted manufacturers to review their current business models in search of new revenue streams. As a result, transport-as-a-service (TaaS) emerges as a strong trend. It means a shift from ownership of vehicle towards a subscription model with on-demand pay-per-use solutions. As such, TaaS sits at the intersection of electromobility, autonomous vehicles and connectivity and to execute that strategy, organizations turn towards open innovation and building ecosystems, where they can play a role of a contributor, partner or an orchestrator.

During an Investors Day, Martin Lundstedt, the CEO of the Volvo Group, announced the company's focus on the TaaS, planning that, by 2030, 50% of revenue will come from those solutions and services (Volvo Group, 2021). At the end of 2020, Daimler announced the launch of Global Connectivity Services focusing on uniting the company's end-to-end digital architecture, including in-vehicle software, cloud platforms and digital solutions. It will also include work on Remote Platform Management to allow "customers to deploy and manage mobile device and mobile application solutions to fit their mixed fleet needs and seamlessly integrate those devices and apps into their trucks". It is still early to assess the long-term impact of the pandemic; however, numerous researchers investigated the impact of COVID-19 on the transportation and logistics industry and argue that the pandemic accelerated the use of digital technologies and digital transformation in the transportation sector (Medyakova et al., 2020; Almeida et al., 2020; Özispa, 2020).

## 7. Digital Transformation as a Catalyst of Technological Adoption

The paths of digital transformation include: digitization, digitalization and digital transformation, where the first two are considered more incremental phases towards the third one (Verhoef et al., 2020).



Oxford English Dictionary (“Digitization,” 2010) defined digitization as “the action or process of digitizing; the conversion of analogue data (esp. in later use images, video, and text) into digital form”. Digitalization (“Digitalization,” 2010), by contrast, is defined as “the adoption or increase in use of digital or computer technology by an organization, industry, country, etc.”

Digitization can be defined also as the encoding of analog information into a digital format (i.e., into zeros and ones) such that computers can store, process and transmit such information (Dougherty & Dunne, 2012, p. 1469). In other words, it is the conversion of existing data and documents into a digital format. Digitalization is the stream in which digital technologies and digitized data augment the modus operandi of the organization, with an impact on products, services, ways of working, thus affecting business models and value creation capabilities. It improves business processes but does not transform them. As a result of digitalization, the IT strategy is seen today “as essential to the framing of overall business strategy, that is, a fusion of IT and business strategy” (Holotiuk et al., 2017, p. 993).

Hence, while the digitization is an innovation that is centered around forward step in processes around the information such as creation, storage, transfer, etc., the digitalization centers around implementation of digital technologies also as a core element of activities that redefines lifestyle and business processes correspondingly (Ilko, 2020).

Morakanyane et al. (2017) describe digital transformation (DT) as an evolutionary process that leverages digital technologies and capabilities to enable business models, operational processes and customer experiences to create value. Verhoef et al. (2019, p. 893) describe digital transformation as a change in how a firm employs digital technologies to develop a new digital business model that helps to create and appropriate more value for the firm. Reis et al. (2018, p. 413) define digital transformation as the use of new digital technologies that enables major business improvements and influences all aspects of customers’ life. Ismail et al. (2018) define it “as the process through which companies converge multiple new digital technologies, enhanced with ubiquitous connectivity, with the intention of reaching superior performance and sustained competitive advantage, by transforming multiple business dimensions, including the business model, the customer experience (comprising digitally enabled products and services) and operations (comprising processes and decision-making), and simultaneously impacting people (including skills talent and culture) and networks (including the entire value system).”

Savić (2020, p. 28), who conducted an overview of terminological, conceptual, and historical differences between digitization, digitalization and digital transformation, points out that digital transformation leads to business transformation with new or altered business models and ways of working, providing new value producing opportunities and revenues. He

also states, based on his literature study, that “most agree [...] that digital transformation, using modern information technology (IT), represents large-scale change in fundamental business processes and components. These changes generally target business models, products, productivity, employee roles, production, marketing, financial management, and other processes. They also include cultural changes that challenge the status quo, and the way information is managed, structured, and positioned within an organization”.

