Increasing manufacturing performance by leveraging Industrie 4.0

Approach and references
Roland Berger

Roland Berger is a European-rooted, global consultancy with extensive experience across all industries and functions
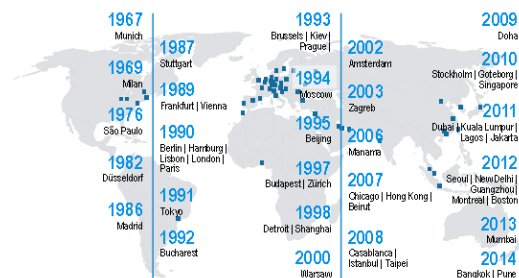
Roland Berger at a glance

Our profile

Created in **1967** in Germany by Roland Berger

50 offices in **36** countries with **2,400** employees

Nearly **220** Partners

~1,000 international clients

1967 Munich	1993 Brussels | Kiev | Prague	2002 Amsterdam	2009 Doha
1969 Milan	1987 Stuttgart	2010 Stockholm | Goteborg | Singapore	
1976 São Paulo	1989 Frankfurt | Vienna	1994 Moscow	2003 Zagreb
1982 Düsseldorf	1990 Berlin | Hamburg | Lisbon | London | Paris	1995 Beijing	2011 Dubai | Kuala Lumpur | Lagos | Jakarta
1986 Madrid	1991 Tokyo	1997 Budapest | Zürich	2006 Manama
	1992 Bucharest	2007 Chicago | Hong Kong | Beirut	2012 Seoul | New Delhi | Guangzhou | Montreal | Boston
		1998 Detroit | Shanghai	2013 Mumbai
		2000 Warsaw	2008 Casablanca | Istanbul | Taipei	2014 Bangkok | Pune

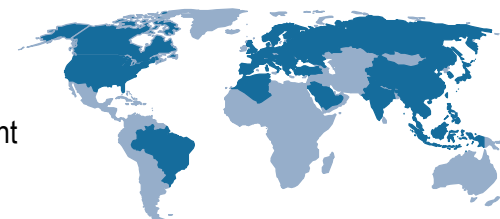### International position

2018

Market position in the strategy segment

Germany **# 3**

Core markets in Western Europe **# 3**

Growth regions China and Russia/CEE **# 2**

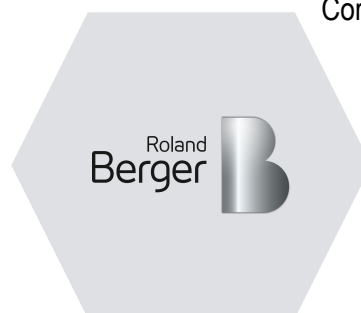World **# 5**

Our values

Entrepreneurship
We follow an entrepreneurial approach and provide creative and pragmatic solutions

Excellence
We achieve excellent results and develop global Best- practices to ensure measurable and sustainable success

Empathy
We are insightful and responsible advisors who contribute to the greater good

Extensive experience

We serve …

… The largest international companies:
30% of the Global 1000
40% of Europe's leading companies

… The most dynamic and innovative mid-size companies

... Governments about to deregulate and privatize

Roland Berger is the leading consultancy in the Industrie 4.0 space with proven strategy and implementation capabilities

References – Digitization/Industrie 4.0 (selection)

Digitization / Industrie 4.0

> Identification and analysis of relevant Industry 4.0 opportunities for two leading aluminum producers and drawing up implementation roadmaps

> Elaboration of a national strategy on Artificial Intelligence (AI) for a European government

> Case for change in favor of Industrie 4.0 for Flanders' Chamber of Commerce and Industry

> Study for Google France assessing the digitalization impact on France

> Study of the digital transformation of the German industry for BDI

> Project for a leading factory automation provider to develop an Industrie 4.0 strategy 2025

> AI & geoscience capability development for an oil & gas major

> Assessment and evaluation of applicable Industrie 4.0 initiatives for a utility company

> Deriving big data business models for an automotive OEM

> Elaboration of additive manufacturing technology strategies for an automotive OEM, two turbine manufacturers and a powder producer

> Multiple projects on improvement potential through shop floor digitization

I4.0 is as well of high relevance for the Aerospace and Defense industry as it support small series production and pred. maintenance

Example of clients in the Aerospace & Defence industry

**OEM/
prime contractors**

**Tier-1
players**

**Governments/
Institutions**

**MRO
(aircraft and engine)**

Detailed case studies are available, summarizing the approach and impact of our project work

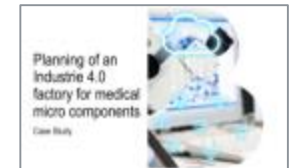Detailed case study documents - excerpt

1 Railway industry

2 Electromechanical industry

3 Primary aluminum industry

4 Automotive industry

5 Metal 3D-printing of turbines

6 Medical micro components

7 Metal and Mining industry
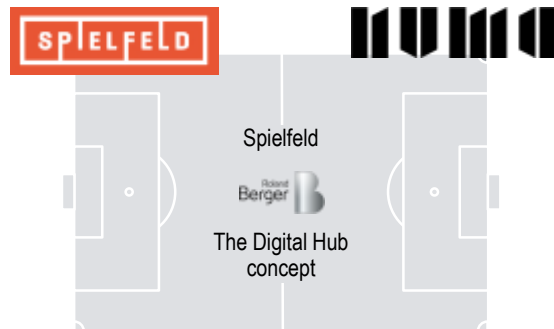
To support Digital Transformation, we have built a unique position and global partnerships that can help you to form your ecosystem

Digitization – Our expertise and knowledge base

Digital hubs

A mixed and interactive workspace of established companies, innovative start-ups, recognized digital leaders and Roland Berger experts

Terra Numerata™
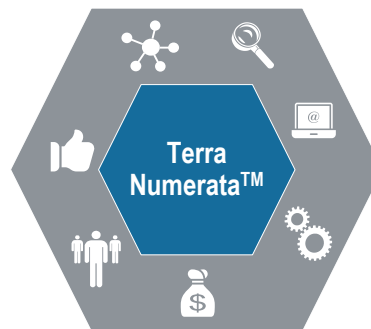
A Roland Berger platform supporting companies in digitalizing their business – Offering access to a full range of services and to selected and complementary leaders within the digital ecosystem

Thought leadership

Comprehensive publishing on the digital transformation and Industrie 4.0, mapping out challenges and opportunities for companies

To identify the latest trends around Industrie 4.0 and medical technology, we continuously conduct research and publish studies

Our commitment to excellence – Selected recent publications [non-exhaustive]

Digital Transformation of Industry
Opportunities and challenges of new business models and structural change requirements

The Industrie 4.0 transition quantified
How the fourth industrial revolution is reshuffling the economic, social and industrial model

Predictive Maintenance
Manufacturers' attitudes towards maintenance are changing. Is the timing right for predictive maintenance in the manufacturing sector?

Skill development for Industrie 4.0
Implications of I4.0 on BRICS countries and their skill development efforts

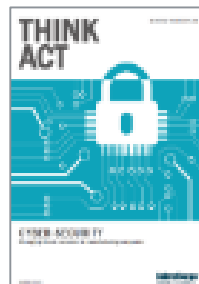**Cybersecurity in manufacturing**
The need to manage cyber threat scenarios as manufacturers drive digital transformation

Operations efficiency radar
Key hot topics and investment themes, e.g. around Robot Process Automation and AI

Business ecosystems
Partnership of equals for corporates, SMEs and startups

Impact of digital economy on organization
Impact of the digital economy on the production and organization of work

Next generation Additive Manufacturing
Technology overview, industry status and market outlook

Trend Compedium 2030
Trend Nr. 5 – Impact of digital transformation on industry sectors and services

A **Brief introduction to Industrie 4.0**

B Project approach

Industrie 4.0 (I 4.0) refers to the digitalization of production, enabling further automation and usage of connectivity, data and AI analytics

Industry 3.0:
Computers and Automation

- Fenced Industrial Robots
- Industrial software (rule based)
- Automation equipment (e.g. conveyors)
- PLC

