Rail supply digitization

Roland Berger study

January 2017

Executive Summary

Digitization as industrywide disruptive trend is now also reaching the rail supply industry. That is why **Roland Berger conducted interviews with rail supply executives during Innotrans 2016** to determine impact and potential of rail supply digitization.

Overall, the respondents **expect positive change due to digitization** – The **majority will invest** in digitization. Most potential is seen in the segments of train control and maintenance, less in infrastructure and rolling stock. The **high implementation costs, the data availability and possible data security breaches** as well as lacking expertise in form of skilled employees are seen **as main challenges of digitization** .

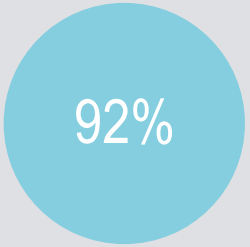
The rail supply industry also expects **several benefits from digitization in terms of new products and a transformation of value chain**.

Especially new business models will bring change to the industry. But the interviewees show **uncertainty about the timeframe and direction of the coming business model change**. Cooperation is proven to support digital change and is already common with the usual suspects, such as universities and operators. Already one fourth of the industry has been working with start-ups. Product innovation is expected to **concentrate on big data and automated trains**. **Intermodal transport does not seem to be in the focus** of the industry, despite required investments in this direction. Furthermore, most respondents request a **simpler and more transparent tender process enabled by digitization** to foster innovation and change.

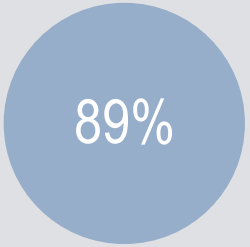
With respect to value chain transformation, the rail supply industry **does not see disruptive production technologies as priority** and focus rather on **incremental improvements** although they are already used widely in other industries. Rather digital supported R&D, condition-based and predictive maintenance as well as digital logistics are in the focus.

How digitally ready is your company?
Visit our Digital Pathfinder to find out (http://www.digitalpathfinder.org)

…of the interviewed rail industry representatives think that their business will **benefit from digitization** in the next 5 years.



…of the rail industry companies will **invest in digitization** in the next 3 years



…of the rail industry executives expect changes of their **business model**

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A. Motivation and overview of survey results

What makes digitization disruptive is the combination of four digitization levers, allowing new possibilities and products

Levers of digitization

Revolution

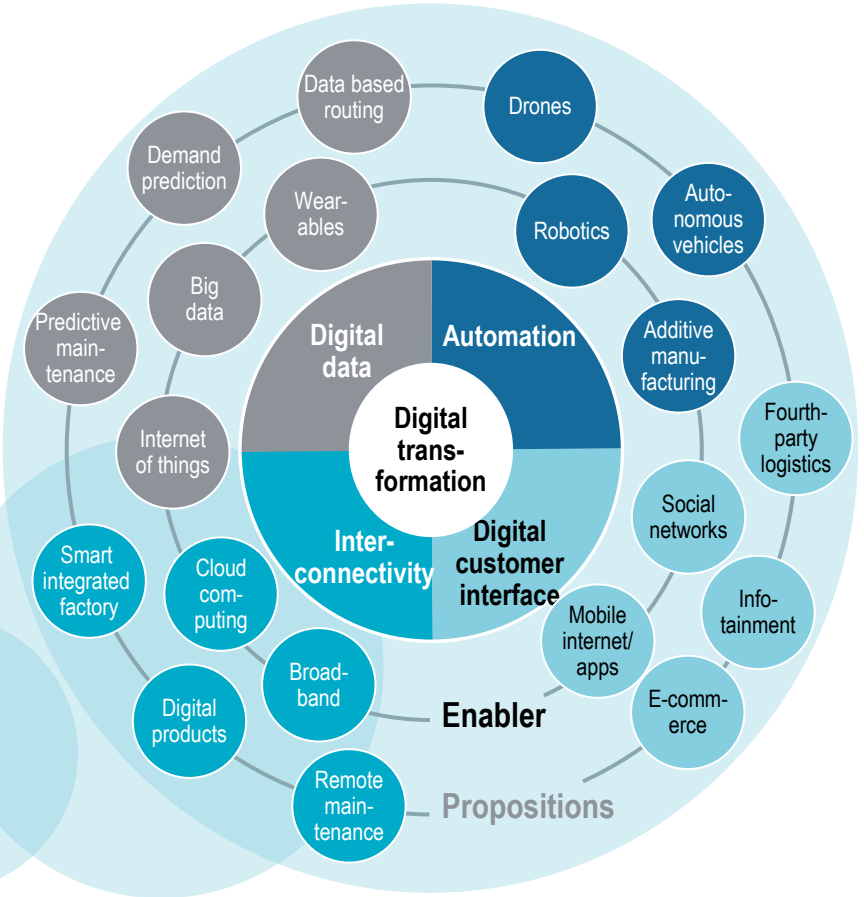
Market makers

Build new digital competitive advantages on strategic control points and **disrupt** – Becoming a digital leader for a specific industry

(In-industry) evolution

Followers

Utilize digital technology for **evolutionary** improvements of core business model – Continuously adapting to new market situations



Rail supply, like other industries, sees four main levers driving the digital revolution as well as transforming existing business models

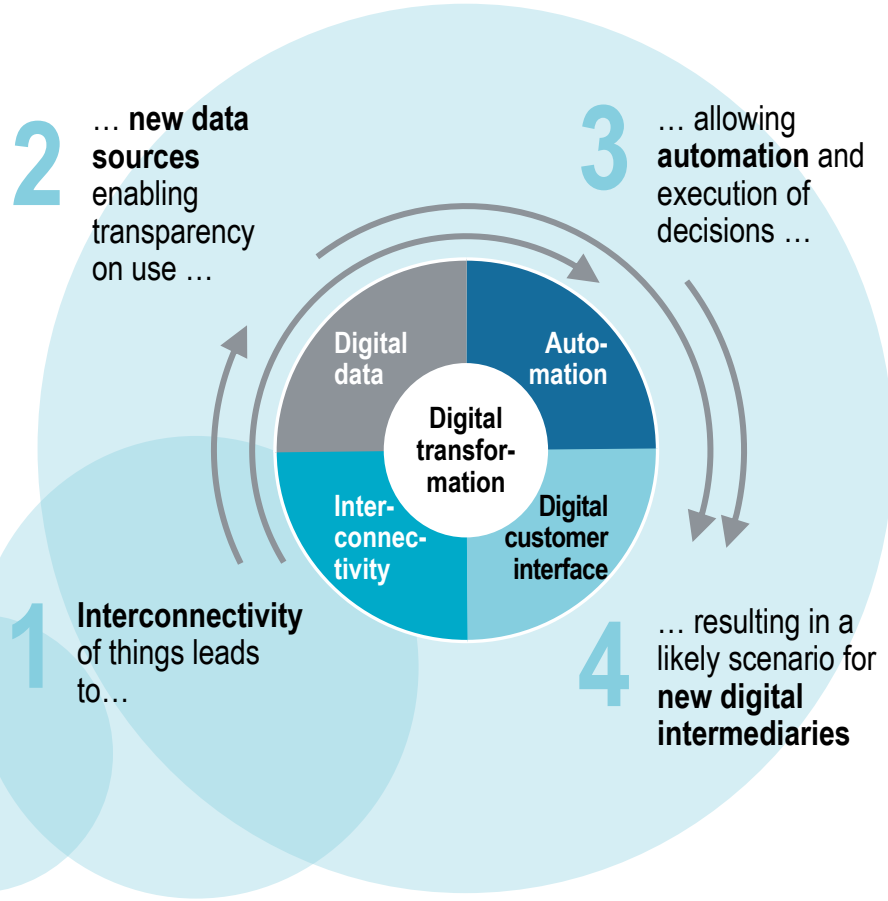
Interplay of digitization levers

1 **Interconnectivity**
Interconnected value chains via mobile or fixed-line high-bandwidth telecom networks

