ASTOC

Digitalization, AI and Predictive Maintenance

UIC Digital Days

Paris, December 6th, 2018

CEO, Björn Westerberg

42 members

Quality - Capacity – Competitiveness

Branschföreningen Tågoperatörerna

Arlanda Express

#Inlandsbanan

CFL cargo Sverige AB

VÄTE CONSULTING TEKNIK TRAFIK

Nordiska Tåg AB

Associerade medlemmar

ALSTOM

ARRIVA

Stockholms Spårvägar Vision och Tradition

DB SCHENKER

railcare

BOMBARDIER

Ansaldo STS Sweden AB

BLÅ TÅGET SKANDINAVISKA JERNBANOR

Stockholmståg

DVVI

STAB

Grenland Rail

BotniaTåg AB

DSB

Keolis

tågkompaniet

green cargo

TMRail AB

Jernhusen

TCC Transport Competence Center

trainpool

SJ

HECTORRAIL

TÅGFRAKT

Tågåkeriet i Bergslagen AB

LKAB

CargoNet

Nobina

transdev VÅR RESA – INSPIRERAD AV DIG

MTR

SANDAHLS BOLAGEN REAL RAIL AB

baneservice

CAPTRAIN

ProTrain BEMANNING AB

Agenda

01 Digitalization and AI

02 Predictive Maintenance - Past – Present – Future

03 Predictive Maintenance – Operator Examples

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01 Digitalization and AI

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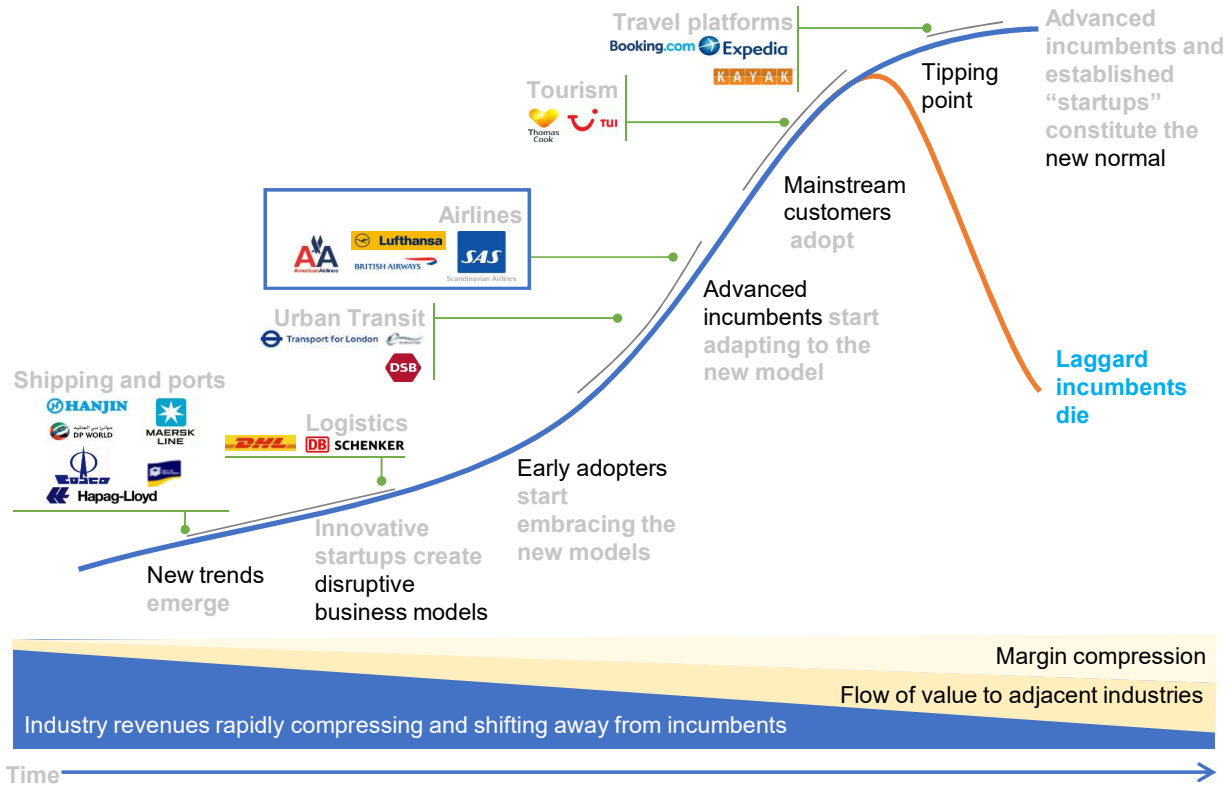
03 Predictive Maintenance – Operator Examples

Digitalization is underway; maturity varies by industry, but most potential is yet untapped

Digital maturity

- Efforts to date have mostly digitized the business “as-is”
- Organizations either haven’t recognized the real digitalization opportunities yet, or aren’t capable of implementing them

The rail industry may soon face the tipping point of the digital lifecycle

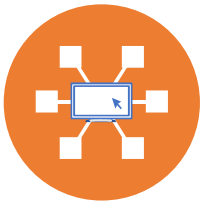


SOURCE: McKinsey & Company

6 disruptions could fundamentally change the travel and transportation industry

Current disruptions

Upcoming disruptions



Online platforms

"Traditional TTL companies as capacity providers only?"

Expansion of large technology companies

"Fear of the hungry tech giants?"

Advanced robotics

"Fundamental changes to cost structures?"

Asset sharing

"*The* door opener for innovative startups in the industry?"

Autonomous vehicles

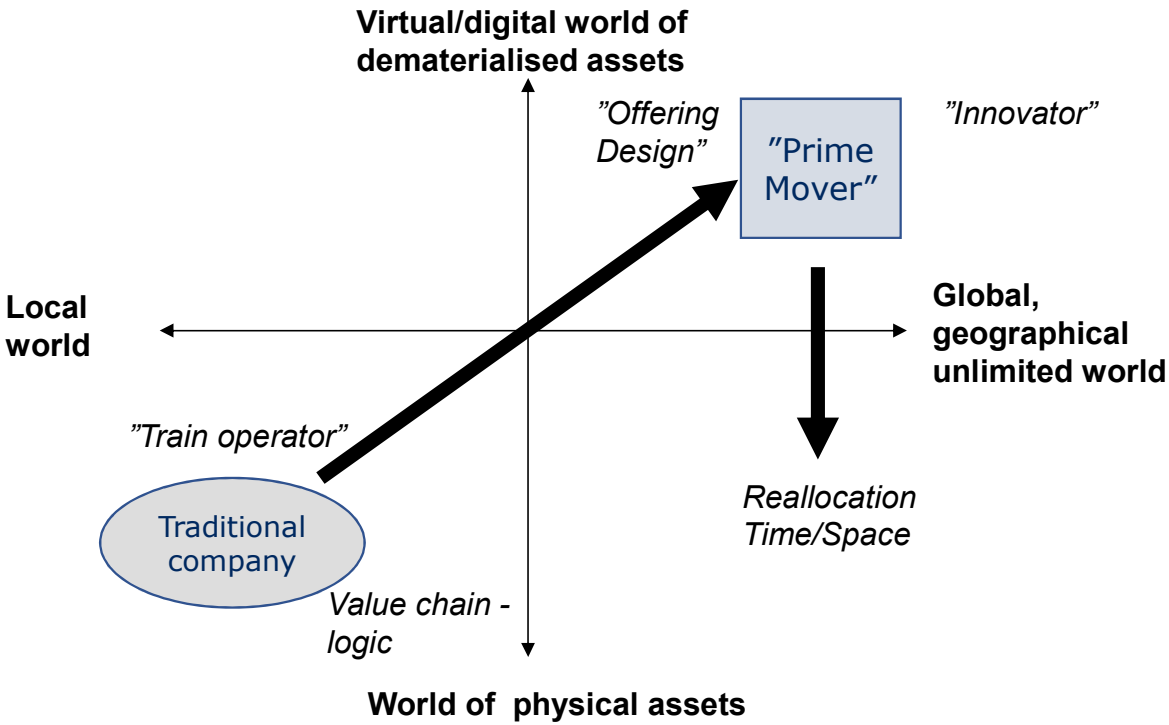
"Cost structures, opportunities, competitors – will everything change?"