Industrie 4.0:
Cyber Physical Systems

- Advanced automation & co/self-learning robots
- Integrated/connected value chains
- Aug-mented operators
- Autonomous logistics and material handling
- Data and AI analytics
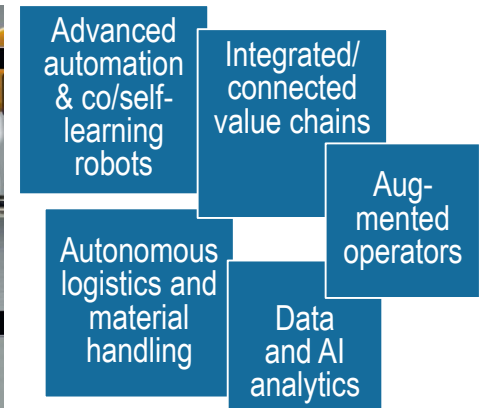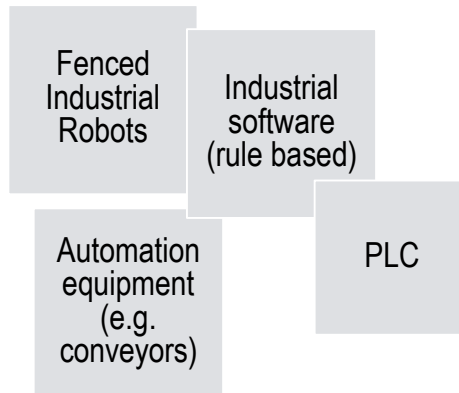
Industry 3.0		Industrie 4.0
> **Replacing manual labor** with automation on a large scale	**Focus**	> Free existing staff from repetitive tasks and use experience for process improvement > Use data to enhance process, products, quality and find new ways of differentiation
Years	**Implementation time**	**Few months** (once the solution is ready)
High	**Add. CAPEX** spending vs. existing equipment	**Low – Medium**

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Mechanization, electrification and computerization influenced our working world radically – Now it's time for the next step!

Development stages of industrial manufacturing

First industrial revolution	**Second industrial revolution**	**Third industrial revolution**	**Fourth industrial revolution**
1.0	2.0	3.0	4.0
1784	**1923**	**1969**	**2014**
Mechanical weaving loom	**Introduction of a "moving" assembly line at Ford Motors**	**First program-mable logic controller (PLC)**	**Real time, self optimizing connected systems**
Introduction of mechanical production assets based on water and steam power	Introduction of mass production based on division of labor and electrical energy	Introduction of electronics and IT for higher automation of production	

Time →

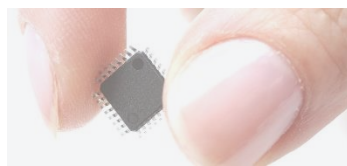# There are five key enablers that form the basis of Industrie 4.0 solutions and support a fast growth

Introduction to key technologies and their latest developments

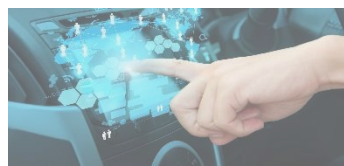| **1** Advanced robotics	**2** Sensors	**3** Connectivity	**4** Computing power	**5** Artificial Intelligence
> Permanent **decrease in price** for robot solutions > Development of **Cobots** for collaborative working **between man and machine** > **Combination** of robots with other I4.0 technologies like **sensors, autonomous vehicles** etc. > Development towards **humanoid robots**	> **Miniaturization** of elements, i.e. higher performance with regard to size, functionality, communication capabilities, battery/energy supply etc. > Usage in **demanding consumer goods applications** like gaming, VR, sports, drones as well as automotive > Usage in **high volume applications** > Continuous **price decrease**	> Continuous **technical performance upgrades**, e.g. 3G, 4G, 5G > Development of l**ow cost applications** (hardware & operations cost) for industrial purposes, e.g. low power wide area networks, short range networks > **IoT, IIoT applications** > Development of **industrial platforms** > Continuous **price decrease**	> Permanent **growth of computing power** towards quantum computing > Easy **access to computing power** in an industrial context via **3rd party services** at low cost > General trend towards **cloud computing** and software as a service (**SaaS**) > **More embedded computing power** in sensors and IoT devices	> Development from today's **deep learning to Artificial General Intelligence** in 10+ years > Automation of standard business processes by **Robot Process Automation** (RPA) > Further use of AI e.g. in **text and voice recognition** for various "service center functionalities" or **data analytics**
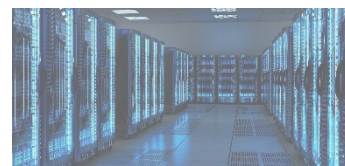
Impact: The rapid development in key technologies combined with falling prices due to economies of scale in other industries enable the use of these technologies as Industrie 4.0 in an industrial, production context

Considerable improvements are possible through I 4.0 initiatives regarding operating efficiency, asset management and safety

Impact of Industrie 4.0 initiatives in manufacturing industries

Illustrative max. effect

Operational levers for the implementation of Industrie 4.0

Operating efficiency improvement ranges [%]

Manufacturing & quality cost	10-20
Logistics cost	10-20
Productivity & labor cost	5-20
Energy cost	20-40
Water usage	Up to 40
Inventory carrying cost	20-50
Overall operating efficiency	5-15
Resource efficiency	Up to 18
EBIT	1-2

Decrease by x%   Increase by x%
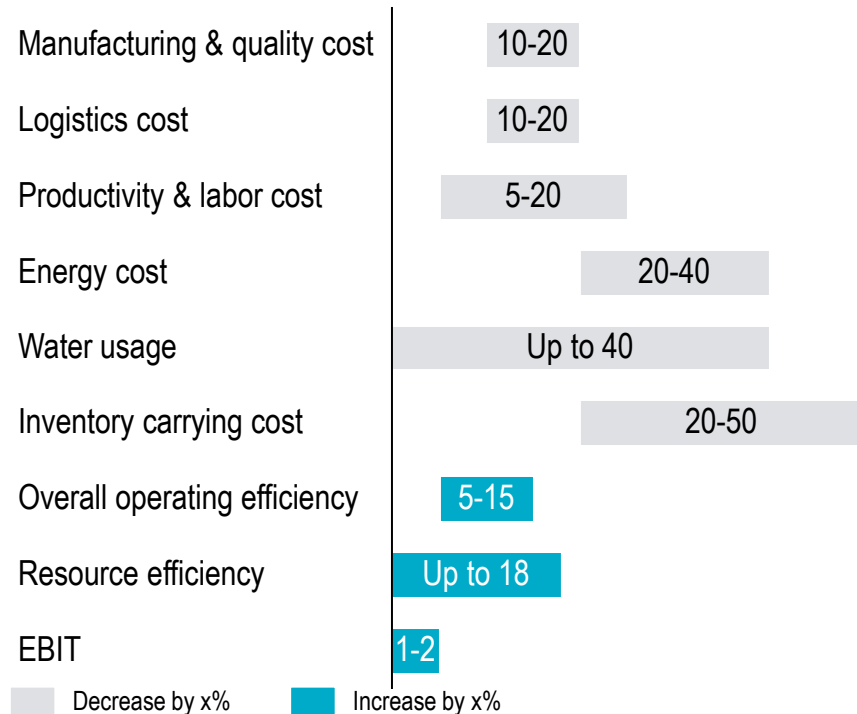
Improvement ranges of asset management [%]

Maintenance cost	10-40
Unplanned downtime	Up to 50

Safety improvement ranges [%]

Safety incidents/ insurance cost	20-50

Revenue improvement ranges [%]

Revenue improvement	Up to 25

Time to market reduction [%]

Time to market	Up to 10%

Our clients are facing similar challenges with regard to I4.0 – We will help you to define your best way towards I4.0 solutions

Key questions about Industrie 4.0

> What potentials does I4.0 offer for my production?

> Are there any low hanging fruits, which can be addressed first by improving the application of lean techniques?

> What is the current status of my production with regard to I4.0?

> With regard to the technical potential of I4.0

– Which technologies are available and have achieved manufacturing readiness?

– What are the emerging technologies that should be addressed in a second step?

> Is it possible to calculate costs and benefits to build a viable business case to justify the investment?

> How do I convince my organization and how do I transform it to make I 4.0 a success? How does a I4.0/digital organization need to look like ? What are best practices ?

> Where are partnerships useful and how do I identify potential partnerships?