2 **Digital data**
Better predictions and decision-making by capturing, processing and analyzing digital data

3 **Automation**
Autonomous and self-learning cyber-physical systems

4 **Customer interface**
Direct access to customers for new intermediaries through the (mobile) internet



In this context, we have interviewed rail supply executives during Innotrans 2016 – All of them are expecting positive change

Future of rail supply digitization

...think that their business will **benefit from digitization** in the next 5 years.

Source: Roland Berger Survey

The industry concentrates on digitization of train control and maintenance – Less potential seen for infrastructure and rolling stock

Segments with the highest potential for digitization

#1. Train control

#2. Maintenance

#3. Infrastructure

#4. Rolling Stock

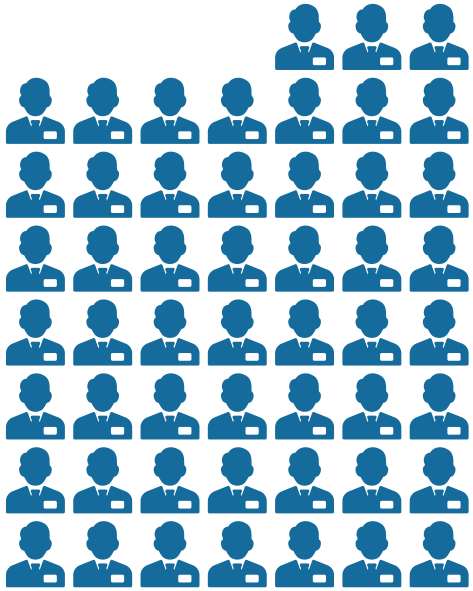
Source: Roland Berger Survey

Companies are going to invest significantly into the further development of digital products and operations in the next three years

Rail supply industry's investments into digitization

92% ….will invest in digitization in the next three years

59% Less than 30% of the total planned investment



33% More than 30% of the total planned investment

8% No extraordinary investments planned

Source: Roland Berger Survey

B. Digitization challenges

As main challenges of digitization, rail supply industry expects high costs and lacking expertise in terms of data and its security

Challenges of digitization[1)]

1 High **implementation cost** of new technologies

2 Continuous availability of **data**

3 Possible **data security** breaches

4 Not enough **skilled employees** to manage new data and technology

5 Increased complexity of daily operations
6 High expectations of operator put under pressure
7 Overall interoperability between systems not given
8 Rapid technology advancements in other sectors as threat for business model
9 Prevailing conservatism or the nature of the industry

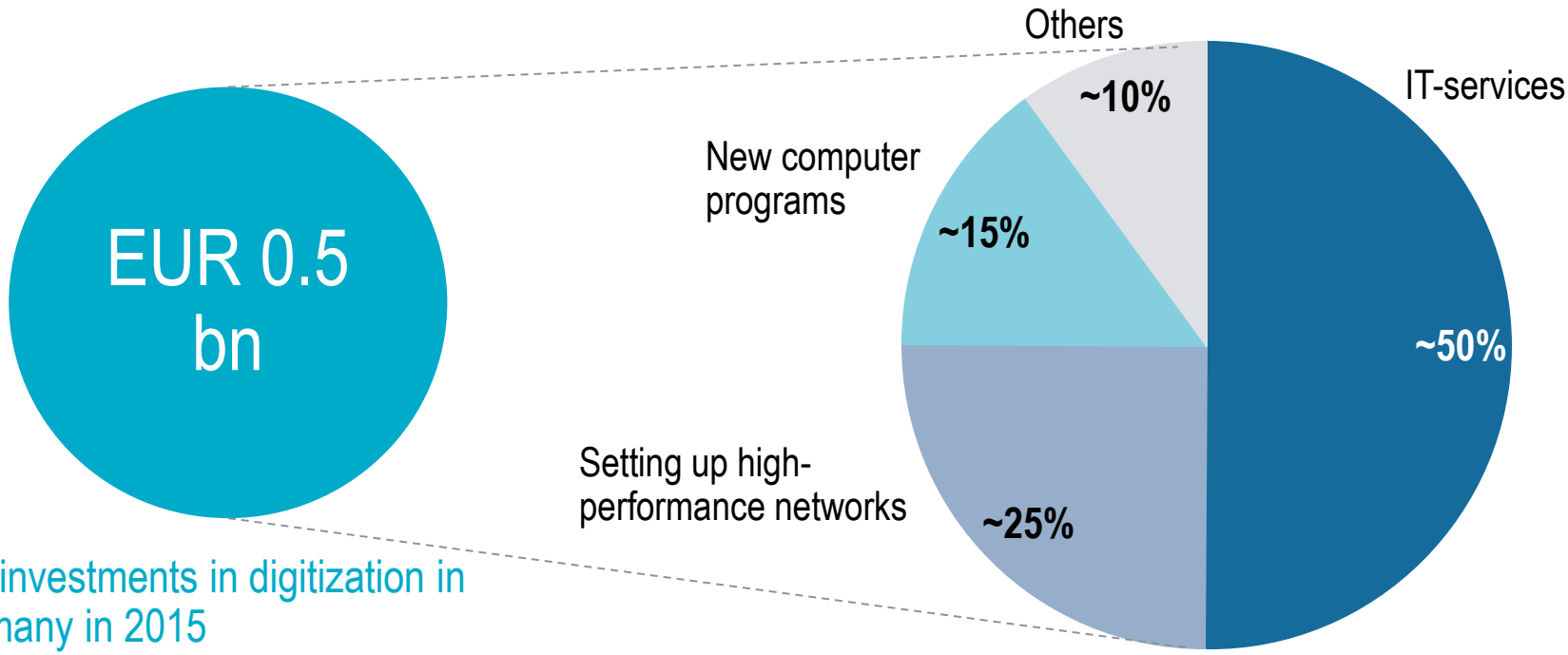
1) Ranking based on answer frequency; ranks 1,2 and 3 as well as 7 and 8 with same frequency but shown as individual topics

Source: Roland Berger Survey

We estimated the cost of digitization for the German industry – Seven times higher yearly investment needed

Digitization implementation cost

EUR 35 bn of investment is needed for the digital transformation of the "industrial heart" of Germany from 2015-2025 – Meaning the average rate of investment per year has to increase by a factor of 70