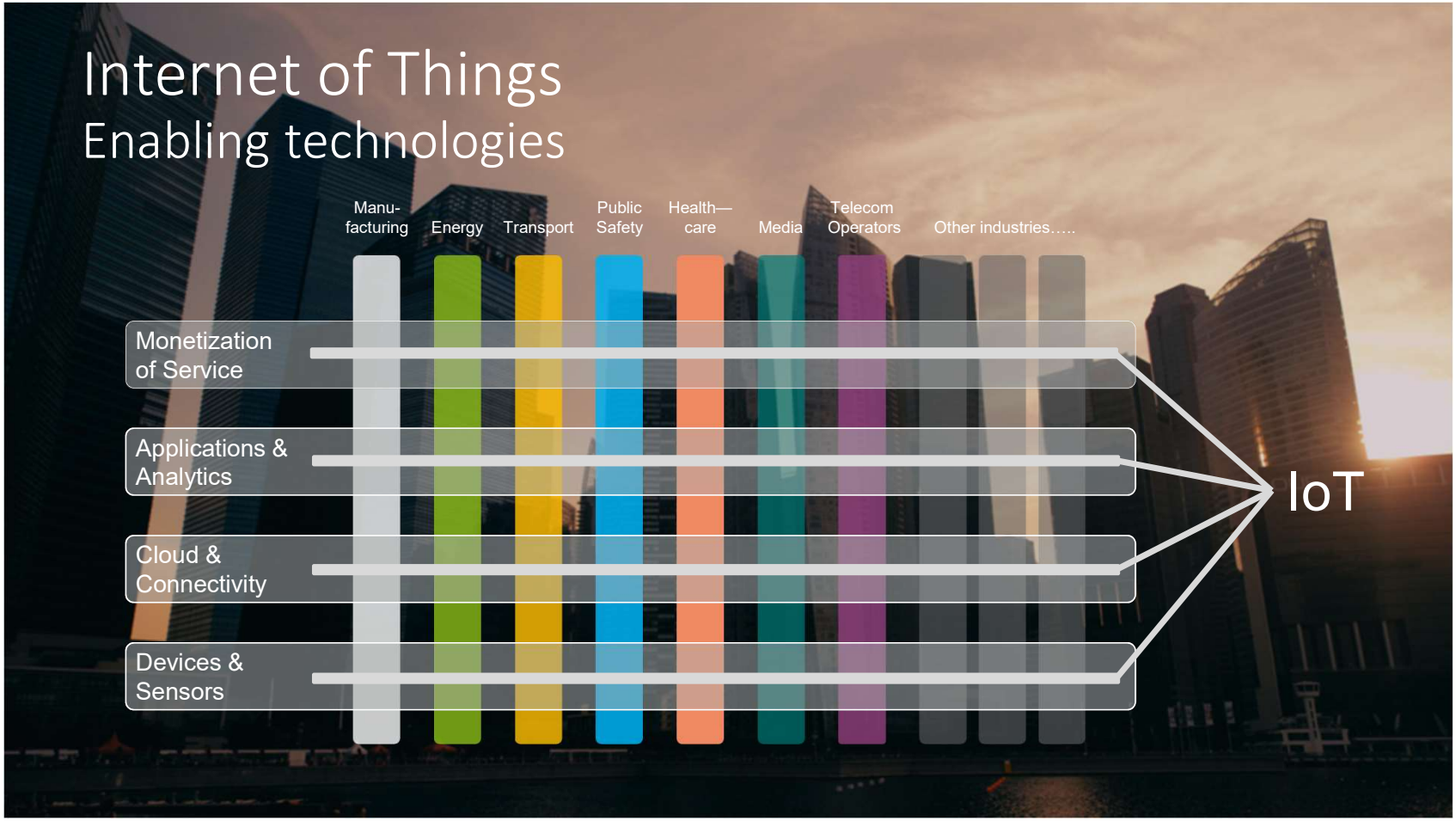
Additive manufacturing

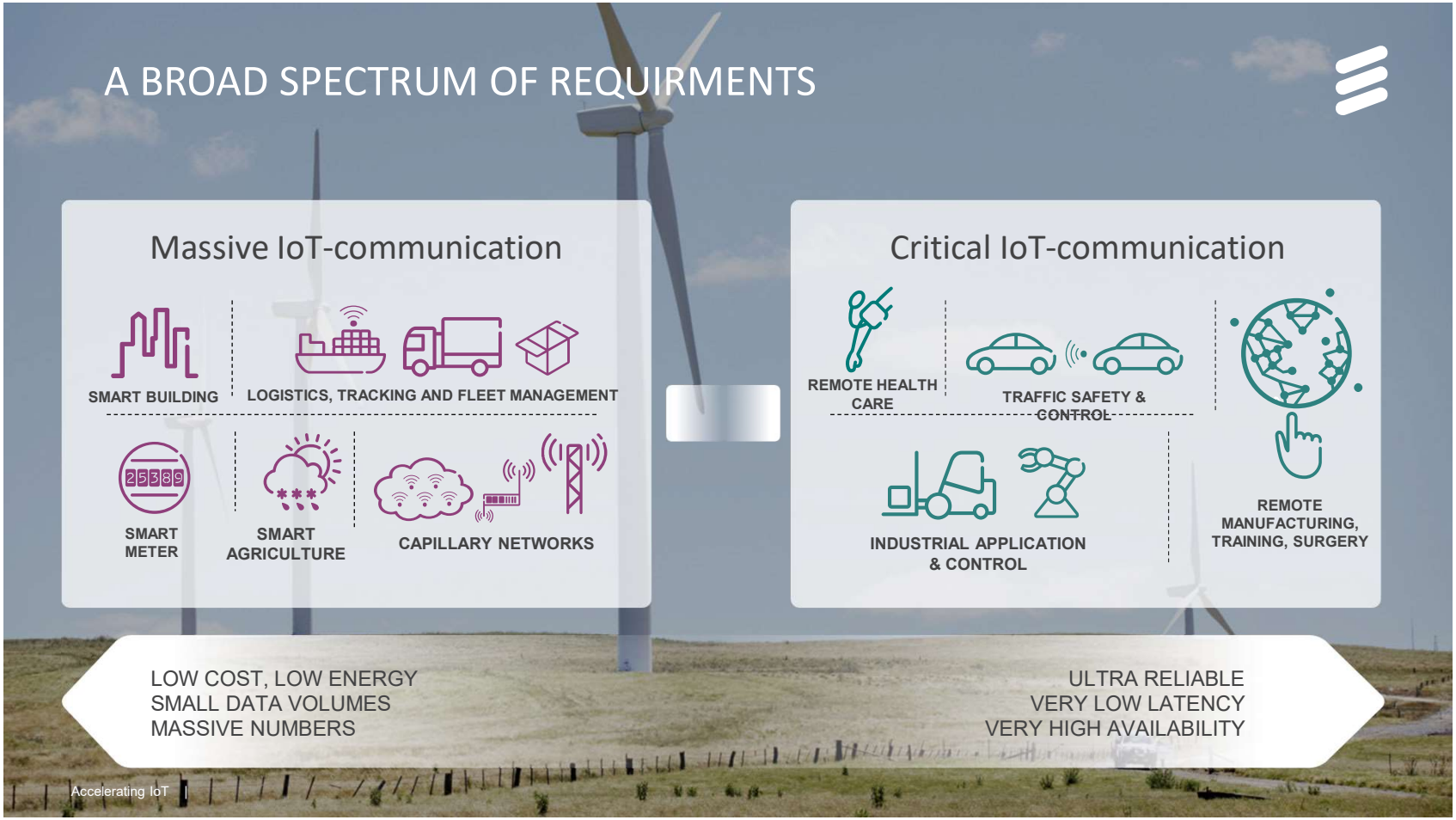
"The 'big hit' to the logistics industry?"