Based on our project experience we have developed a proven 2 step approach helping clients along the entire I 4.0 process

Approach (to be tailored to individual client situation)

I. Rapid screening	II. Deep dive	III. Measure definition	IV. Business case	V. Implementation
… to quickly get an overview of the current improvement potential	**… to better understand the status quo**	**… to improve current performance**	**… to estimate the financial impact**	**… to put theory into practice**

I. Rapid screening

… to quickly get an overview of the current improvement potential

Step A: Rapid Plant Assessment (RPA)

> Standardized tool to measure operational performance
> "Simulation" of customer audit

Step B: Industrie 4.0 Factory Audit

I 4.0 Maturity Level

> Framework to assess operational fitness for Industrie 4.0
> Analysis along comprehensive set of six dimensions

II. Deep dive

… to better understand the status quo

> Utilization analysis
> Make-or-buy and core competence analysis
> Material flow assessment
> Review of corporate LEAN activities
> Value stream mapping
> Layout analysis
> Equipment state
> Warehouse analysis
> Function analysis
> OTD study
> Investment strategy
> Product roadmap
> …

III. Measure definition

… to improve current performance

> LEAN initiative
> Portfolio optimization
> Material flow optimization
> Software integration/MES systems
> …

… to implement I 4.0 production

> Warehouse/logistic robots
> Wearables, safety devices
> Predictive maintenance
> Automated high-runner line
> I4.0 Organization
> ….

Improved operating model

IV. Business case

… to estimate the financial impact

As-is   Step A   Step B   To-Be

Quantification of the identified measures in terms of **impact on revenue, cost and profitability**

V. Implementation

… to put theory into practice

> Transformation
> Change management/Project Management
> Supplier and partner selection
> Set-up and build-up of I 4.0 organization
> …

| Overview of current performance regarding operations and I 4.0	Thorough understanding needed to define measures	Definition of detailed use cases	Specific action plan with estimation of financial impact	Emphasize lean focus & implement I 4.0 technologies on shop floor

To get an overview of current operational performance, we first conduct the Rapid Plant Assessment as standard analysis tool

Rapid Plant Assessment (RPA) – Approach

Sources of information

Client information
> Information supplied by the client (floorplans, maintenance, utilization data etc.)
> Standardized data request prior to project start to make efficient use of project time
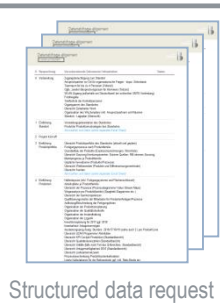
Structured data request

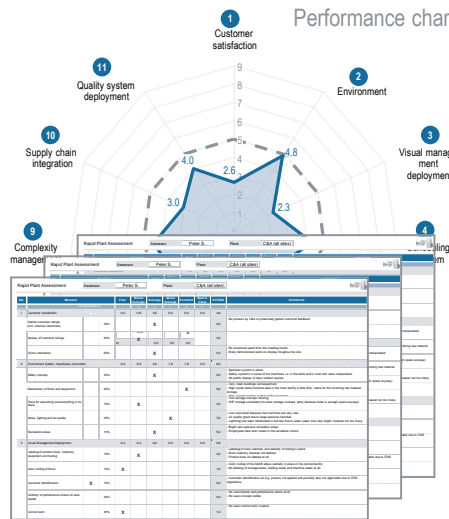» **Screening of available documentation supplied by the client**

Information gained during plant visits
> Operations assessment during shop floor tours
> Expert sessions on operations

» **Visual impressions from customer perspective**

Rapid Plant Assessment

Performance chart

Standardized scorecard

> Standardized analysis tool for the rapid and comprehensive assessment of operational plant performance
> The RPA reflects the impression of a client during a factory tour and evaluates strengths and weaknesses
> Results are evaluated using industry benchmarks

Industry benchmarks

Automotive · Medical · Tooling manuf. · Long lifecycle products · Plant engineering · Aerospace

Engineered products clients

Potential areas for further investigation (exemplary)

Utilization analysis

Make or buy analysis
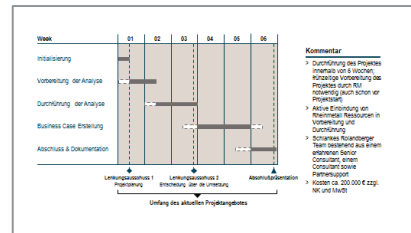
Review of Lean activities

Material flow assessment

> RPA identifies areas for further deep-dive analysis of operational performance and related company issues
> Efficient deep dives due to early availability and analysis of data (data request) and insights from shop floor visit

The RPA is highly standardized and scalable across networks – close cooperation and feedback to local production teams

Rapid Plant Assessment (RPA) – Details

Standardized approach for rapid assessments across multiple sites/plants

Upfront data request

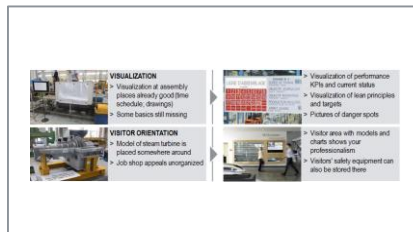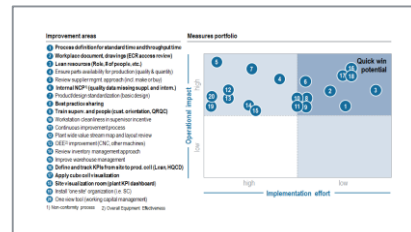Upfront planning of audits, inter-views, feedback meetings etc.

Standardized weekly plan across sites
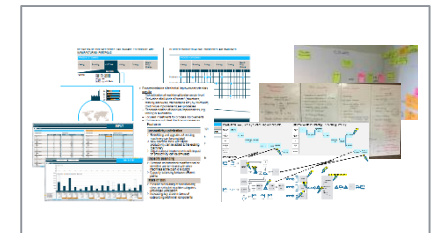
Proven tools for deep dives

Definition of measures and detailed feedback
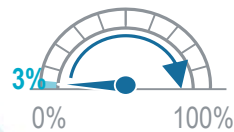
Prioritization

Tracking of financial effects

Global network of RB experts available

The I 4.0 factory audit provides an overview of Industrie 4.0 potential along six dimensions - Focusing on equipment, processes and IT

Industrie 4.0 Factory Audit – Overview on dimensions

**Customer interaction** — 3% (0% – 100%)

Does the company leverage external partners for open innovation and is the customer granted access to real-time production data?

Production planning and controlling — 0% (0% – 100%)

Is production data captured, analyzed and used for real-time yield optimization and does this have any implications for the company's production network?

Machine equipment state — 0% (0% – 100%)
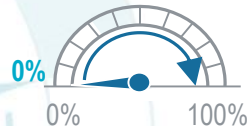
Is the production system agile, interlinked with flexible automation solutions and a "smart device" in itself (e.g. autonomous process optimization)?

Software integration — 22% (0% – 100%)

Is the production process simulated and controlled by a fully integrated software solution that enables the customers to release work orders themselves?

Man-machine interaction — 11% (0% – 100%)
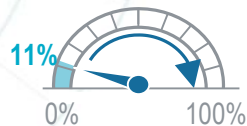
Are employees supported by advanced machine interfaces (e.g. augmented reality) and do they work in close collaboration with robots (cobotics)?

Resource and inventory management — 0% (0% – 100%)

Can each individual product be traced on the shop floor and are the transport processes performed by autonomous, self-driving vehicles?

> Assessment of Industry 4.0 potential along six dimensions
> Focus on equipment, processes and IT
> Combination with RPA highly recommended – Stable and well managed operations required for I 4.0 solutions to unfold full potential
> Standardized questionnaire with 19 items to be discussed during workshops with the client's local team in expert sessions (Production, IT, Sales, Procurement, Strategy) etc.