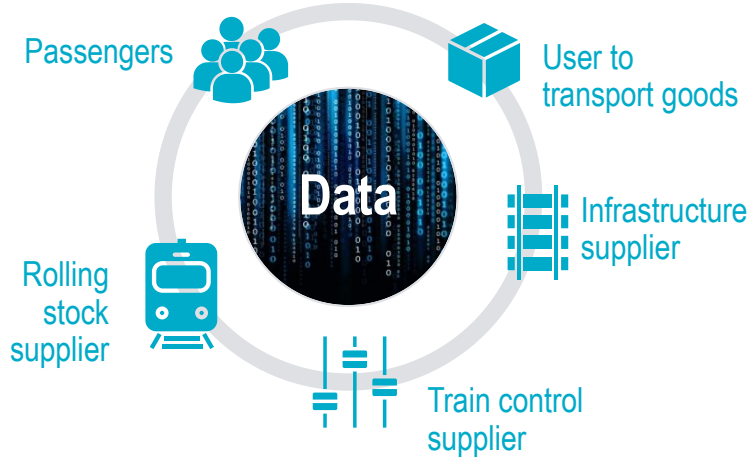


Source: Roland Berger and BDI study on digital transformation of industry

Data in the rail industry is being collected and can be accessed, but questions still remain around its ownership and future use

Data availability and usage

Main area of concern for data ownership

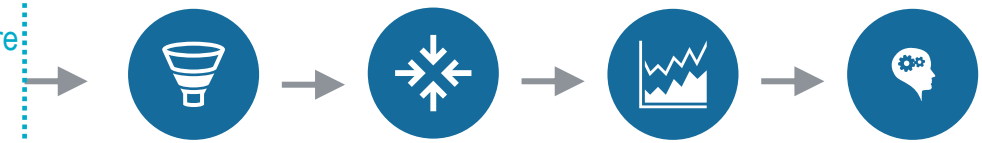


Collection

Access to data with e.g. sensors from

- > Rolling stock and infrastructure (e.g. location, condition)
- > Train control (e.g. traffic flow)
- > Passengers and transported goods (e.g. number, travel times)

Main questions over all steps:
Who owns the data?
What are standards?
How is the data centralized?



Extraction
System selects relevant information to ensure high quality results

Aggregation
System bundles relevant information

Visualization
System analyzes, models and visualizes information

Interpretation
System interprets data and spreads information to relevant users

Source: OECD, Unife, Roland Berger

Data breaches or cyber attacks as main threat for rail operations – Data security needs to be ensured by the right measures

Data security

UK railway network – Victim of cyber attacks

- At least **four major cyber attacks** were discovered by Darktrace, a British cyber-security startup from '15-'16
- During attacks computer system was explored, but no active disruption
- But actually, such an attack could result in **changing the behavior of the trains or even traffic lights** leading to collisions or derailments
- Especially for **high-speed trains** dangerous since speed limit can be adjusted

Ensure data security with

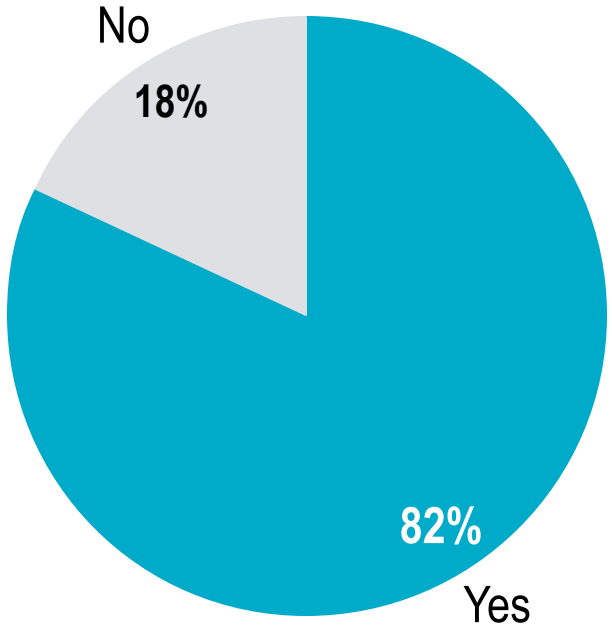
- **Standards** to provide guidance for users and requirement frameworks for suppliers
- **Certifications** to measure compliance with standards
- **Knowledge and skills** to cooperate with security professionals, system engineers and suppliers
- **Security controls** to protect products and services operated by trained employees
- **Cooperation** to secure data flows from protected to unprotected systems and network-to-network communication
- **Security awareness** to lower risk by training employees on security importance
- **Intruder detection** by analyzing and visualizing data flow and reporting suspicious traffic
- **Physical protection** to secure physical access to network devices
- **Cross-industry cooperation** to be part of initiatives to share best practices and possible threats
- **Border determination** to secure the boundaries of the system and network and control data in- and out-flow, e.g. by encryption

Source: The Telegraph, Progressive Railroading, Thales, Roland Berger

In order to manage digital data and technology, the rail supply industry needs skilled employees – Worldwide shortage of experts

Skilled employees

Is there an Information-Communication-Technology-skill shortage in Germany?



- IT-sector experiences a **skill shortage worldwide**, although more and more students are enrolled for respective courses
- For the rail supply industry not only pure IT experts are in demand, but employees that are familiar with the **specialized rail knowledge as well as IT expertise**
- Companies need to **internally train** their rail experts or the other way around – IT experts need to gain experience in the railway sector
- Rail Control companies with advantage over e.g. infrastructure companies since they already have inhouse IT experts for their products
- The rail supply industry faces **similar barriers as other industries** and needs to ensure
  - Open mindset for digital change by all employees – Being open for new technology and processes as well as sensitivity for the importance of the new technology
  - Attractiveness compared to digital companies such as Google or Uber

Source: Statista, Roland Berger

C. Digitization benefits

Rail supply companies see the main benefits of digitization for new products and the internal transformation of the value chain

Main benefits of digitization

A

1. New business models and opportunities
2. More innovation

B

1. Cost reduction
2. Increased production efficiency

Other named points with lower significance:

- > Enabling interoperability
- > More intense cooperation and transparency
- > Enhanced energy efficiency and sustainability
- > Enhanced product quality