In the context of transportation, digitalization can enhance transport sustainability with respect to physical, environmental, economic and social dimensions (Sarkis et al., 2020, p. 68). Thanks to the digital transformation of the entire transport sector, new business models are emerging and give rise to innovative mobility services (Tsakalidis et al., 2020). Almeida et al. (2020) suggest that “the impact of digitalization is expected to be transversal to each area and will encourage the emergence of new digital products and services based on the principle of flexibility”. Kayıkçı (2018, p. 783) points to the benefits of digitalization in transportation, such as connected processes and decentralized autonomous management, real-time full transparency from suppliers to customers, and argues that best results will be achieved when combined with the entire supply chain and not limited to the organization’s production activities. Digitalization is not only focused on cost savings, but also includes process improvements that may enhance customer experiences (Verhoef et al., 2021).

Forrester Consulting has conducted an in-depth survey on the current state of digital transformation in the global transportation industry and revealed that the three most important internal forces driving transformation, according to the respondents, include: 1) improving customer and passenger experience (65%), 2) enhancing business and IT agility (49%), and 3) improving operational efficiency (46%) (ITS International, 2021). Robin Joffe, Partner-President, Frost & Sullivan, Japan explains: “Digitalization is driving greater resource efficiencies, sparking innovation, and opening up unprecedented opportunities for growth. By upturning traditional value chains, it is encouraging stakeholders to look anew at business models, partnership strategies, and investment focus” (Frost & Sullivan, 2020).

Digital transformation is driven by implementation and adoption of technologies. At the early stage, it allows for optimization of selected processes. With the technology maturity through adapt, scale and disrupt phases, the organization can extract more value from the technology to transform the existing solutions and business models to create new value for the organization.

One such example of the journey from digitization to digital transformation can be demonstrated with cloud computing. In the increasingly digitized world, the amount of data is experiencing tremendous growth. This creates

immense opportunities for businesses to develop new products, services and business models, through data alignment and democratization. As a result, the organization can improve operational stability, resilience and performance of the data platform, expand data capacity while reducing the runtime and maintenance costs. With time, it can transform towards a data and insights driven organization. For example, telematics data captured initially to optimize the performance of an asset can be leveraged to provide 1) two-way communications capabilities; 2) situation technology (geographic attitude); 3) computing model for system rule and interface to self-propelling electronics systems (Neumann, 2018).

Vogelsang et al. (2018, p. 127) conducted research and concluded that “DT can only be successful if companies collaborate with customers, suppliers and other firms from the branch. A cultural change is necessary to enable an agile working environment as well as more interdisciplinary activities. It becomes evident that the choice of technology is essential. However, driving only technology forward is not enough to gain benefits from DT”.

## 8. Digital Transformation Frameworks

Issa et al. (2018, p. 974) conducted research on digital transformation in Industry 4.0 and argued that “defining one big project to realize the full potential of digital transformation in a given organization is not feasible and will definitely end in management disappointment and failure”. Hence, they developed a conceptual framework which is based on the capability maturity concept and addresses transformation through 4 levels of maturity:

Level 1 – No Industry 4.0 or only “ad-hoc”

Level 2 – Departmental level (isolated silos)

Level 3 – Organizational level (cross-departmental)

Level 4 – Inter-organizational level (cross value chain/supply chain partners).

Vial (2019, p. 127) presented a conceptual framework of DT. He describes the framework as built upon “relationships that emerged through our analysis across eight overarching building blocks describing DT as a process where digital technologies play a central role in the creation as well as the reinforcement of disruptions taking place at the society and industry levels. These disruptions trigger strategic responses from the part of organizations, which occupy a central place in DT literature. Organizations use digital technologies to alter the value creation paths they have previously relied upon to remain competitive. To that end, they must implement structural changes and overcome barriers that hinder their transformation effort. These changes lead to positive impacts for organizations as well as, in some instances, for individuals and society, although they can also be associated with undesirable outcomes”.