The Industrie 4.0 readiness of 'client plant A' is low – Typical score in engineered products and several improvement actions defined

Summary results Industrie 4.0 audit

Comments
> Open innovation culture and digital hub missing (strong link with Industrie 4.0 Team)
> No Industrie 4.0 Team on corporate level and no team on plant level
> IT architecture with many different systems and media breaks including three different ERP systems
> In general missing standards, multiple divisions on site with own technical infrastructure (i.e. visual management with three different training matrices
> No or limited best practices sharing within site and between sites
> No established shop floor KPI system -> Data detail level missing (i.e. non conformity costs only on plant level, no in or output in real time)
> MES[1] as backbone is missing on many manufacturing lines
> Automatic consolidation of KPIs on one screen not available (MES would deliver data, especially OEE[2])
> Link to CAD and PLM systems is missing

1) Manufacturing Execution System 2) Overall Equipment Effectiveness

Roland Berger

During the deep dive we identify client specific I4.0 solutions and measures along value chain and detailed process maps

Technical deep dive

Integrated process map

Each process step is checked for Industrie 4.0 applicability

Derive Industrie 4.0 opportunity long-list
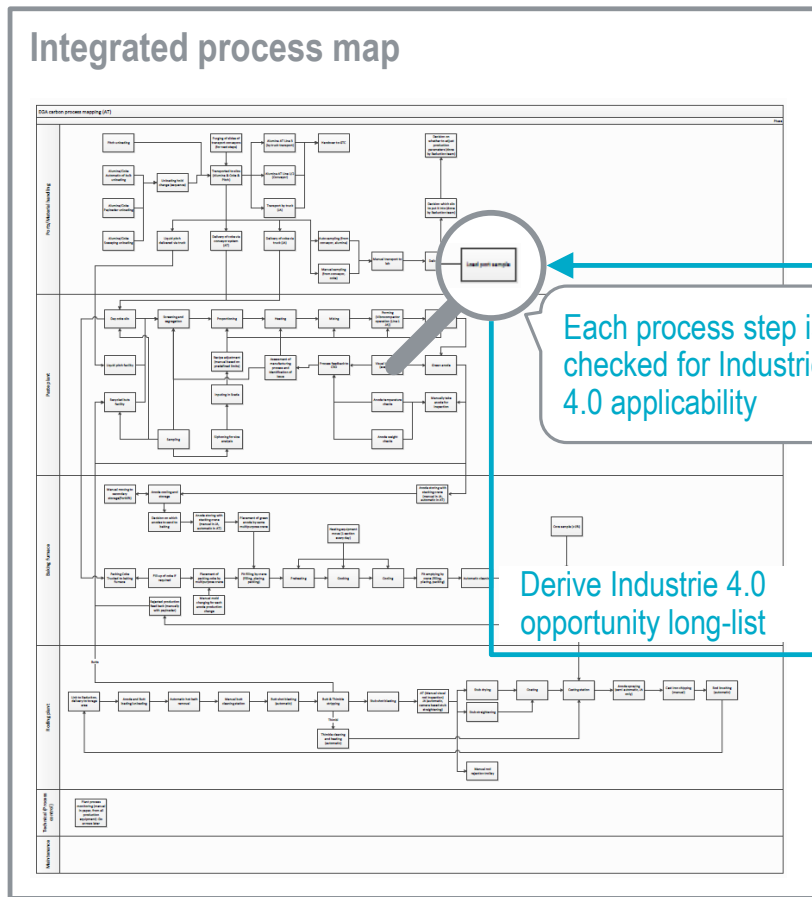
Industrie 4.0 know-ledge data-base

Advanced automation

Logistics / Material handling

Augmented operators

Connectivity & Communic.

Big Data & AI analytics

On-side assessment of RB technical experts

Industrie 4.0 solution long-list

Industrrie 4.0 solution cluster	Area	Sub Area	Solution class/Enabler	Industrie 4.0 solution description	Category	Time to market	Brown-field	Green-field
Solution 1	Reduction	Sub Area	Industrie 4.0	Solution description 1	Connectivity	immediate	yes	yes
Solution 2	Reduction	Sub Area	Enabler	Solution description 2	Advanced automation	immediate	no	yes
Solution 3	Casthouse	Sub Area	Industrie 4.0	Solution description 3	Augmented operator	2-3 years	no	yes
Solution 4	Casthouse	Sub Area	Industrie 4.0	Solution description 4	Big Data analytics	4-5 years	yes	yes

> In several iterative workshops, we generated >250 ideas
> Key representatives of the respective areas participated in the meetings

The I 4.0 audit findings and the RPA are combined to select suitable I 4.0 solutions and design the future operating model

Industrie 4.0 Factory Audit – Measure definition

Exemplary (project example)

Step A: Rapid Plant Assessment

Operational performance along classic dimensions – Prerequisite for successful I 4.0 transformation

Step B: Industrie 4.0 Factory audit
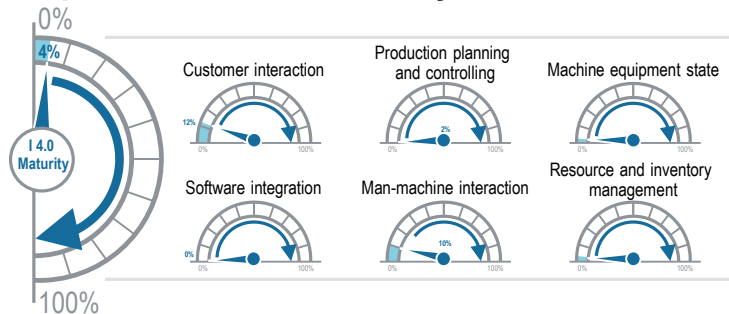
I 4.0 readiness and improvement potential by using I 4.0 solutions

Selection of suitable Industrie 4.0 solutions

Potential solutions   High relevance for client

Self-reconfiguring machines · Cobotics
Demand driven provision of material and tools
Autonomous pick and place robots
Equipment monitoring with brownfield solutions
Automated modular assembly stations
Demand-response energy management systems
Rapid investment casting using 3D-printing technology
Mobile device based machine control
Smart versatile robots for work piece handling
Self-learning robots
Exoskeletons for enhanced operators
Digital twin of production for simulation and optimization
Smart storage bins for small part replenishment
Industrial image processing for visual inspection
Smart products
Augmented Reality
Augmented assembly stations
Intelligent molds with cloud based remote surveillance · Intelligent transport robots

Computing Hardware · **Production Hardware** · **Connectivity** · **Software** · **Interfaces**

Technology screening of suitable I 4.0 solutions from RB-knowledgebase, desk research and expert interviews

During the projects, we assess our client's value chain for Industrie 4.0 potential along the RB assessment framework

Approach detailing and value chain examples

Profound understanding of our clients business as basis for successful application of the Roland Berger Industrie 4.0 potential assessment framework