- > Continuous improvement
- > Higher safety of workers

Source: Roland Berger Survey

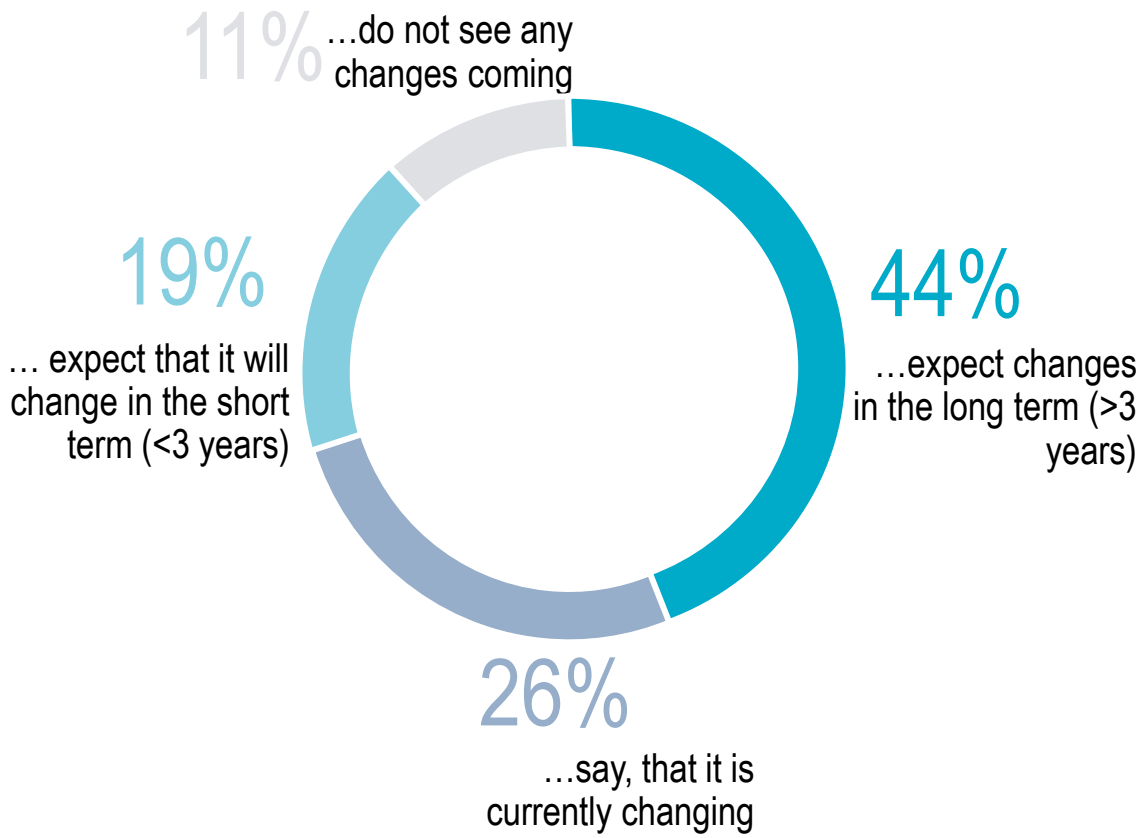
A

Rail suppliers are expecting a change of their business models, but the timeframe and direction of the change so far not clear

New business models and opportunities

89%

….expect changes of their **business model**



Source: Roland Berger Survey

Future business models driven by digitization will revolve around a more service-oriented approach

New business models and opportunities – Examples

More service than product

Not only offer the physical product but also services to complement it, e.g. maintenance or leasing contracts

Life-cycle optimization

Enhance the product life-cycle in regard to sustainability, utilization, re-use and maintenance

More cooperation

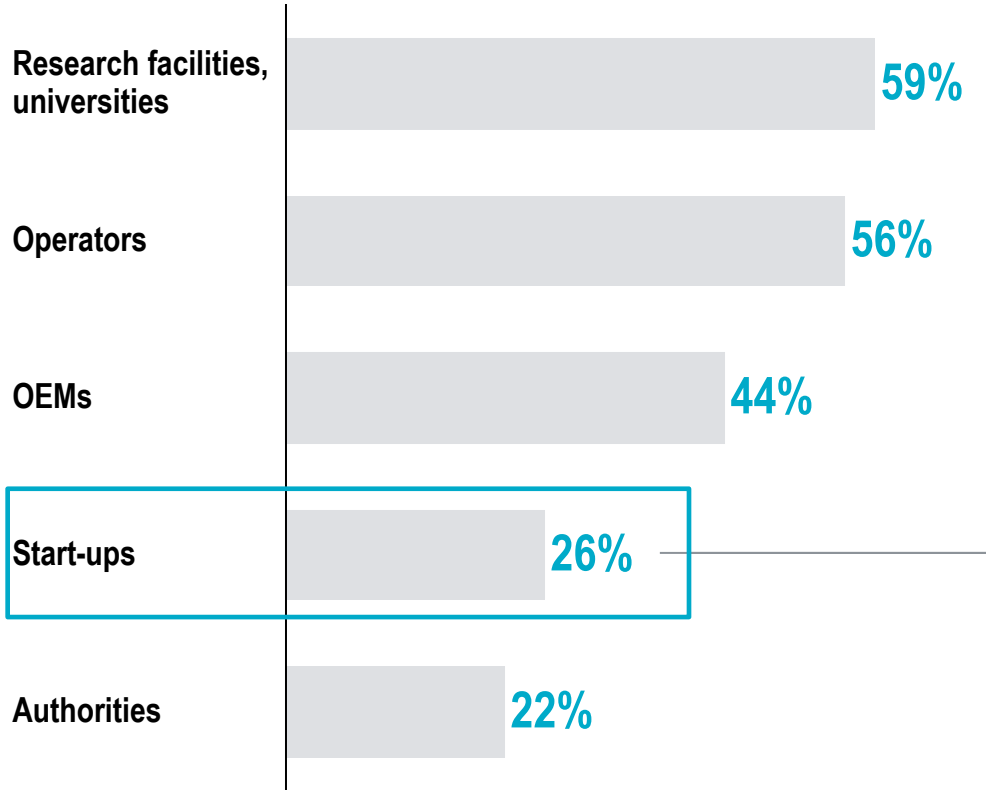
Cooperate with companies of same industry or foster cross-industry team work, also include start-ups

Source: Roland Berger Survey

A

Cooperation with the usual suspects, but at least one fourth of the rail supply industry is already somehow working with start-ups

Cooperation



Interviewees had to choose up to three answers

Examples

GE Ventures

- Venture capital subsidiary of GE headquartered in California
- Investments in start-ups in healthcare, energy, software and advanced manufacturing sector
- E.g. investment in Mocana, providing IoT mobile solutions and app security i.e. for rail signals

Schaeffler

- Schaeffler as member of Munich Network
- Munich network is an organization to promote innovation and entrepreneurship that links industry, investors and start-ups

Source: Company websites, Roland Berger

A

Not only cross- and same-industry cooperation proves to foster digital innovation, also working with start-ups is successful

Cooperation – Examples of other industries

Same-industry cooperation

- SIXT rent a car + BMW = On demand mobility with DriveNow
- Lufthansa + Fraport = Digital lounge shopping at Frankfurt airport
- BMW + Audi + Daimler = Precise "Here" maps as basis for autonomous cars

Cross-industry cooperation

- Netflix + Virgin America = Wi-Fi onboard sponsored for Netflix users
- Google + Uber + Ford and more = Self-driving coalition for safer streets
- Nike + Apple = Apple Watch Nike+ for sports

Start-up cooperation

- DB + KONUX = Sensors for controlling switches
- Swiss Post + Matternet = Drone testing for mail delivery
- e.on + orcan The Efficiency Company = Innovative process to turn heat loss into energy

Source: Company websites, Roland Berger

A

Product changes in rail supply industry regarding digitization focus especially on big data-based products and automated trains

More innovation – Potential of digital products and technology

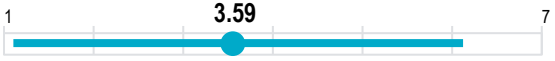
1 Sensors and big data

1. Internet of things

2. Big data analytics

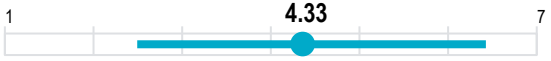
2 Autonomous trains

3. Automated trains



3 Intermodality

4. Mobility platforms and apps



5. Mobile Ticketing

Source: Roland Berger Survey

Smart digital data analytics enables forecasting as well as real-time monitoring the train's condition and operations