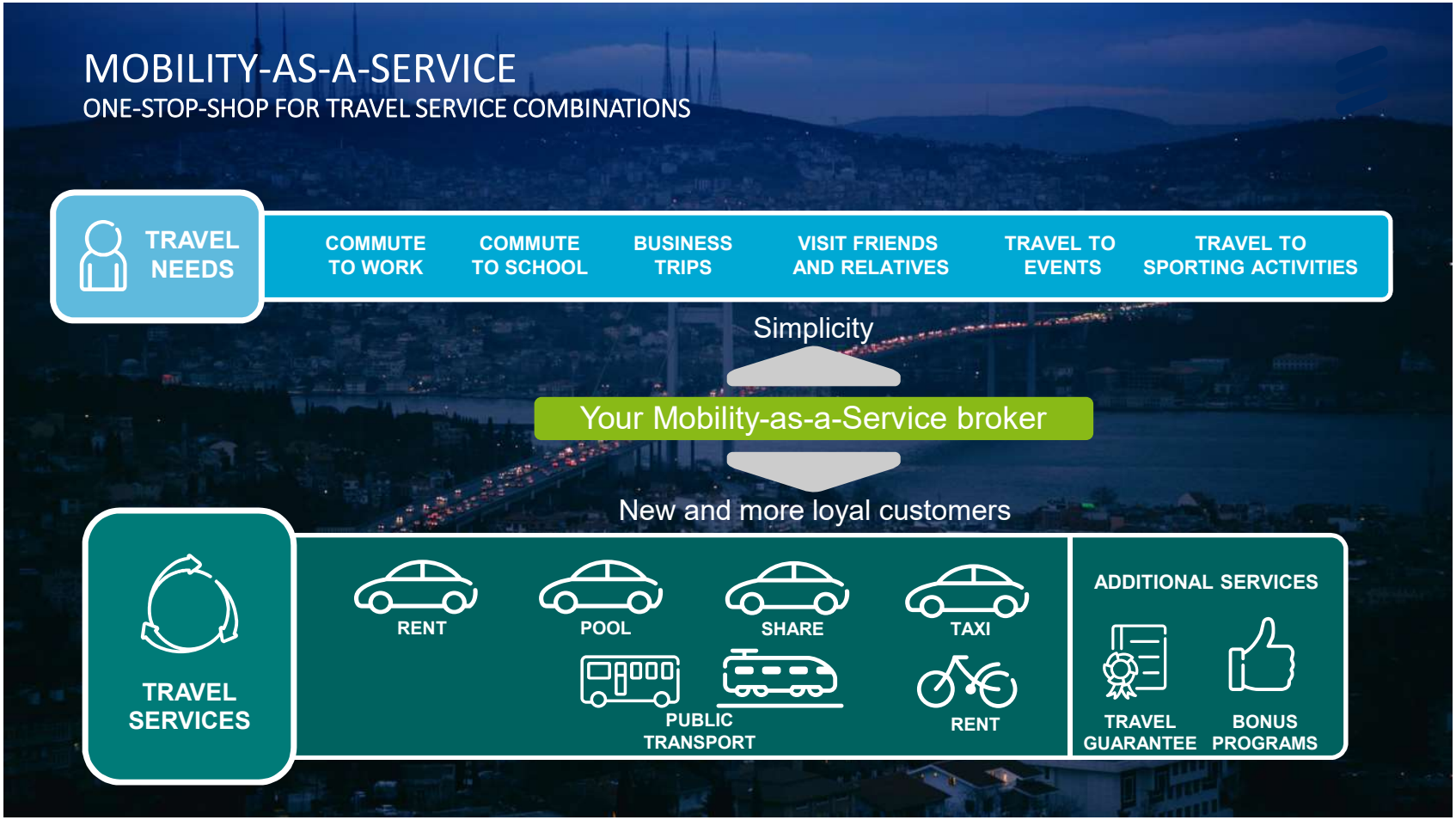
SOURCE: McKinsey & Company

Reconfigure or be reconfigured – Rail as prime mover..?

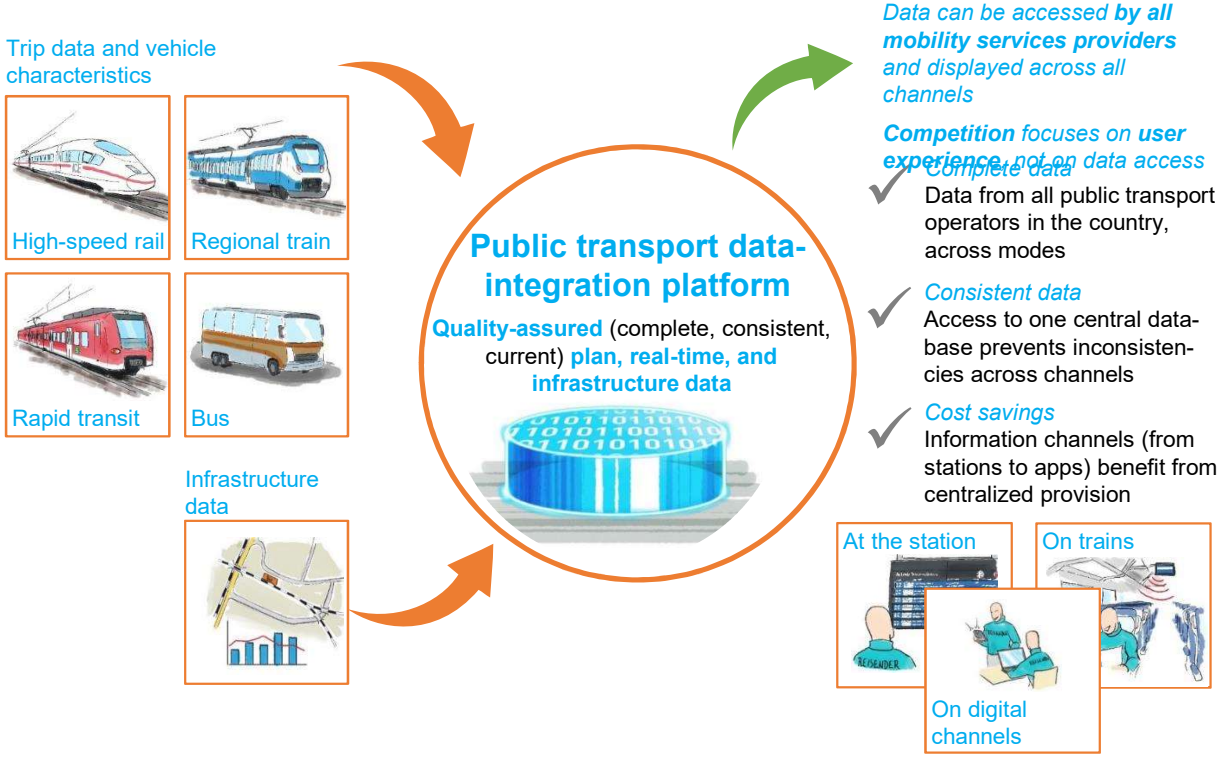



Internet of Things
Enabling technologies
Manu-facturing
Energy
Transport
Public Safety
Health—care
Media
Telecom Operators
Other industries…..
Monetization of Service
Applications & Analytics
Cloud & Connectivity
Devices & Sensors
IoT