1 Adv. automation & robotics

2 Logistics and material handling

3 Augmented operator

4 Connectivity & communication

5 Data and AI analytics

6 Robot Process Automation & AI for business processes
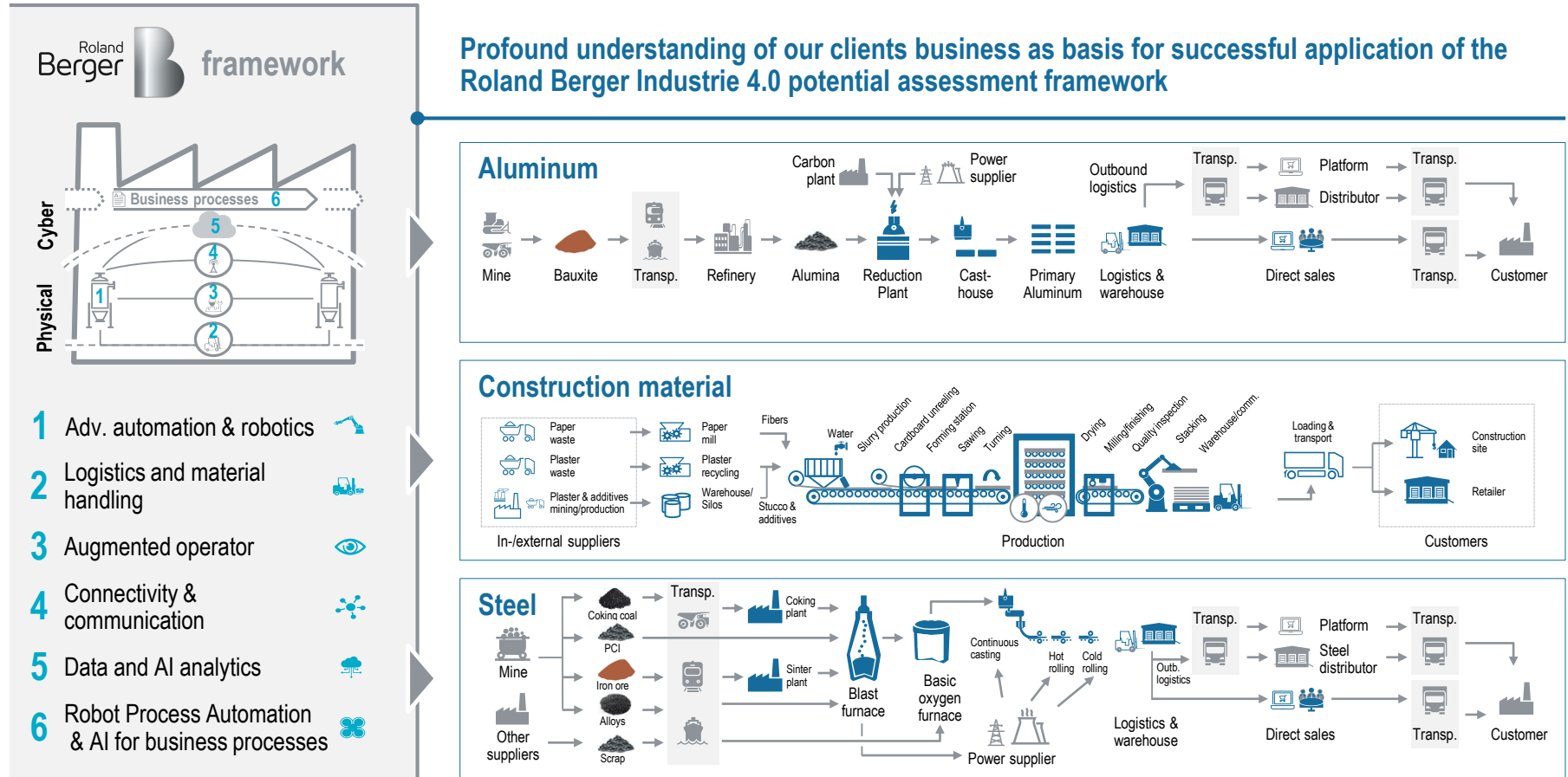
Ideas are described, technically and financially detailed and following prioritized according to a strict logic

Measure definition and prioritization – Example

Definition of hardware solutions

Hardware solution 4

Hardware solution 3

Hardware solution 2

Automated tapping

> Crane to perform tapping autonomously

> Sensor applica-tions to ensure tapping of exact amount without bath intake

Prioritization logic

High-level I4.0 solution assessment

Feasibility
> Technology maturity
> Fit with existing processes
> Potential to develop necessary skillset
> Expected costs

Impact
> Financial impact
  – …
> EHS
  – …

Clustering of ideas

Financial impact

Health, safety & environment

Prioritization of clusters

Solutions only, enablers mapped separately

Detailing & qualification

Implementation planning

Definition of time frame and general organi-zational requirements

Detailed technical assessment

Detailed planning and project launch

Industrie 4.0 clusters

Supplier assessment and prioritization

Detailed business case aligned with finance

>250 Industrie 4.0 solutions

~50 solution cluster

~20 solution cluster

We identified and categorized solution suppliers along the Roland Berger Industrie 4.0 assessment framework

Overview of solution suppliers

Non-exhaustive

1 **Adv. automation & robotics**

SMS group   ABB   KUKA   rethink robotics   FANUC

2 **Logistics and material handling**

CATERPILLAR   NKM NOELL   DEMAG Cranes & Components   TECHMO   SEEGRID
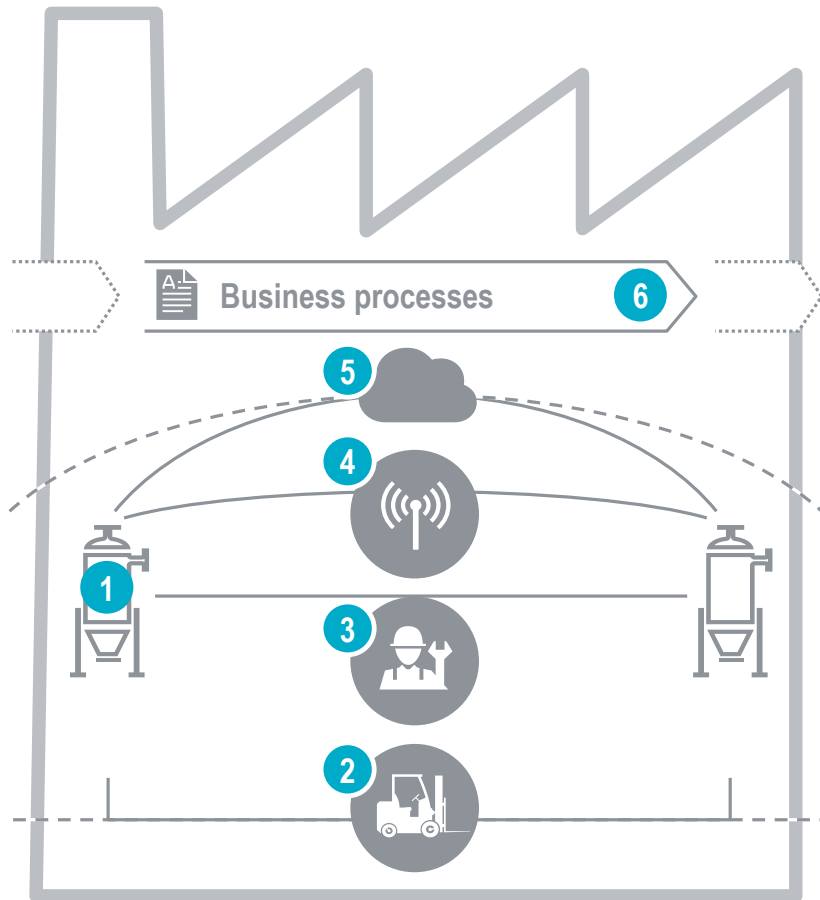
3 **Augmented operator**

INFORMANTIS   CYBERDYNE   Robot of Everything   PROGLOVE

4 **Connectivity & communication**

sigfox   QUALCOMM   ERICSSON   libelium   red lion

5 **Data and AI analytics**

GE Predix | GE Digital   Schneider Electric   SIEMENS   DATATRONIC CASSANTEC   QuinLogic

6 **RPA & AI for business processes**

blueprism   UiPath   FourNet   solv.ai   mya   HireVue

Business processes **6**

5

4

1   **3**

2

A comprehensive technology screening needs to be conducted to identify solutions with the highest improvement potential & feasibility

Screening of suitable Industrie 4.0 solutions

Exemplary (project example)

ProGlove uses an integrated scanner, connectivity and motion sensors to improve and facilitate material tracking and handling

Use case – Intelligent wearables

PROGLOVE

Today

Mark.

1D & 2D Barcodes
Datamatrix, Code128, QR, ITF, Aztec ...

Wireless Connection
Frequency 868 MHz
> 30 m distance

USB (HID / CDC)

RS232 + power supply (12V)

Plug-and-Play
Connect to terminal, IPC, tablet ...

- Automated barcode scanning
- Sequence compliance
- Motion tracking
- 100% documentation

User application

BMW | Saving per scan ✖ Scans per car ✖ Cars per day ≡ **Total saving** per day
| 4 secs | 1000 scans | 1000 cars | **~1111 hours**

Impact

$ **CapEx**   EUR 1000 /glove

> Product in pilote stage
> Enhanced ergonomics – picking and scanning of goods with both hands
> Motion-tracking to ensure process compliance
> Tracking and tracing at almost no documentation costs
> Tracking of users vitals

> Suitable Industrie 4.0 solutions are selected using desk research, past project experience and expert interviews
> Consideration of technological fit with the client's operating model, project & machine portfolio, capabili-ties and financial boundary condi-tions
> Evaluation of CapEx and financial upsides