Sensors and big data

Smart data analytics

- Gathering and analyzing relevant real-time data of train operation and condition to create intelligent rail systems
- Improve reliability and minimize overall risks and costs
- Better understand customer demands on passenger routes

Train Control

Future delays prediction

- Stockholm commuter train operator uses **automatic predictive model** to visualize and forecast rail network operations up to 2 hours into the future to forecast and then prevent disruptions of the service

Maintenance

Real-time health checks

- Alstom's TrainScanner technology in UK with laser scanner and 3D cameras for real-time health checks of high-speed trains
- Automatic monitoring system to increase availability of trains

Infrastructure

Real-time infra-structure data

- Voestalpine's company Railpro together with ProRail offers technology to fit tracks with RFID sensors
- Data is transmitted to measuring systems in trains and to engineering companies as basis for procurement

Rolling Stock

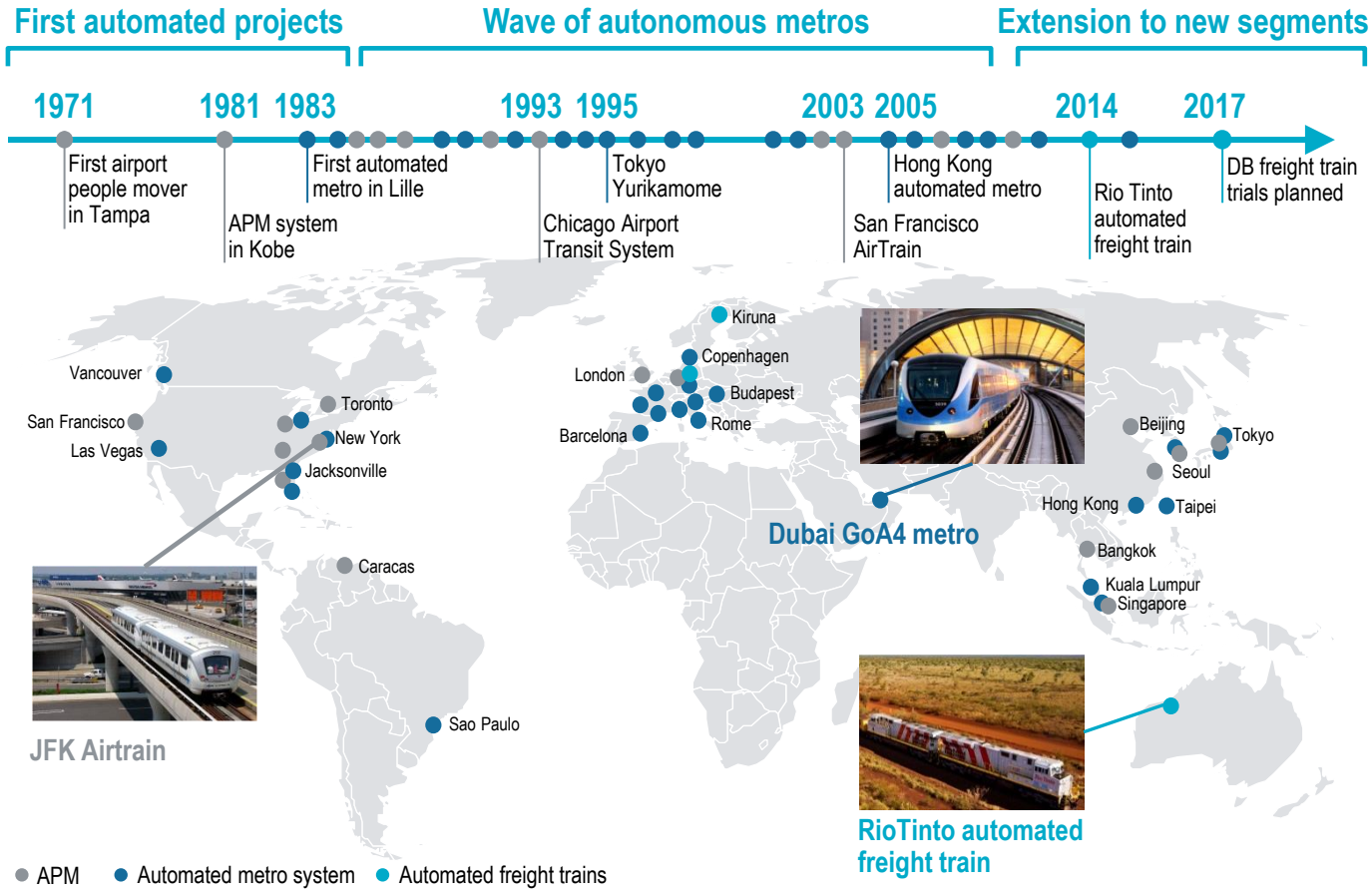
Connected wagons

- Telematics solutions and sensors for shock detection, temperature, loading, location etc. to **monitor real-time conditions** of train operation and loaded freight
- Examples: Savvy, Bosch & SBB

Source: Company websites, Railway Gazette, Roland Berger

The rail industry has been introducing autonomous vehicles for many years to improve its competitiveness – Pilots in new segments