The importance of digital transformation resulted in leading technology and consulting companies developing the digital transformation frameworks. A selection of the most commonly used ones is presented below.

**PwC** built the framework “Industry 4.0: Building the digital enterprise – Industrial manufacturing key findings”, focusing on and following the stages of:

1. digitalization and integration of vertical and horizontal value chains;
2. digitalization of products and services;
3. new business models and customer access.

The transformation is powered by data and analytics as a core capability. Convergence of emerging technologies drives transformation for value creation.

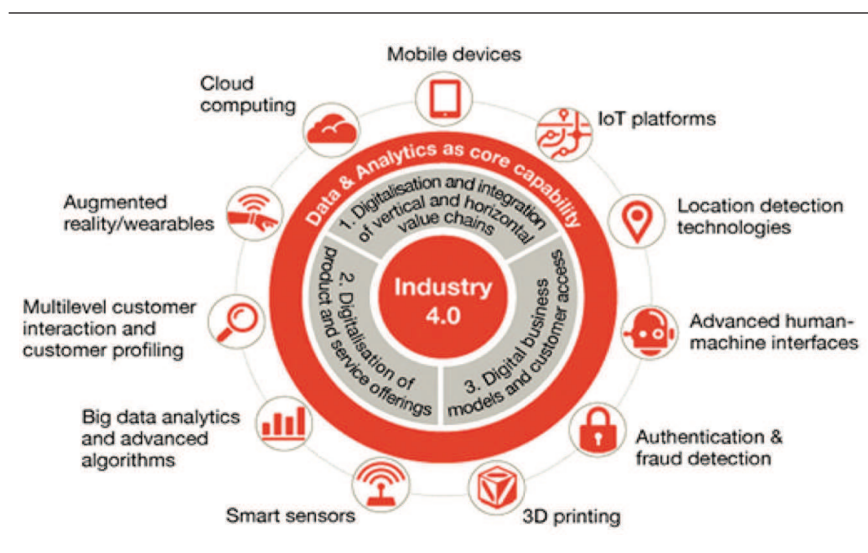


Fig. 2. Digital transformation framework for Industry 4.0 by PwC. Source: *Industry 4.0: Building the digital enterprise, 2016 Global Industry 4.0 Survey, PwC. Engineering & Construction.*

**Cognizant** built their digital transformation framework based on four distinctive sections dedicated to Customer, Product, Processes & Systems and Organization. It highlights that digital transformation stretches beyond technology implementation and digitalizes customer experience, products and services, operations and the overall organization. It suggests that transformation cuts through the entire value chain, including partnerships.

The framework does not provide a clear guide on execution.

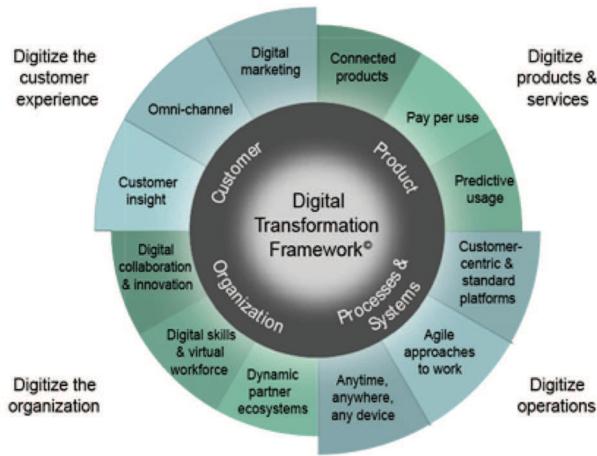


Fig. 3. Digital transformation framework by Cognizant. Source: Cognizant Services: Digital Strategy.

**Boston Consulting Group’s** digital transformation framework is centered around people, technology, and data. It emphasizes the importance of culture, leadership, and governance. DT is driven through phases of innovation, incubation and industrialization, where each phase includes the Outcome, Technology and Human perspective.