Based on an I4.0 vision a long term strategic roadmap needs to be developed – example mining industry

|	Traditional mine	Automated mine		Autonomous mine		Self sufficient mine
Advanced automation & robotics	Traditional processing equipment (e.g. beneficiation, crusher)	Automated processing equipment		Autonomous process execution and modification	**Worker-less mine**	**Autonomous mine planning, operation and design**
Logistics and material handling	Traditional logistic & handling equipment (e.g. trucks & conveyer belt)	Semi-automated logistics		Autonomous logistics		
Augmented operator		Enhanced operator		Augmented operator		
Connectivity and communication	Radio	4G	LPWAN	5G	**Digital twin**	
	Traditional sensors	Digital sensors	Data analytics	Self-sufficient sensors		
Big Data	Visibility / Basic transparency	Supervised learning		Unsupervised learning		
Artificial Intelligence						
Energy	Diesel / Power grid	Diesel & LNG / Power grid / Electrification		LNG / Renewable energy / Electrification	**Eco mine**	
Procurement	Catalogues and standardization	Autonomous procurement		Autonomous produce to quality system, end to end		
Commercial	Traditional sales	Autonomous commercial planning				

Industrie 3.0   **Industrie 4.0**

Together with our clients we identified digital opportunities for technical improvements, process optimization and new business models

Examples for project illustrations – vision development
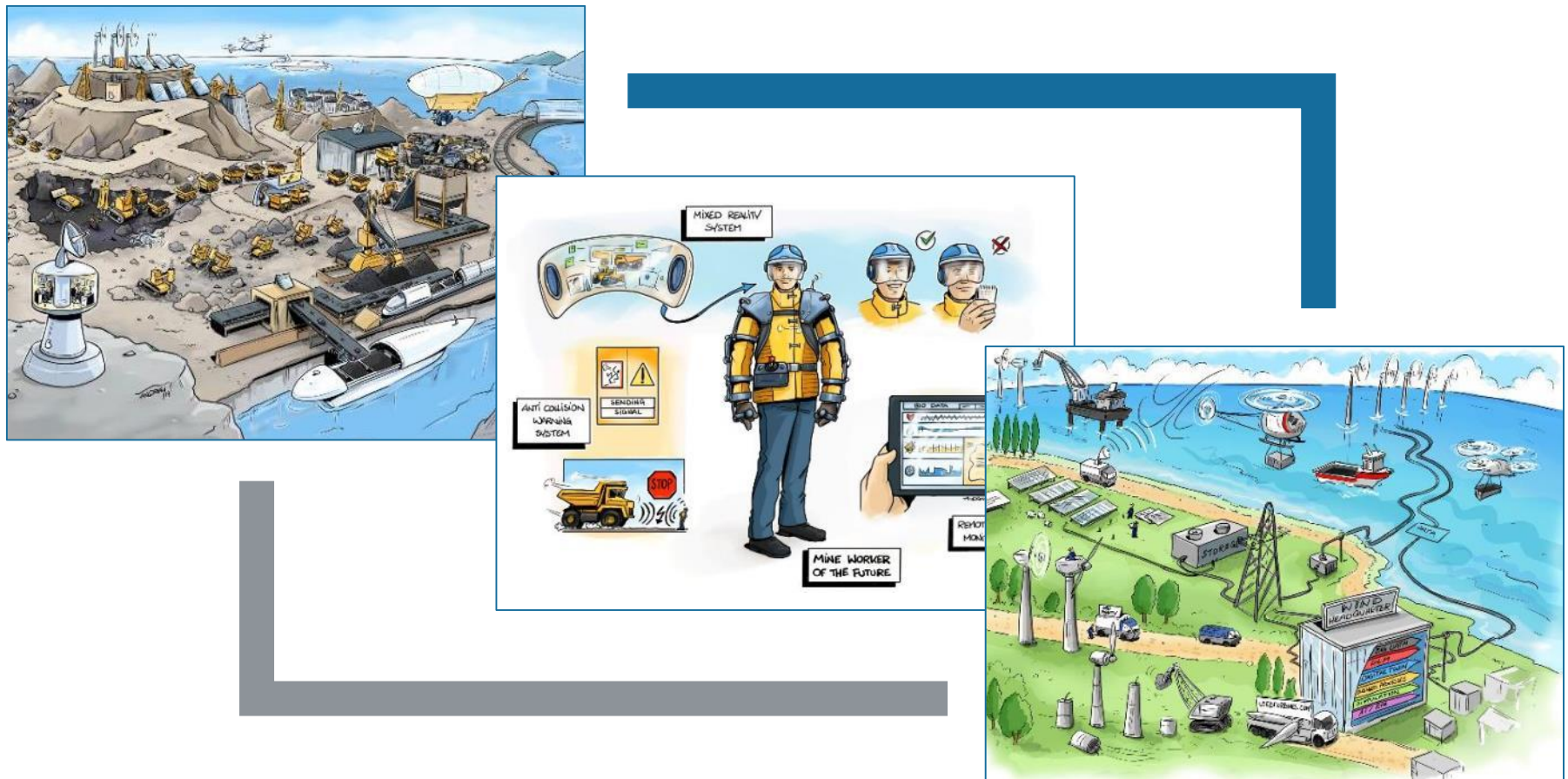
To assure a successful I4.0 roll out as well the capabilities of the internal organization need be considered and developed

Measure definition – I4.0 organization

Identification of capability gaps
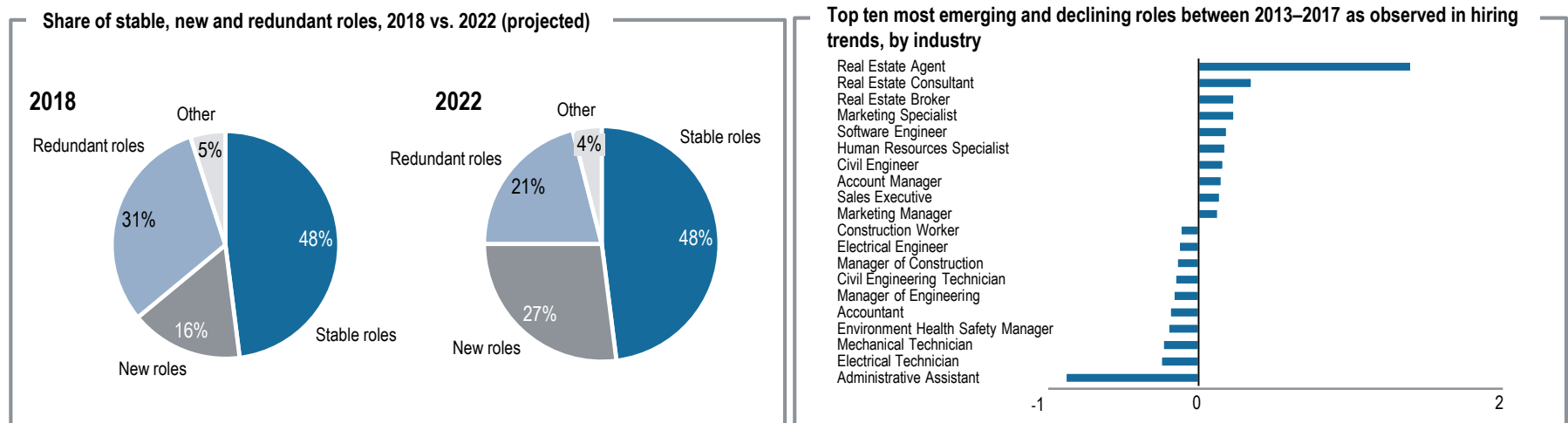

Potential improvements needs

⚡ Operators' capabilities
> e.g. Digital literacy

⚡ Shop floor readiness
> e.g. Connectivity-readiness

⚡ Industrial software & planning
> e.g. Flexibility of operations planning

⚡ Data mgmt., infrastructure & gov.
> e.g. Data infrastructure & scalability

⚡ Data analytics
> e.g. Big Data processing

⚡ Organization & processes
> e.g. Agile innovation culture

Archetypes and benchmark for I4.0 organization

1 Archetype "Embedded"   2/15

2 Archetype "Scattered"   1/15

Corporate   CEO

Local

Description **No dedicated digital staff/ activities nor organizational unit,** digital initiatives executed by same teams as other initiatives

Digital specialists distributed across business units and functions in organization with no central digital unit

3 Archetype "Centralized"   5/15

4 Archetype "Hybrid"   7/15

Corporate   CEO   CEO
            CDO   CDO

Local

Description **Dedicated Digital Unit** responsible end-to-end for digital initiatives

Central competence center supporting local teams in defining and executing digital activities

A new holistic strategy linking business and HR is needed, since the implementation of Industrie 4.0 will strongly influence the workforce

Impact of Industrie 4.0 on labour

Share of stable, new and redundant roles, 2018 vs. 2022 (projected)