Overview of main autonomous rail projects worldwide



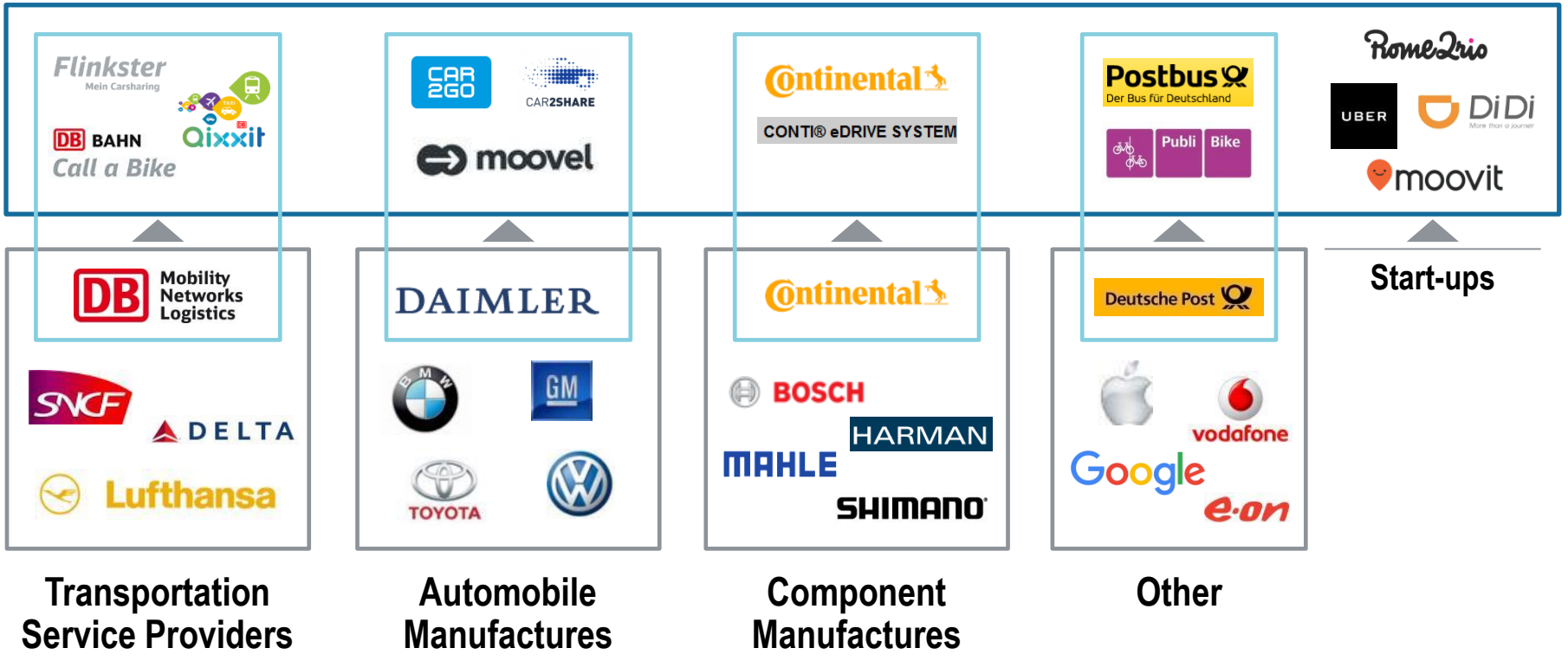
- First automated metros and people movers introduced in the 1970s and 1980s
- Since then, automated people movers serve relatively small areas such as airports; automated metros as mass transit solutions
- Reliable and frequent service enabled by different grades of automation
- Beyond passenger transportation, driverless freight trains tested and operated successfully especially in mining industry, e.g. Rio Tinto or Kiruna
- Automation as possibility to reduce costs, e.g. labor cost and increase reliability, frequency as well as safety of passengers and freight

Source: Company websites, Railway Gazette, Railjournal, UITP, Roland Berger

Next to various established players, new players are considering to enter the mobility market – What about the rail supply industry?

Intermodal transport – Examples of players entering the mobility market

Innovative Mobility Players – Selection



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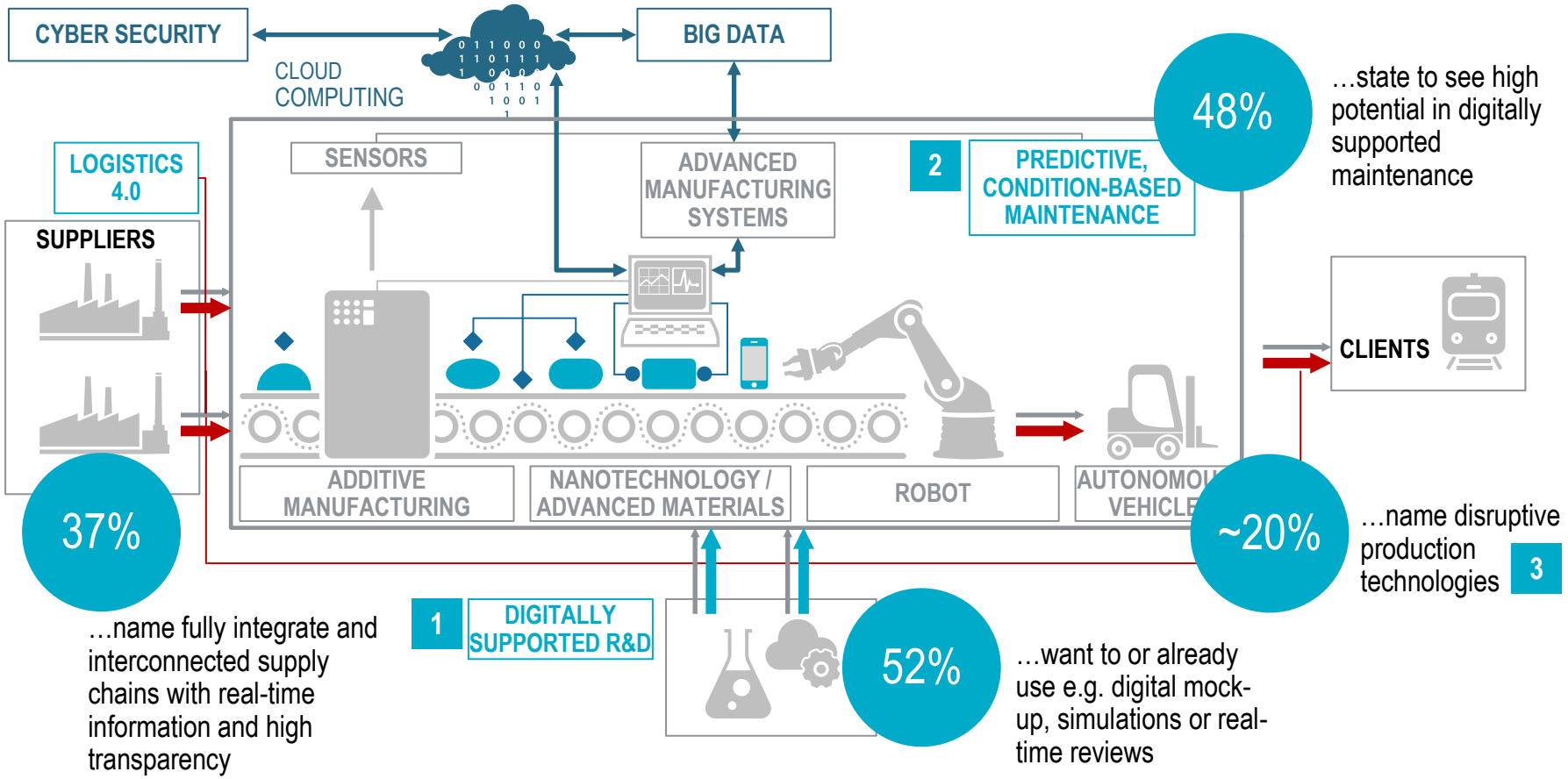
Source: Roland Berger Survey

The rail supply industry does not see disruptive production technology as priority – Digitally supported R&D and logistics in the focus