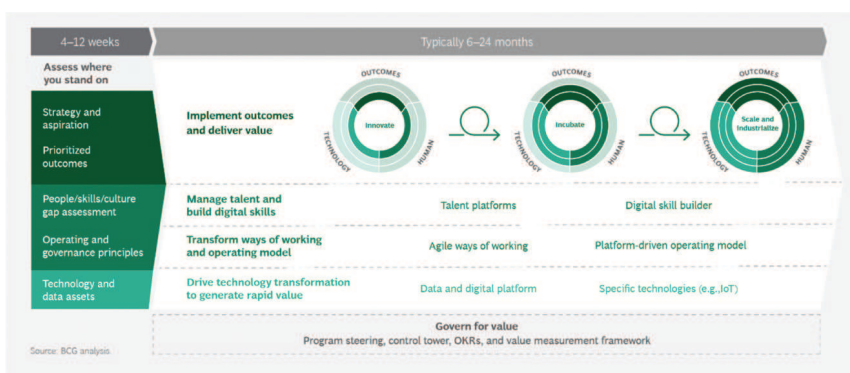


Fig. 4. BCG digital transformation framework. Source: BCG Analysis, Digital Transformation.

**Accenture** released its Digital Enterprise Framework in 2019. It focuses on the external perspective of customers and partners, as well as the internal perspective of employees. Digital operations cover the full cycle,

including the manufacturing and supply chain, relevant to the transportation industry. Emerging technologies are positioned as potential vehicles for transformation, while digital platforms are the enablers. Strong emphasis is also put on data.

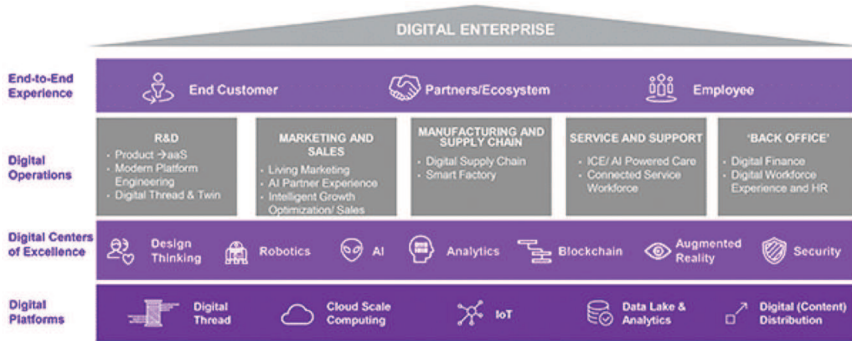


Fig. 5. Digital Enterprise Framework by Accenture. Source: Accenture.

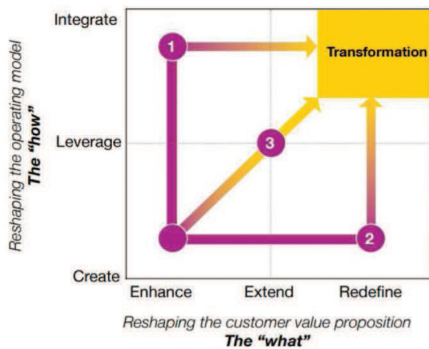
The IBM Institute for Business Value developed a framework that focuses on the process of transformation, explained through three paths (IBM 2011).

Path 1 – Focuses on creating and integrating digital operations first.

Path 2 – Enhances, extends or reshapes the customer value with digital content.

Path 3 – Builds a new set of capabilities around the transformed value proposition.

**Paths to digital transformation**



- 1 Path 1**  
Create and integrate digital operations first. Then address the customer value proposition to achieve full transformation.
- 2 Path 2**  
Enhance, extend or reshape the customer value proposition with digital content, insight and engagement. Then focus on integrating digital operations.
- 3 Path 3**  
Build a new set of capabilities around the transformed customer value proposition and operating model in lock-step.

Fig. 6. Digital transformation framework by IBM. Source: IBM Institute for Business Value analysis.

## 9. Suggested Conceptual Framework for Digital Transformation in Transportation

Research has been done in a focus group at one of the leading transportation companies, where eight top executives, representing a mix of business, technology and support functions (i.e. HR), reviewed the selected frameworks and suggested the one that would be suitable for the transportation organization.