2018
- Other 5%
- Redundant roles 31%
- New roles 16%
- Stable roles 48%

2022
- Other 4%
- Redundant roles 21%
- New roles 27%
- Stable roles 48%

Top ten most emerging and declining roles between 2013–2017 as observed in hiring trends, by industry

- Real Estate Agent
- Real Estate Consultant
- Real Estate Broker
- Marketing Specialist
- Software Engineer
- Human Resources Specialist
- Civil Engineer
- Account Manager
- Sales Executive
- Marketing Manager
- Construction Worker
- Electrical Engineer
- Manager of Construction
- Civil Engineering Technician
- Manager of Engineering
- Accountant
- Environment Health Safety Manager
- Mechanical Technician
- Electrical Technician
- Administrative Assistant

(scale: -1 to 0 to 2)

Industrie 4.0 will change how people work. At Roland Berger, we do not only provide the technological Industrie 4.0 know-how, we also develop **a holistic strategy** coping with changes directly affecting your companies **most crucial asset – the employees**

Organisation
> Establish strong link between business and HR strategy
> Create awareness of top management and define project ownership (e.g. CDO)
> Develop more agile, less hierarchical organization, to be able to react fast to a changing job environment

Retraining and redeployment
> Involve workers and unions right from the beginning in the planning and implementation of Industrie 4.0
> Early identify skill mismatch of employees to their current position and prepare retraining
> Redeploy employees working in redundant roles
> Release employees when tasks can be automated more efficiently and no retraining and redeployment possible

Recruiting
> Accelerate deployment of automation, data analytics and AI by talent acquisition or source externally
> Identify partner institutions (e.g. universities, institutes) for training, knowledge sourcing and recruiting

Based on our project experience we see the following Key Success Factors (hard and soft skills) for Industrie 4.0 implementation

Key Success Factors

Vision and top down targets:
Definition of a clear vision and quantitative goals for the program

Continuous process for bottom-up idea generation and detailing:
Detailing of ideas by operative experts in cross-functional teams (e.g. involving maintenance, IT, operations, process control, …)

Program governance and execution organization:
Strong and skilled implementation team, anchored within the organization with management access to production sites and enabling best-practice transfer across the entire organization

Prioritization and focus:
Prioritization of most promising solutions with qualitative assessments and high level business cases. Execution of high value, medium effort initiatives, if possible quick wins executed via the lean organization

Solution infrastructure and house:
Link all ideas into a "solution architecture" building upon technological enablers which are pushed step by step across the whole organization following an integrated roadmap

Continuous support from top-management and stakeholder alignment:
Continuous involvement in program by participating in regular SteerCos and prioritizing program/ assigning necessary resources from the business side. Stakeholders are aligned in increasing the value for the company

Active learning from failures:
Creating a "fail fast" culture in which people are encouraged to learn from mistakes and are constantly challenging themselves to further improve
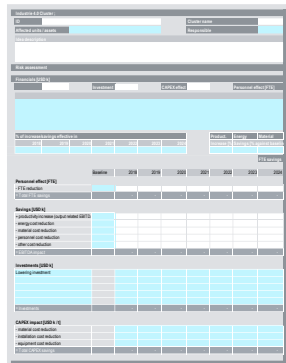
As basis for decision-making, detailed business cases are developed and typically show strong benefits and impact of I4.0 solutions

Overview of business cases calculated
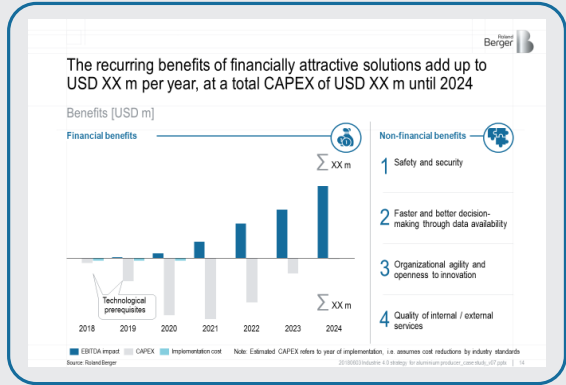
Illustrative project example

Excel template

Business cases for short-listed solution clusters

Benefits and cost ramp-up

The recurring benefits of financially attractive solutions add up to USD XX m per year, at a total CAPEX of USD XX m until 2024

Roland Berger standardized Excel for business case calculation

For each of the Industrie 4.0 solutions we calculated high-level business cases showing benefits and costs of implementation

Impact estimation for continuous anode testing

> Assumptions were sanitized

Payback time of X years

Non-financial benefits include
> Safety and security
> Data-based decision making
> Orga. agility & innovation openness
> Higher service quality

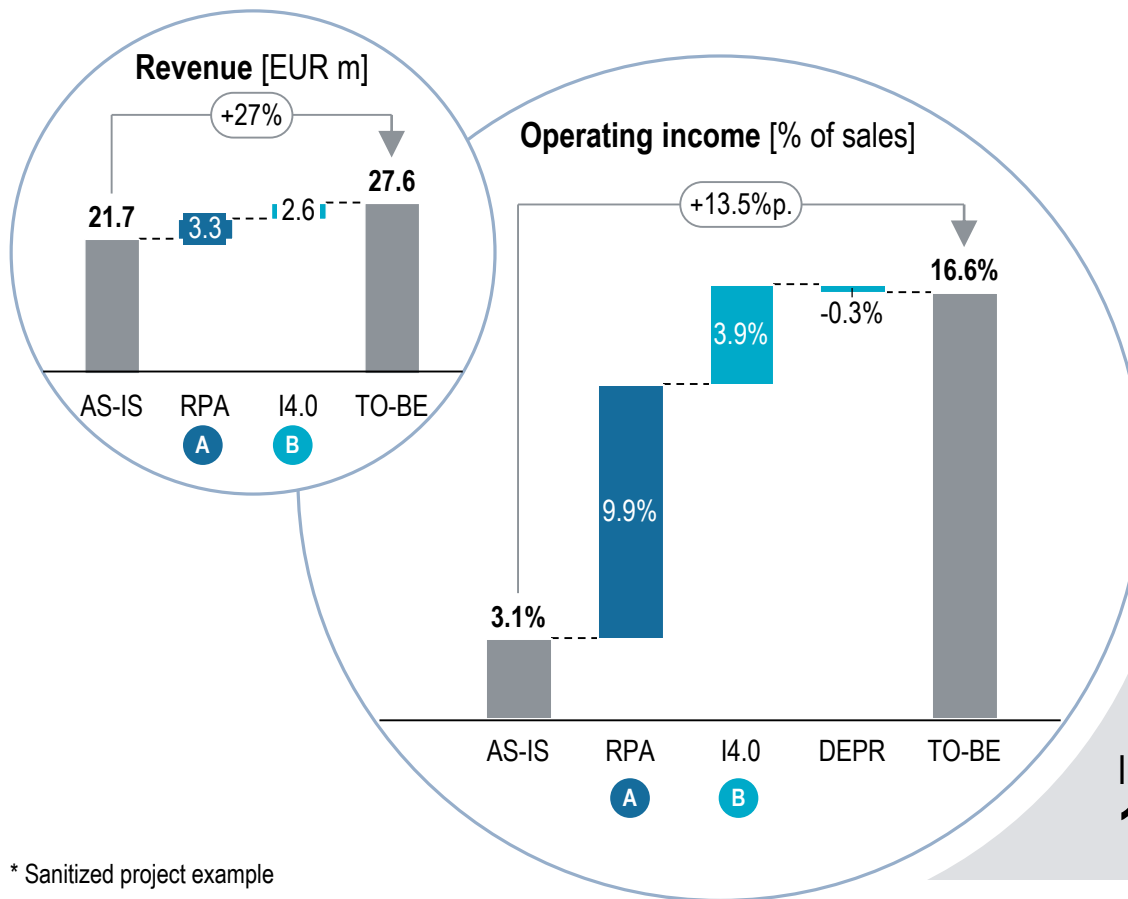**Project impact: Additional improvements by I4.0**

| **Triple digit million USD OPEX** savings p.a. | **CAPEX** reduction for multi-billion dollar investments | **15-25% FTE** reduction for prioritized business processes |

The final business cases summarizes the impacts of Step 1 and 2 and reveals often significant savings in bothe areas

Overall improvement potential

Indicative project example*

Revenue [EUR m]

+27%

21.7   3.3   2.6   **27.6**

AS-IS   RPA (A)   I4.0 (B)   TO-BE

Operating income [% of sales]

+13.5%p.