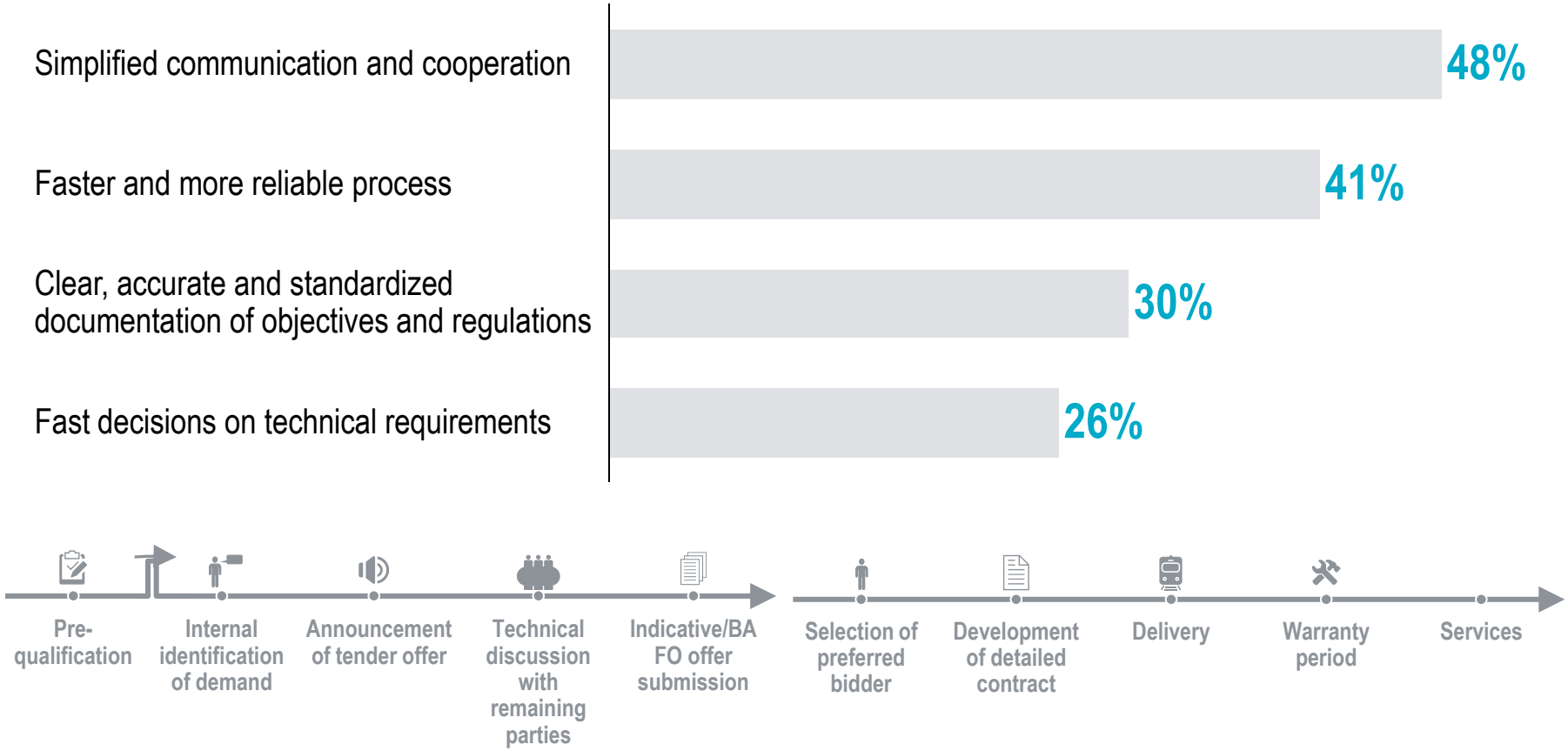
Digital operations – RB industry 4.0 framework



Source: Roland Berger Survey

Simplifications and improvements for the tender process by digitization are welcome and will foster innovation in the industry

Requested changes to tender process of operators



Interviewees could choose up to three answers

Source: Roland Berger Survey

Rail supply companies with complex and customized research and development see clear advantages of utilizing digital technology

Digitally supported R&D

70%

… can be saved on prototypes by using digital manufacturing tools, claims **Bombardier**

BOMBARDIER

Digital Mock-up

> Digital mock-up as **standardized tool and methodology** for Bombardier worldwide

> Collected data flows from CATIA design system into a virtual reality solution

> The developed vehicle can then be reviewed on **high resolution powerwalls**

> Moreover, technology of "**virtual hands**" makes it possible to touch the vehicle virtually

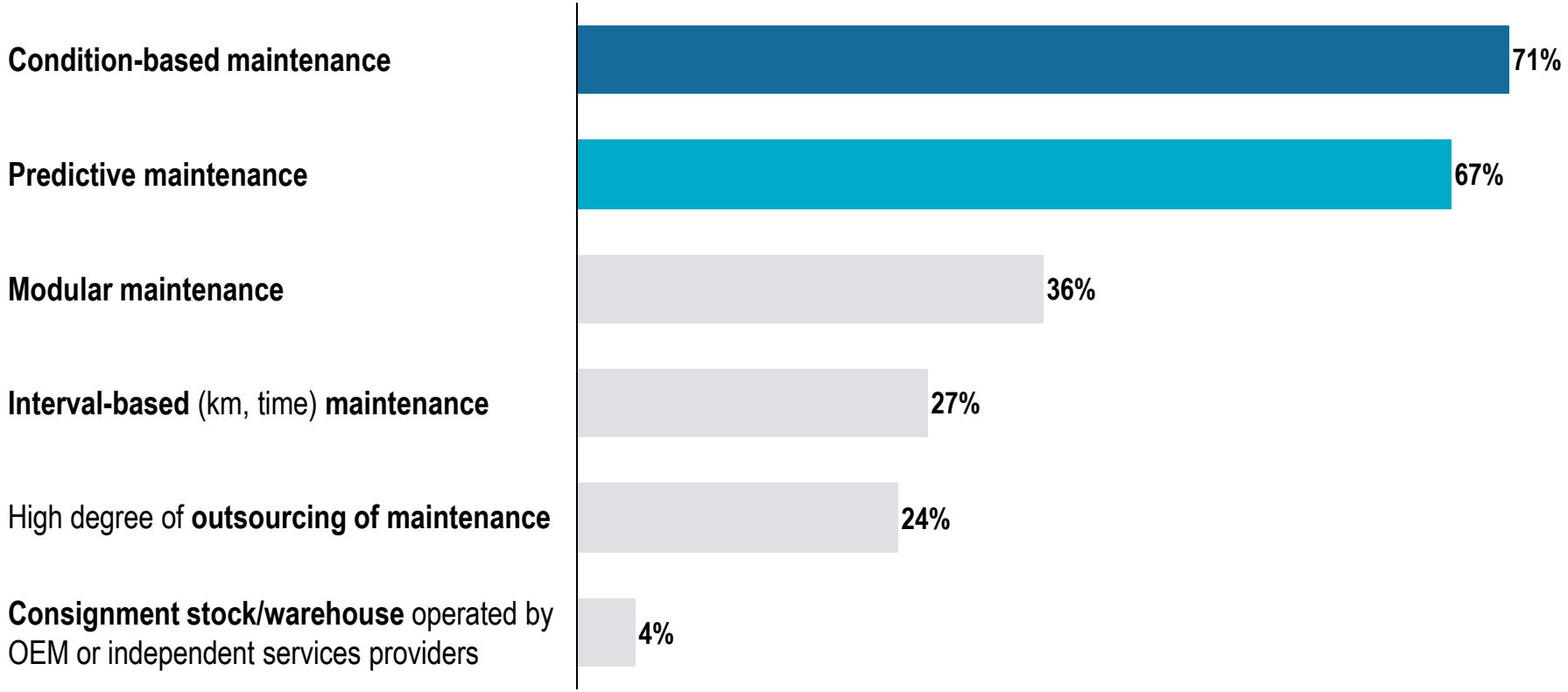
> Technology enables employees of all relevant business areas, such as R&D, production and management to make **quicker and more precise decisions** together in **real time**