A BROAD SPECTRUM OF REQUIRMENTS
Massive IoT-communication
SMART BUILDING
LOGISTICS, TRACKING AND FLEET MANAGEMENT
SMART METER
SMART AGRICULTURE
CAPILLARY NETWORKS
Critical IoT-communication
REMOTE HEALTH CARE
TRAFFIC SAFETY & CONTROL
INDUSTRIAL APPLICATION & CONTROL
REMOTE MANUFACTURING, TRAINING, SURGERY
LOW COST, LOW ENERGY
SMALL DATA VOLUMES
MASSIVE NUMBERS
ULTRA RELIABLE
VERY LOW LATENCY
VERY HIGH AVAILABILITY
Accelerating IoT


MOBILITY-AS-A-SERVICE
ONE-STOP-SHOP FOR TRAVEL SERVICE COMBINATIONS
TRAVEL NEEDS
COMMUTE TO WORK
COMMUTE TO SCHOOL
BUSINESS TRIPS
VISIT FRIENDS AND RELATIVES
TRAVEL TO EVENTS
TRAVEL TO SPORTING ACTIVITIES
Simplicity
Your Mobility-as-a-Service broker
New and more loyal customers
TRAVEL SERVICES
RENT
POOL
SHARE
TAXI
PUBLIC TRANSPORT
RENT
ADDITIONAL SERVICES
TRAVEL GUARANTEE
BONUS PROGRAMS

Data-integration platforms consolidate transport data across providers and modes, supplying mobility services providers with coherent data sets



Definitions AI

Artificial intelligence: A definition

AI is typically defined as the ability of a machine to perform cognitive functions we associate with human minds, such as perceiving, reasoning, learning, and problem solving. Examples of technologies that enable AI to solve business problems are robotics and autonomous vehicles, computer vision, language, virtual agents, and machine learning.

Machine learning: A definition

Most recent advances in AI have been achieved by applying machine learning to very large data sets. Machine-learning algorithms detect patterns and learn how to make predictions and recommendations by processing data and experiences, rather than by receiving explicit programming instruction. The algorithms also adapt in response to new data and experiences to improve efficacy over time.

Definitions – Machine Learning

Machine learning provides predictions and prescriptions

Types of analytics (in order of increasing complexity)

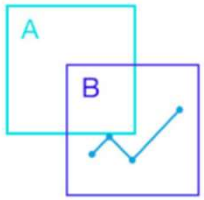
Descriptive

- Describe **what happened**
- Employed heavily across all industries

Predictive

- Anticipate **what will happen** (inherently probabilistic)
- Employed in data-driven organizations as a key source of insight

Prescriptive

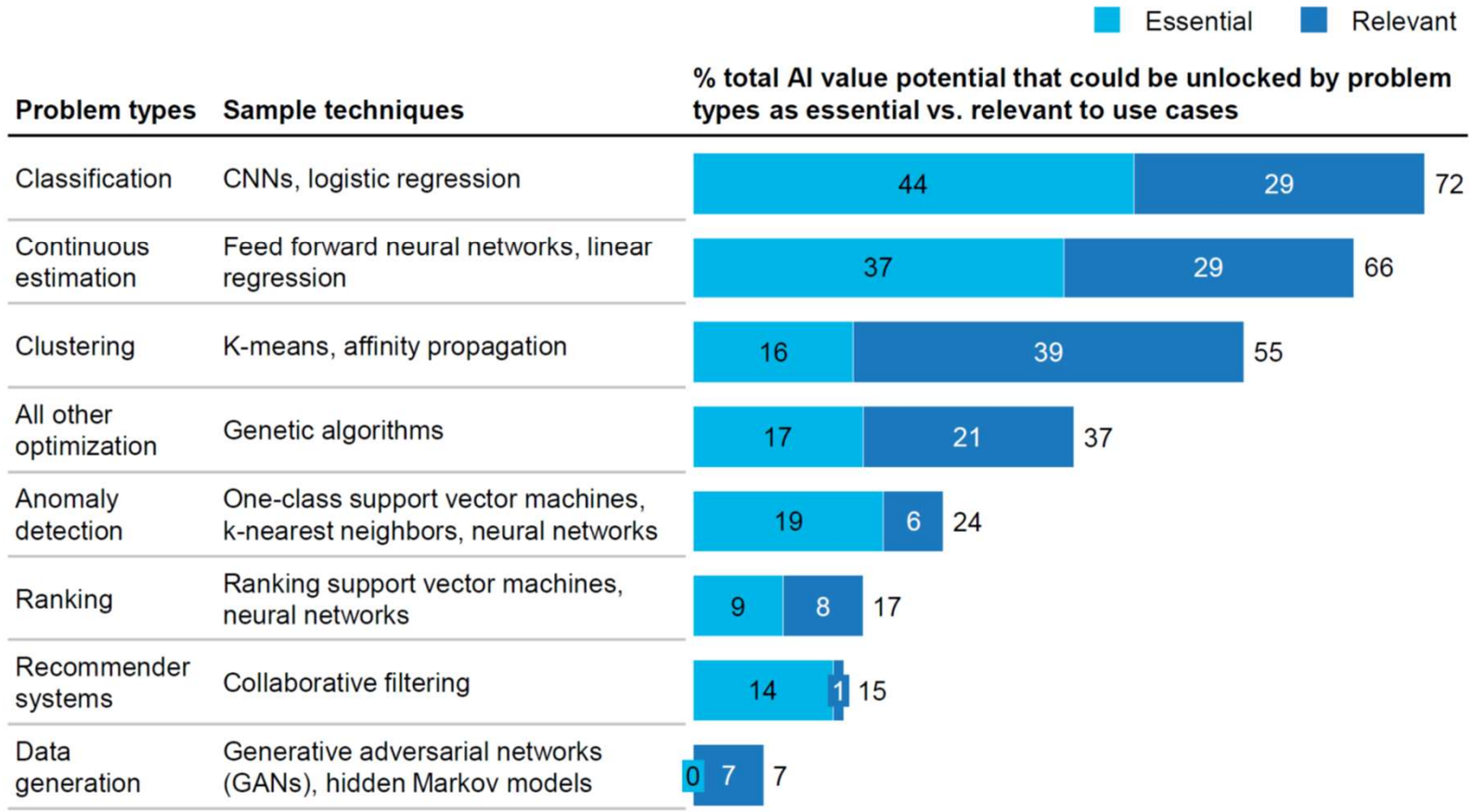


- Provide recommendations on **what to do** to achieve goals
- Employed heavily by leading data and Internet companies