16.6%

3.9%   -0.3%

9.9%

3.1%

AS-IS   RPA (A)   I4.0 (B)   DEPR   TO-BE

Step A: **Rapid Plant Assessment**

Rapid Plant Assessment (RPA) reveals several operational inefficiencies that can be eliminated with the help of targeted improvement measures

Revenue potential of 15-20% expected in optimized setup

Step B: **Industrie 4.0 Factory Audit**

Industrie 4.0 Factory Audit shows a very low maturity level– selected solutions proposed for implementation in proposed new operating model

Revenue potential of ~12% expected in new operating model

Revenue growth potential of **27%** identified

Improved operating income of **14%p.** expected

* Sanitized project example

Our approach navigates through strategic and methodological challenges to ensure the sustainability of the digital transformation

There is a high failure rate in digital transformations…

70% failure rate in corporate transformation approaches, due to **strategic and methodological issues**[1].

According to a **VDMA study 73%** of the companies are **dissatisfied with their digital progress**

Key success factor is the combination of business knowledge, technical know how and soft skills!
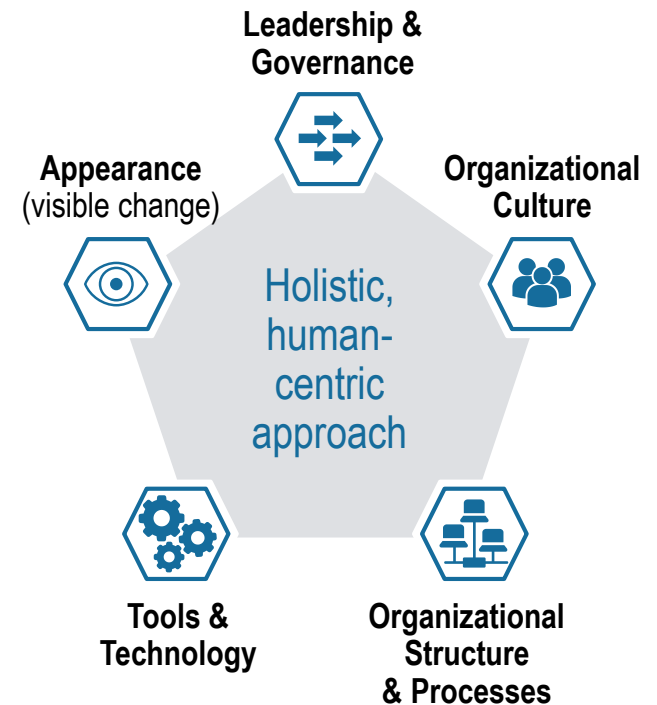
…due to a multitude of challenges…

Strategic challenges

> Lack of consensus on what digital transformation means
> Lack of executive sponsorship
> Incomplete focus
> Missing KPIs and risk management
> Change resistance of top-management
> Lack of investments

Methodological challenges

> Lack of continuity to change behavior significantly
> Lack of knowledge and purpose to persuade employees
> Inefficient training methods

…thus, our approach combines counter measures to succeed

Leadership & Governance

Appearance (visible change)

Organizational Culture

Holistic, human-centric approach

Tools & Technology

Organizational Structure & Processes

1) Source: Dikert et al (2016): Challenges and success factors for large-scale agile transformations: A systematic literature review; Roland Berger

75% of VDMA members acknowledge the importance of digitalization while 73% are dissatisfied with their own progress

Study together with Verband Deutscher Maschinen- & Anlagenbau (VDMA)

October 2018

Understanding the ten most important barriers to digitalization

VDMA + Roland Berger
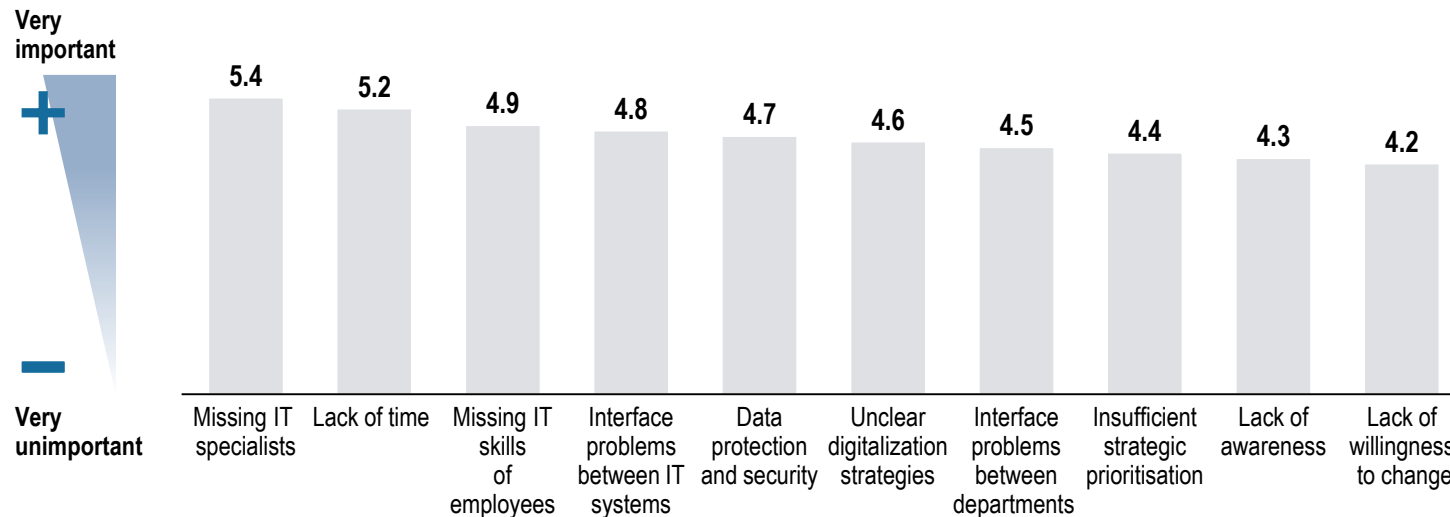
Of the VDMA member companies...

75%
…say that digitalization is very important

73%
..are not satisfied with their activities in digitalization

!

Additional problems are…

> Full order books due to good current business situation
> Challenges in adapting to new business models

Very important
+

—

Very unimportant

Barrier	Score
Missing IT specialists	5.4
Lack of time	5.2
Missing IT skills of employees	4.9
Interface problems between IT systems	4.8
Data protection and security	4.7
Unclear digitalization strategies	4.6
Interface problems between departments	4.5
Insufficient strategic prioritisation	4.4
Lack of awareness	4.3
Lack of willingness to change	4.2

Summary

> Missing IT skills and specialist talent as well as resource constraints are the largest barriers to implement digitali-zation initiatives

> Increased coopera-tion with start-ups, universities and companies from other industries required

> Vision of top-management seen as important prerequisite to inspire and lead the middle management

Our proven approach addresses holistically all leavers in production and helps to focus on the most relevant measures

The Value Add of consulting in I4.0

✓ Our approach equally focuses on **lean as well as I4.0 improvements** and points out the improvements with the **highest return of investment**

✓ The approach "**Rapid Plant Assessment**" and "**Industrie 4.0 Factory Audit**" are **proven, ready to use tools**, which have been used and optimized over a **large number of projects** and therefore allow **benchmarking** and comparison to **best practices** in other industries. The approach is **fully scalable** and has often been used in projects across **entire manufacturing networks.**
Our results are ready for implementation and often become part of the managment objectives.

✓ We can support I4.0 projects on a **global level with internal and external experts**. We have access to a wide network of experts from **academia, industry, associations, governmental institutions** etc.

✓ With **Spielfeld**, Roland Berger's innovation hub, and our partners we can offer **digital innovation support** with regard to **business models** and offer access to **hard- and software solutions**

Please contact us if you have any further questions

Dr. Bernhard Langefeld

Partner Industrial Products & Services

OpernTurm, Bockenheimer Landstraße 2-8

D-60306 Frankfurt

Tel.: +49 160 744 6143

bernhard.langefeld@rolandberger.com