> Bombardier is using this technology actively, **five installations** are already in usage worldwide

Source: Bombardier

Condition-based and predictive maintenance are the top trends cited in the execution of maintenance operations in rail industry

Main trends in maintenance operations[1)]



1) % of respondents choosing the answer; multiple answers

Source: Survey results Roland Berger Executive rail radar

Disruptive production technologies are already used widely – Assessed with rather low further potential for digitization

Disruptive production technologies - Examples

Connected glasses

> Device to enable precise positioning during cabin installation marking process
> Time spend per aircraft on marking process decreased by over 80%

Digital factory

> Largely automated production in Amberg with machines handling 75% of value chain
> Products equipped with individual ID codes, tracking in real time

Automated robot production

> Kuka smart factory in Augsburg with increased number of robots
> Introduction of RFID technology to enhance logistics

Multi-product assembly

> Multi-product assembly line within existing production facility in Homburg
> Products equipped with RFID chip including information on required production steps

Predictive analytics

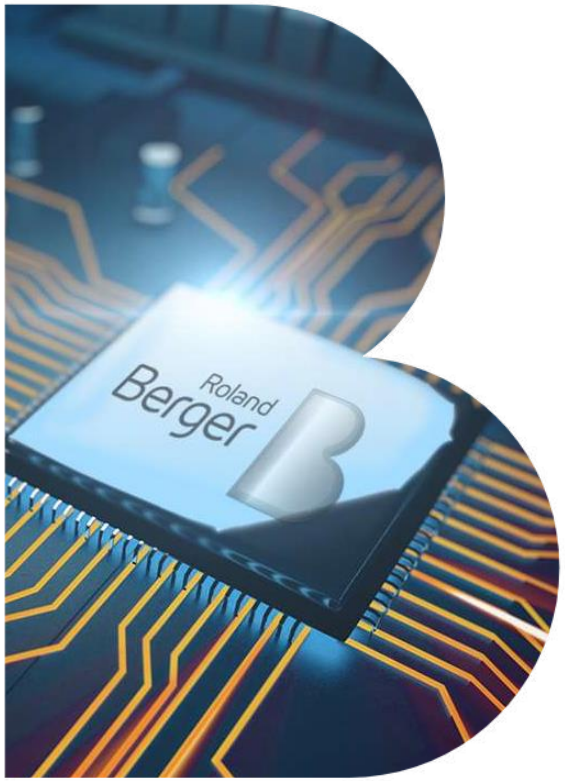
> Usage of big data analytics and predictive analytics for improving output and quality in the production, e.g. reduction of defect rate with new methods and tools

Digital plant

> 3D model for each individual current asset as comprehensive digital mirror out of digital documents
> View with augmented reality and holographic models

Source: Company websites

D. Our Digital Pathfinder for assessing Digital Readiness and facilitating Digital Transformation

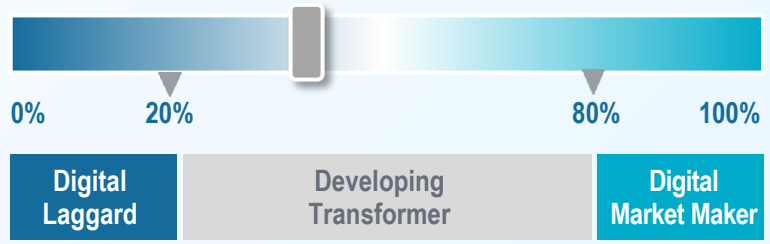


Coming back to you now: How digitally prepared are you today?

Roland Berger Digital Pathfinder – Questions

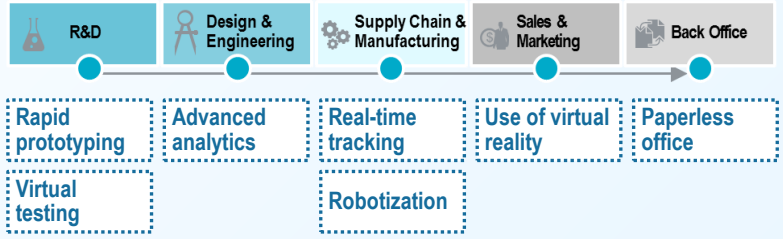
1 Digital readiness

HOW digitally ready are you?



2 Digital activities

WHICH digital activities are you pursuing along the rail supply value chain and how effective are you?



The Digital Pathfinder for Rail Supply framework comprises three steps to digital readiness – Online self-assessment survey as a first step

Digital Pathfinder – Three steps to digital readiness

1. High-level self-assessment

ONLINE and FREE

- ✓ Determine your **digital readiness score**
- ✓ Get your personal **high-level digital readiness evaluation** and a preview of the Digital Pathfinder analysis
- ✓ Leave your **contact details**. We will get in touch to plan the best next steps to digital readiness

2. Detailed organizational assessment

ONLINE

Contains all features of the high-level assessment, **plus**:

- ✓ Analyze **digital use cases** that are or will be in place **in your entire organization**
- ✓ Identify **unexploited potentials and pain points** between digital use cases & digital readiness
- ✓ **Get deep insights from a Roland Berger digital expert** through an in-depth call or video conference

3. Digital expert workshop

IN PERSON

Contains all features of the detailed organizational assessment, **plus**:

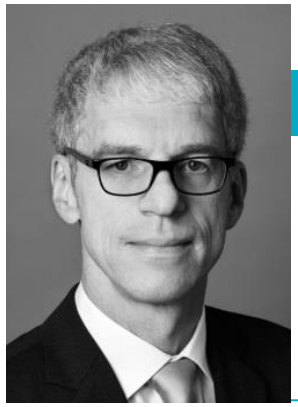
- ✓ **Get Benchmarks** of use cases with industry peers
- ✓ Develop **potential disruptive use cases** together with Roland Berger experts in a dedicated Workshop – either in your offices or at the Roland Berger digital SPIELFELD in Berlin
- ✓ Evaluation of **selected use cases** and assessment of approaches to **integrate** them into your current business model

Try it out now and visit our website of the Digital Pathfinder for Rail Supply

Digital Pathfinder website

Do not hesitate to contact us – Our team has an extensive and practical experience in the rail supply industry

Our rail supply experts



Andreas Schwilling

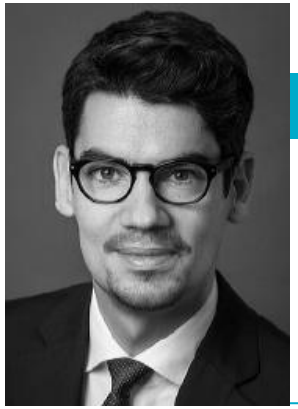
Partner

> 24 years of consulting experience in the transportation and rail sector
> Head of Rail practice

Tobias Schönberg

Partner

> 16 years of consulting experience in the mobility and rail sector
> Co-Head of Mobility practice



Bertrand Parizot

Project Manager

> 6 years of experience in rail industry with OEM manufacturer
> Expert for rail supply and autonomous driving

Katja Kürbis

Consultant

> Project experience rail industry and part of Mobility-Practice