Focus of machine learning

Exhibit 2

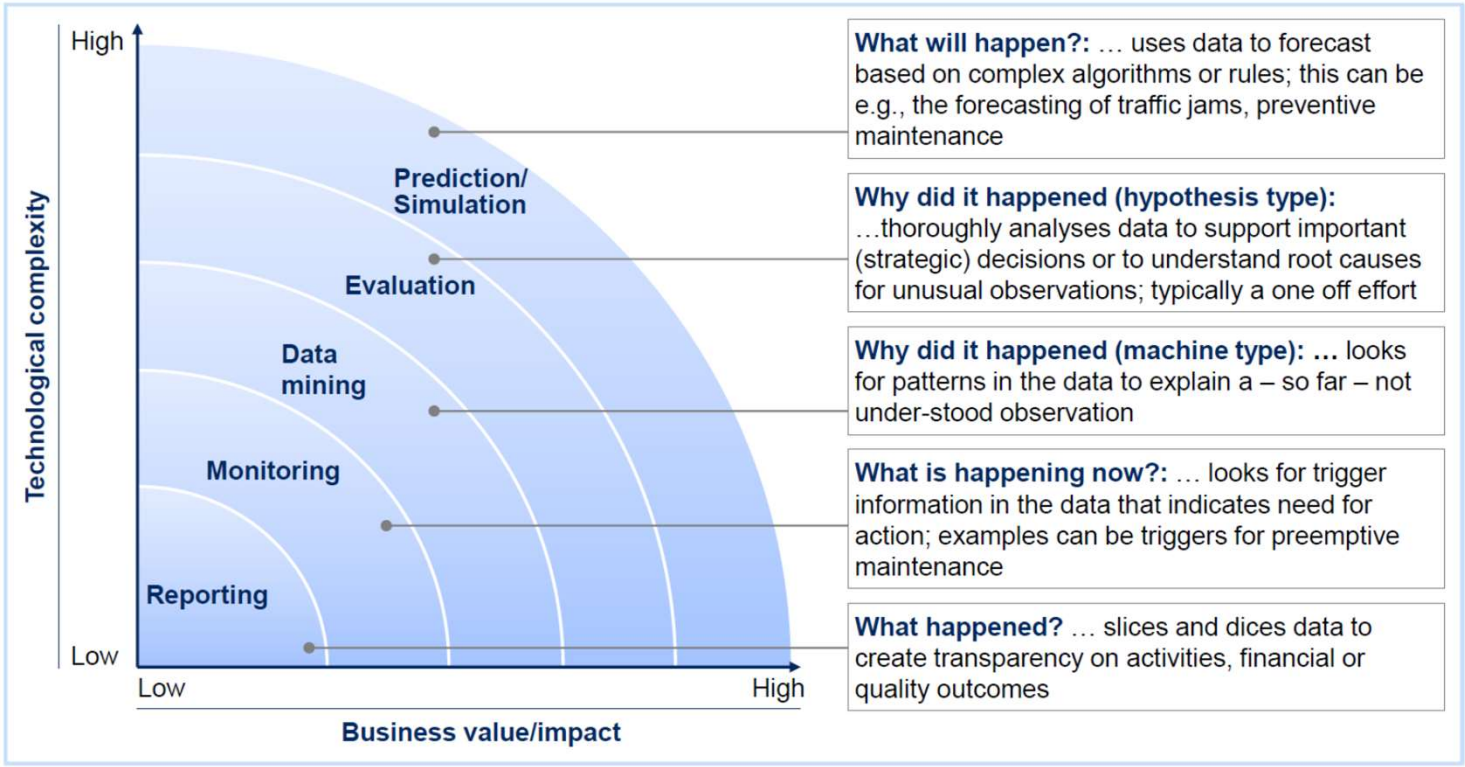
Problem types and sample techniques



NOTE: Sample techniques include traditional analytical techniques, machine learning, and the deep learning techniques we describe in this paper as AI. Numbers may not sum due to rounding.

SOURCE: McKinsey Global Institute analysis

Use of AI and Big Data



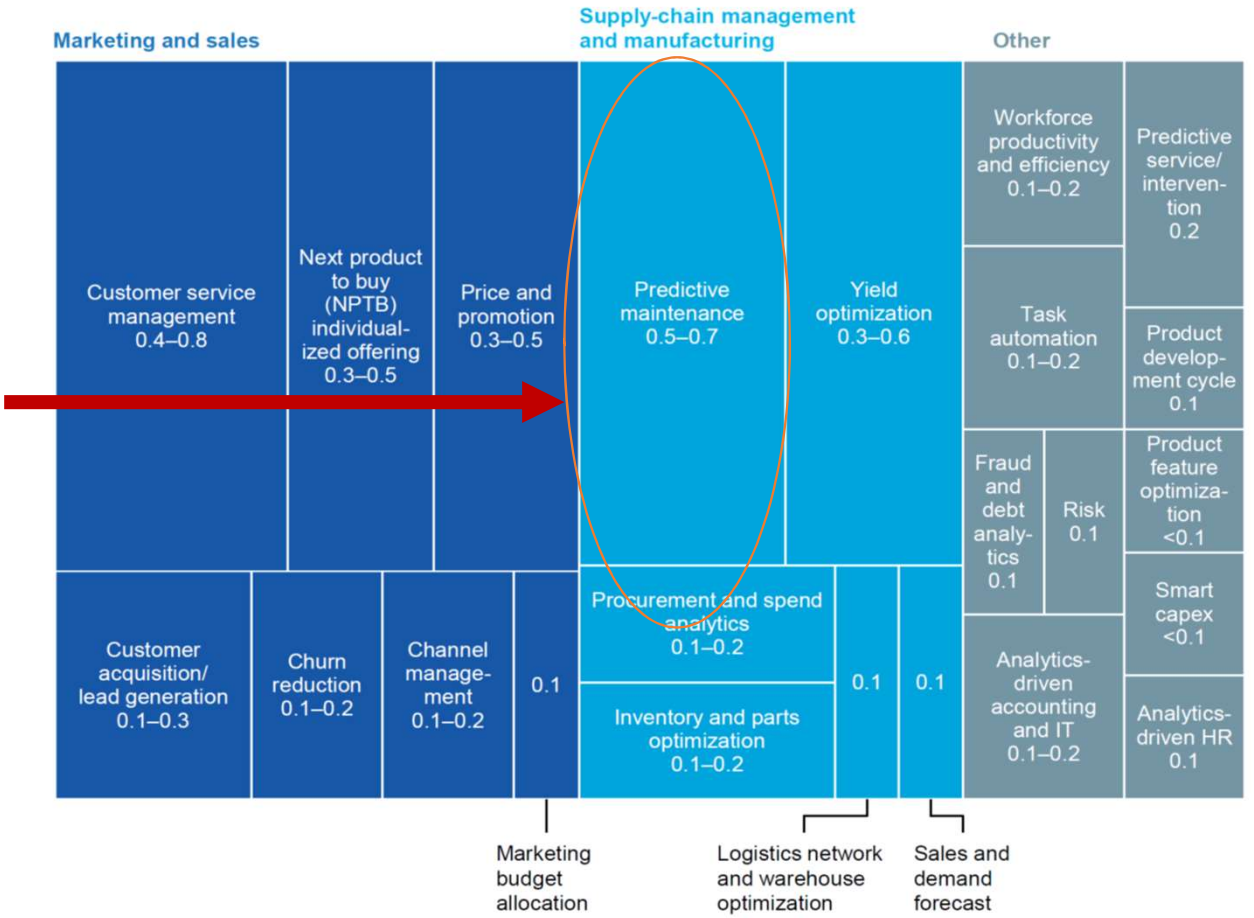
SOURCE: McKinsey & Company Big Data Analytics Team

Predictive Maintenace
500-700 B USD

Exhibit 12

Marketing and sales and supply-chain management and manufacturing are among the functions where AI can create the most incremental value

Highest potential impact business problems per functional area
Impact size comparison by chart area)
$ trillion



NOTE: Numbers may not sum due to rounding.