The discussion was guided around the following questions:

- Does it support the company strategy?
- Does it place customer at the heart?
- Is it easy to implement?

The pros and cons were captured during the discussion:

Framework	Pros	Cons
PwC	<ul style="list-style-type: none"> <li>+ It is rooted in Industry 4.0, which relates to the transportation industry</li> <li>+ It allows to approach DT as a staged process</li> <li>+ It positions data as a key capability</li> <li>+ It includes emerging technologies and is up to date</li> </ul>	<ul style="list-style-type: none"> <li>– Not clear where the customer is positioned</li> <li>– Seems to be driven from technology and not business perspective</li> <li>– Not intuitive to implement</li> </ul>
Cognizant	<ul style="list-style-type: none"> <li>+ It positions customers at the heart of transformation</li> <li>+ It takes business perspective, includes the whole organization</li> <li>+ It is intuitive and can be applied to transportation, e.g. connected products are linked with the trend of connectivity</li> <li>+ It emphasizes role of the ecosystem and partnerships</li> </ul>	<ul style="list-style-type: none"> <li>– People and culture are not addressed</li> <li>– Not clear how to apply through stages of digitization, digitalization, digital transformation</li> </ul>
BCG	<ul style="list-style-type: none"> <li>+ Focused on outcomes</li> <li>+ Incorporates human and technology perspective</li> <li>+ Builds on existing elements</li> <li>+ Promotes agile ways of working</li> </ul>	<ul style="list-style-type: none"> <li>– Not clear where to start and how to execute</li> <li>– No clear process of defining and managing priorities</li> <li>– Not clear how to apply through stages of digitization, digitalization, digital transformation</li> </ul>
Accenture	<ul style="list-style-type: none"> <li>+ Suitable for transportation industry</li> <li>+ Covers both, internal and external perspectives, positions customers at the heart</li> <li>+ Prompts executives to ask relevant questions and lead analysis</li> </ul>	<ul style="list-style-type: none"> <li>– No easy step-by-step process</li> <li>– No staged approach</li> </ul>
IBM	<ul style="list-style-type: none"> <li>+ Clear directions of how to apply through stages of digitization, digitalization, digital transformation</li> <li>+ Parallel focus on customer and business outcome</li> <li>+ Allows for building on existing assets while creating new</li> </ul>	<ul style="list-style-type: none"> <li>– No emerging technologies specified</li> <li>– No listed criteria and measures of success</li> </ul>

Tab. 2. Pros and cons of digital transformation frameworks. Source: Own analyses, based on focus group discussion.

Having assessed the proposed frameworks, the experts agreed that the IBM framework allowed most flexibility for adoption by the transportation industry. It incorporated a staged approach to transformation. It also allowed for the transformation pace to be adjusted to the strategy, abilities and maturity of the organization. The following modifications were suggested, which are finally reflected in the proposed conceptual framework presented in Fig. 7.

1. The IBM framework positioned transformation at the heart of the concept. The experts argued that at the heart of every business is the value creation, hence the transformation should be closely linked to such business objective. Hence, value creation should be positioned as the key objective of transformation.
2. Further, the IBM framework suggests that transformation as a process of reshaping the operational model or changing the customer proposition. However, in practice, in complex organizations, transformation cuts across operational and value dimensions. Hence, the proposed framework incorporates three stages of digitization, digitalization and digital transformation. The experts agreed that digital transformation is not so much about technology as it is about people. This is in line with the findings of a survey conducted by Harvard Business Review, which states that “70% of all DT initiatives do not reach their goals. Of the \$1.3 trillion that was spent on DT in 2018, it was estimated that \$900 billion went to waste. Fundamentally, it’s because most digital technologies provide possibilities for efficiency gains and customer intimacy. But if people lack the right mindset to change and the current organizational practices are flawed, DT will simply magnify those flaws“ (Tabrizi et al., 2019).
3. Hence, the stages of transformation should be paced with account being taken of the maturity of technology as well as the maturity of competencies across organization. For a successful digital transformation, leading to value creation, it is important that the organization invests in development of digital capabilities. Moving towards digital means a mindset shift, cultural change and adoption of new methods of working. In times of COVID-19, a prompt response to challenges required organizations to set up cross-functional task force teams that, via a collaborative approach, were able to address challenges and leverage new ways of working characterized by agility, speed and innovation (ADEPT LIVE Labs, 2020). A pragmatic approach and time to market become key drivers for developing new solutions.
4. Such transformation is led through a change management process. At the first stage, *Awareness*, employees are explained why change is required and what it means to them and to the organization. It is also when the company conducts a skills gap analysis to identify which competences must be nurtured or brought to the organization. In the next stage,