SOURCE: McKinsey Global Institute analysis

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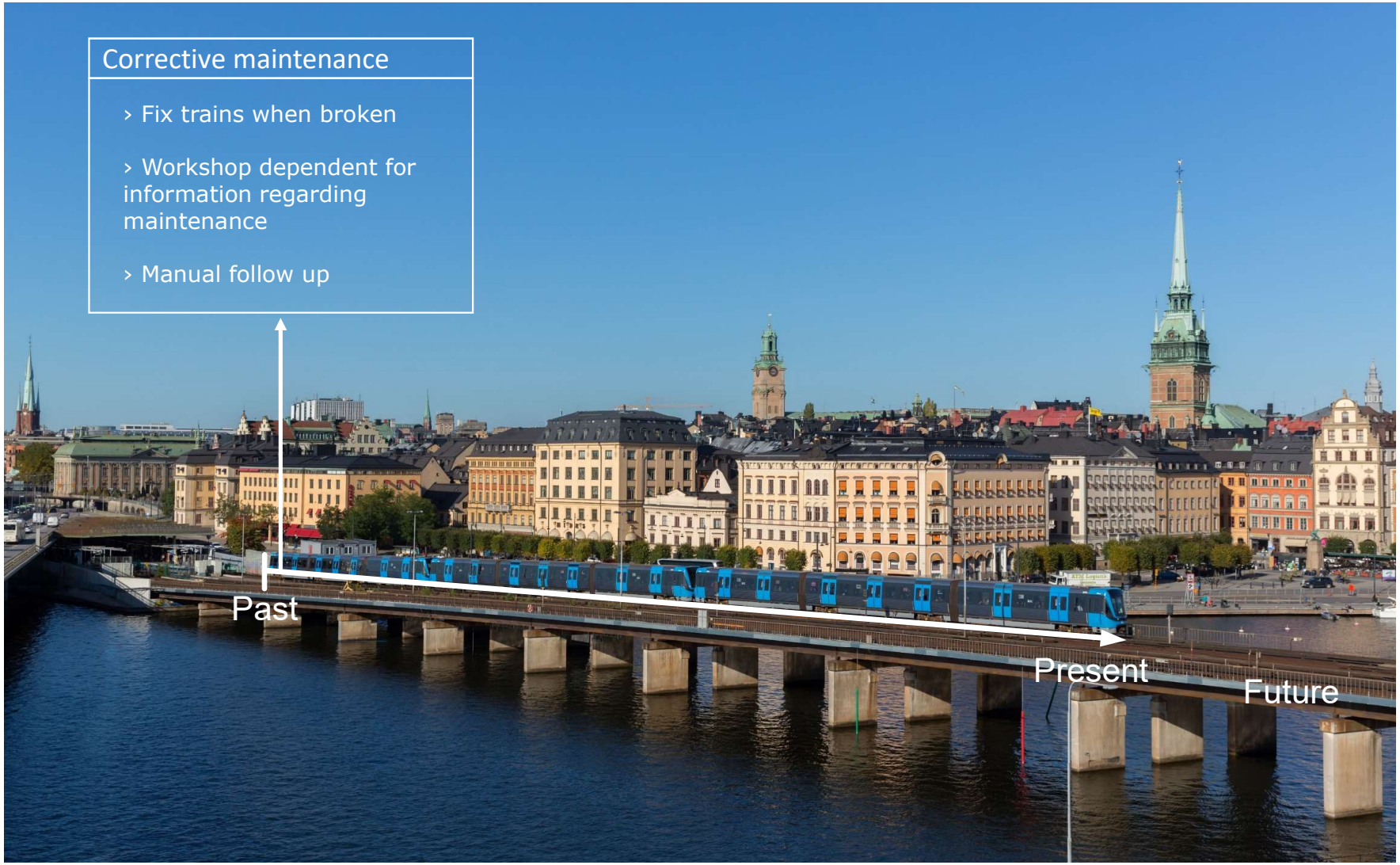
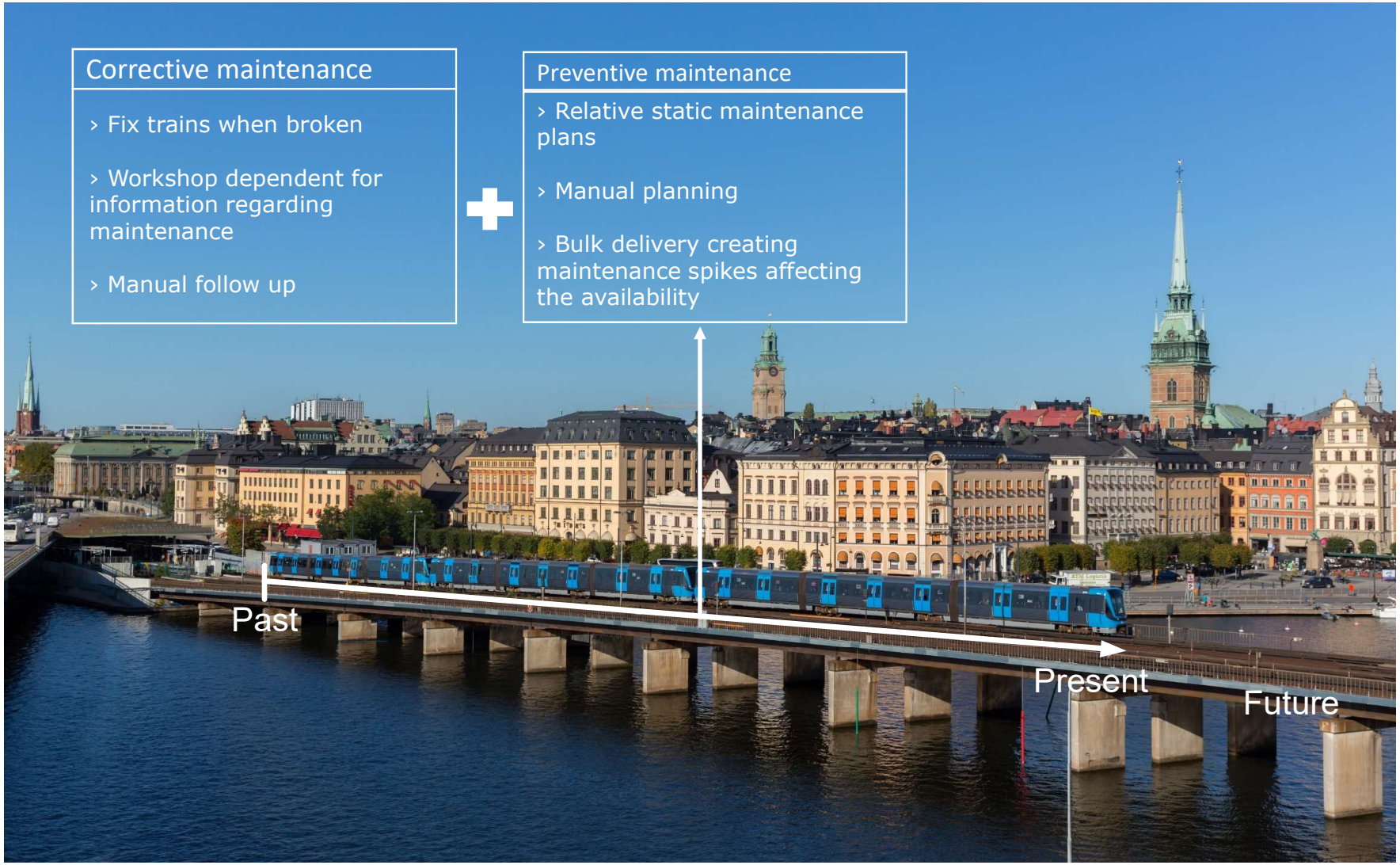
Past
Present
Future


Corrective maintenance
› Fix trains when broken
› Workshop dependent for information regarding maintenance
› Manual follow up
Past
Present
Future


Corrective maintenance
› Fix trains when broken
› Workshop dependent for information regarding maintenance
› Manual follow up
Preventive maintenance
› Relative static maintenance plans
› Manual planning
› Bulk delivery creating maintenance spikes affecting the availability
Past
Present
Future


Predictive maintenance
› Predict the maintenance needed based on historical data such as MTBF, performance and current vehicle status
› Perform "What if" analysis to eliminate future risk factors and ensure highest availability
› Ensure no maintenance spikes in the budget the coming 5 years
Past
Present
Future

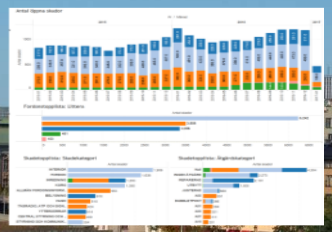
Corrective maintenance

› Automated follow up of corrective actions

› Statistical basis for improvement of preventive maintenance

› Automated systematic failures

› Overview of MTBF for components

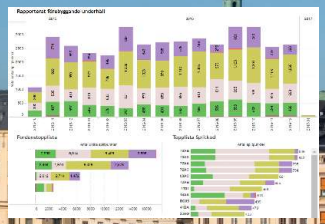


Preventive maintenance

› Automated follow up of preventive maintenance

› Identify improvement potential by knowing how the maintenance is performed relative plan

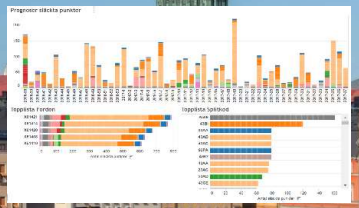
› Ensure highest availability by knowing which task that are critical



Predictive maintenance

› Predict the maintenance need based on historical data such as MTBF, performance and current vehicle status

› Perform "What if" analysis to eliminate future risk factors and ensure highest availability



Past

Present

Future

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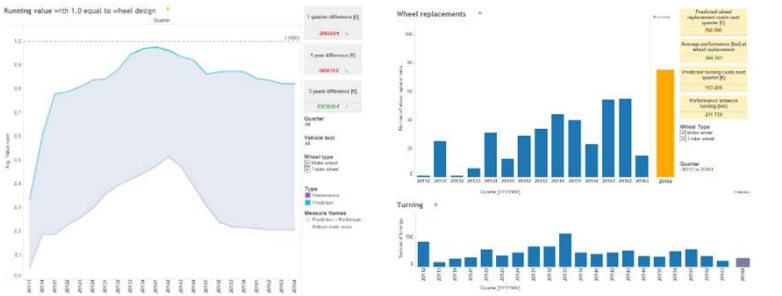
Operator Case I

Predictive maintenance of components



- Machine learning
- Scenarios
- Value over time
- Decision making

By analysing the performance and measurement data, building a decision tree gave the possibility to do predictive maintenance on critical components. The model provided a better understanding of reliability, asset value and economic outcome of different scenarios.

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Operator I

Data to value

Data Harvest

Collect data from different sources, API, IoT, .xlxs

Master Data Management

Secure and certified processes enhanced data quality.

Data sources are connected to enable effective and standardized analyses.

Domain expertise

Industry experience and genuine system knowledge combined with advanced data analytics resulted in industry leading know-how.

Data science and BI

KPI's, algorithms, statistical models, machine learning, reports and system data for business recommendations and decision making.

Making the difference

Through change management processes and implementation, identified opportunities that provided local lasting value.

Agile and continuous improvements of business processes.

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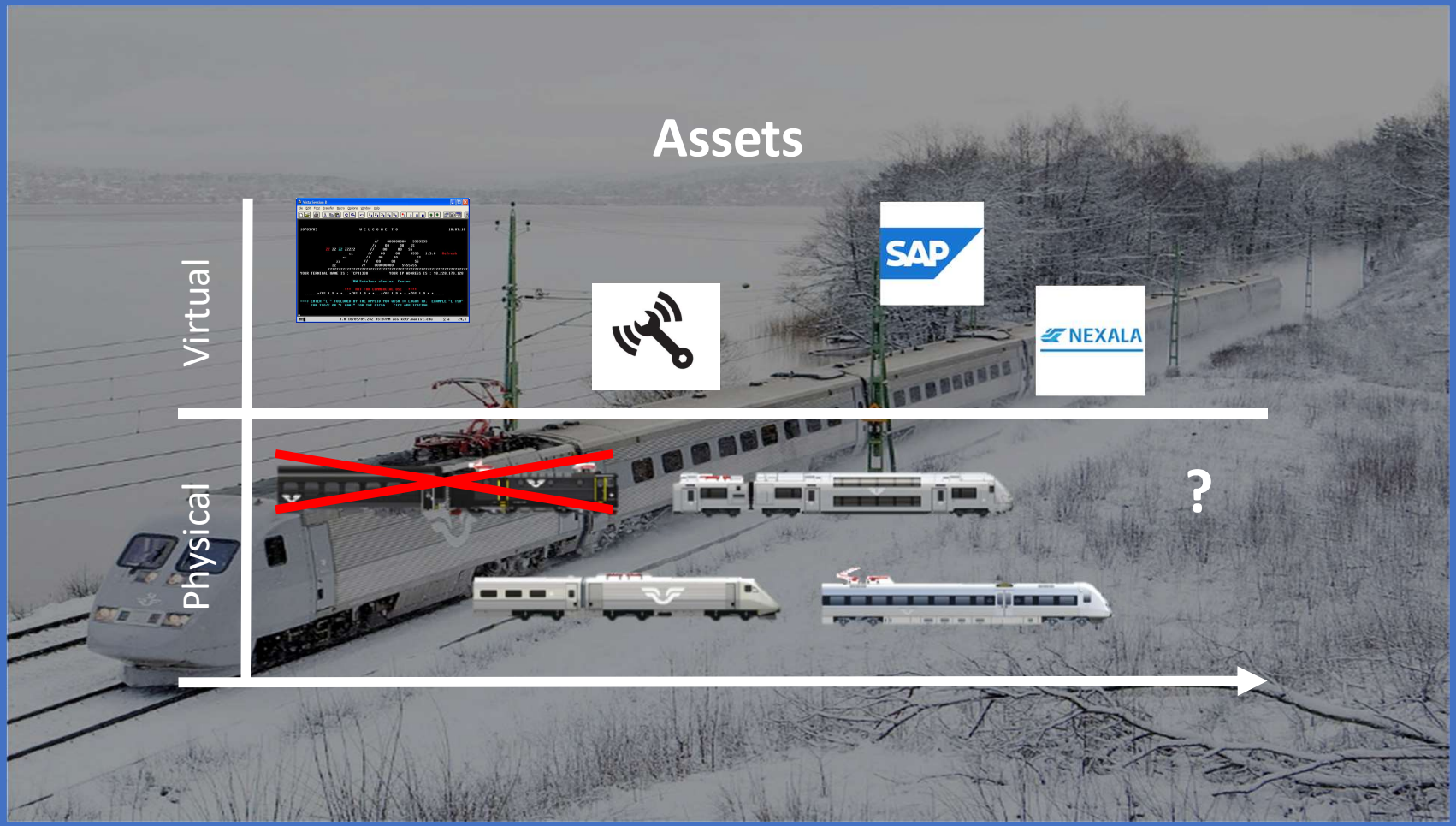
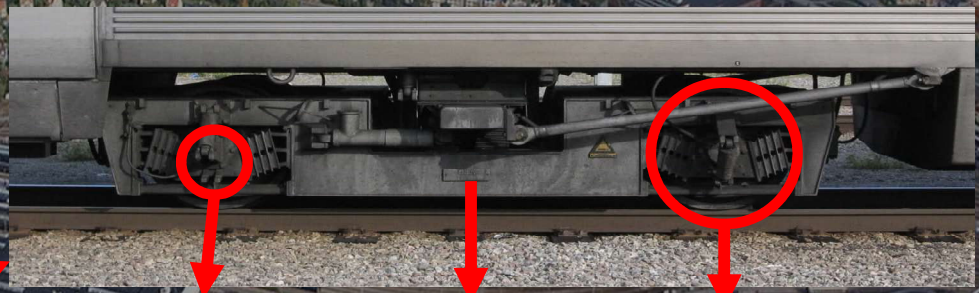
Operator case II: SJ


Assets
Virtual
Physical
SAP
NEXALA
?