*Acceptance*, employees are empowered with the tools and resources enabling them to embark on change. It is a stage where employees buy-in into a process of change. Finally, with an increasing confidence towards digital they enter the *Action* stage and take ownership and responsibility for the actions. This is where the organization is ready for disruptive changes, such as launching new business models.

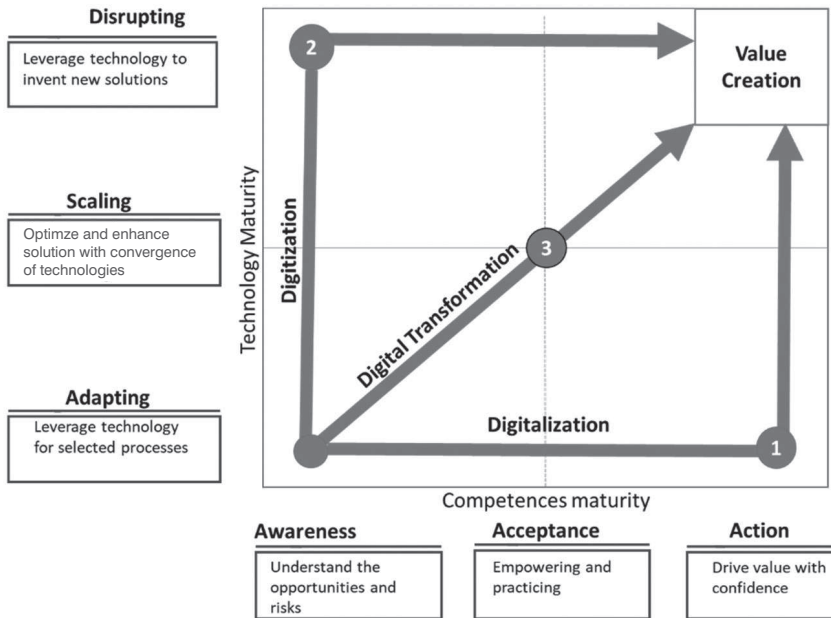


Fig. 7. Digital transformation conceptual framework. Source: Own concept, inspired by IBM Institute for Business Value analysis, IBM 2011.

For the full picture, it is also important to acknowledge the enablers of the process, such as data and selected technologies. The Strategic Transport Research and Innovation Agenda (European Commission, 2020) defines the aim of digital transformation as increasing value creation and allowing an organization to remain relevant, competitive and effective. In the context of the transportation industry, the emerging technologies can contribute to the “improved traffic flows, optimize the use of infrastructure, lower noise levels, shift greater volumes of passenger traffic towards public transport, increase the efficiency of goods transport and foster the emergence of multi-modal transport solutions”. This is where data lakes, cloud computing as well as emerging technologies like: AI, IoT, blockchain, etc. should be analyzed, and leveraged, where applicable.

## Closing Remarks

COVID-19 has created the opportunities for the transportation industry to accelerate digital transformation. Some of the trends, such as new and remote ways of working, or near-shore supply demands are believed to stay and become a “new normal”. Those companies that will continue transformation by investing in new capabilities, emerging technologies and partnerships will be able to gain competitive advantage and create greater value for their customers and shareholders. For, as Steve Jobs once said, innovation distinguishes between a leader and follower.

When got right, transformation will bring benefits for the planet, people and profit, creating transportation that is safer, cleaner and more efficient.

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