Case

€ ?



0,63 Mkm

1,2 Mkm

0,8 Mkm

1,2 Mkm

1,2 Mkm

Punctuality

Availability

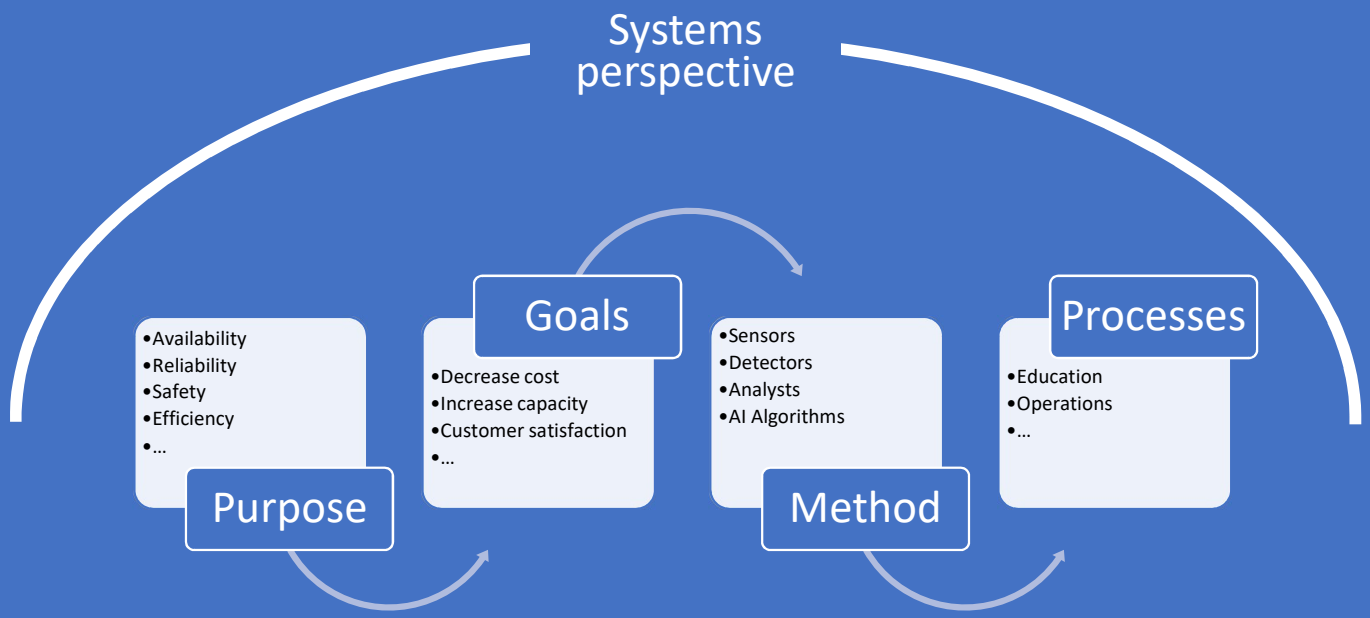
Efficiency

Solution: Wheelbearings

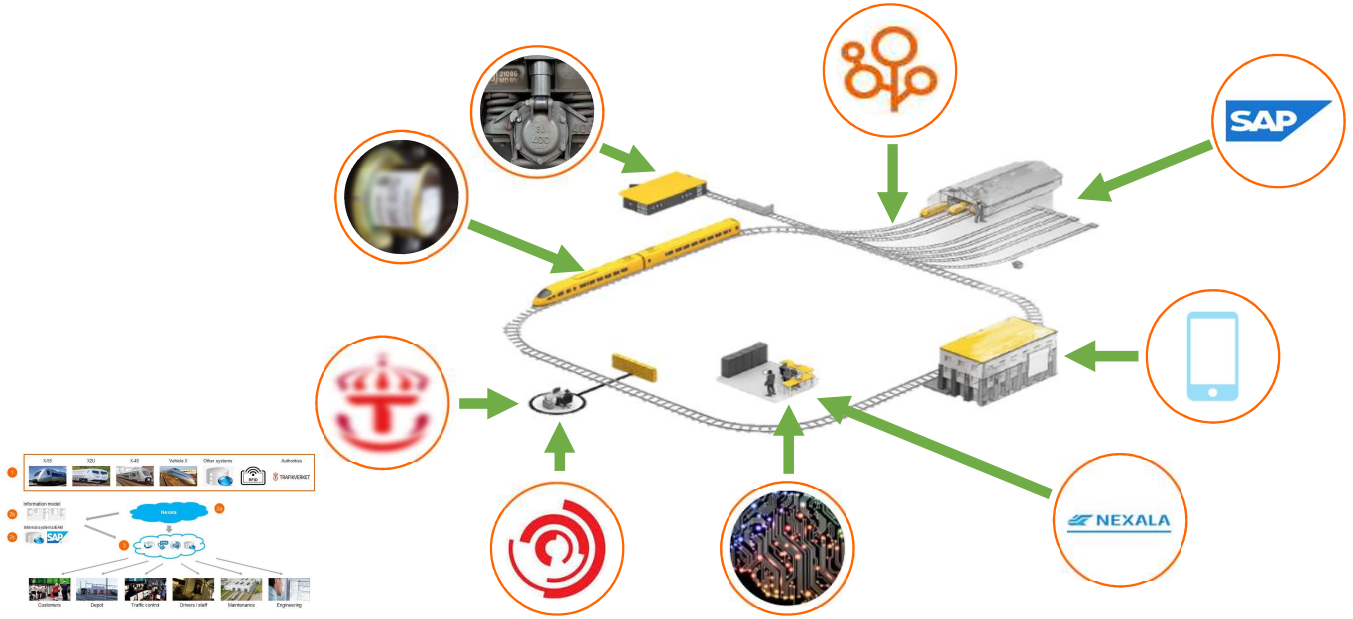
- Continuous measurement of temperature and vibrations
- External analysis
  - Bearing condition reported to SJ
- Added values
  - Wheel damage
  - Rail health
- 3 months warning

Making the data useful

Structure


Systems perspective
Purpose
•Availability
•Reliability
•Safety
•Efficiency
•…
Goals
•Decrease cost
•Increase capacity
•Customer satisfaction
•…
Method
•Sensors
•Detectors
•Analysts
•AI Algorithms
Processes
•Education
•Operations
•…

Future outlook



Lessons learned

Digitalization and the extended condition based monitoring approach with remote diagnostics offered the following key benefits:

- Predictive Maintenance/Condition Based Maintenance
- Fewer disruptions in traffic and better decision support when problems occurs
- Better analytical capabilities to find improvements
- Lower costs

Implications of AI
Member feedback

- The real question: How to improve decision making?
- No definition of AI, need for a standard?
- No clear business case yet, moving target. Automatization most common area
- AI – useful for pattern recognition, classification and prediction
- AI – machine learning and probabilities
- AI does not yet solve new problems, do we fit AI to the right problem?
- Moving AI to complex and unsolved existing problems
- New trains equipped with many sensors and data - potential

Think Big,
Start Small,
Act now!

Björn Westerberg, CEO, ASTOC

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