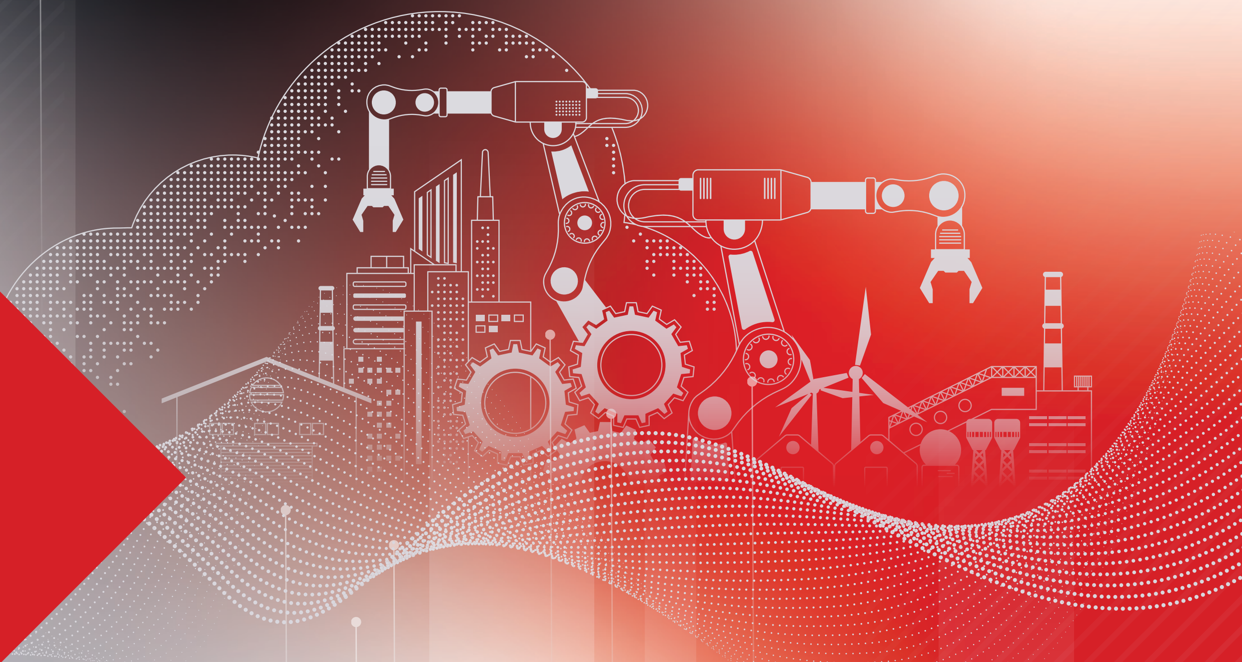
Operations



Smart Factory. High tech, higher challenge?

How to shape a successful transformation and avoid major pitfalls

Porsche Consulting

Strategic Vision. Smart Implementation.

INSIGHTS

//01

96 percent of all companies have embarked on their smart factory transformation. But only 8 percent have fully met their expected targets.

//02

Implementing a smart factory can result in a 15–20 percent reduction in factory costs as well as improvements in flexibility, sustainability and employee attractiveness.

//03

Eight common pitfalls must be avoided in order to make smart factory transformations a success.

CONTENT

TRANS FORMATION

towards a smart factory

This paper serves as blueprint for decision-makers in operations. It helps to set up and steer a holistic smart factory transformation with the goal of increasing the overall performance of factory operations by tackling eight major pitfalls.

All too often, the discussion about Industry 4.0 and smart factories focuses only on the dimension of automation of physical processes and leaves employees with the fear of dark factories and job loss. This limited view is neither exhaustive nor does it account for the growing possibilities of collaboration between humans and technology in factory operations. The automotive industry has been able to achieve substantial productivity gains through the automation of manufacturing and logistics processes. However, even though the technical capabilities are increasing, reality shows that there are economic and functional limits to the implementation of automation technology and industrial robotics, at least in the medium term. In addition to high initial investment costs, the economic limits are also set by high follow-up costs, i.e., adoption of automated processes, production line rearrangement, and ongoing supportability. The functional limits often result from a lack of flexibility, system availability, and reliability.

The real lever for achieving the next big leap in performance in factory operations is digitalization, i.e., the automation of information processing. To reach a perfect mix of human and technical capabilities should be the focus when designing a smart factory. This will create a strong collective intelligence along the human and robotic participants of the value chain.

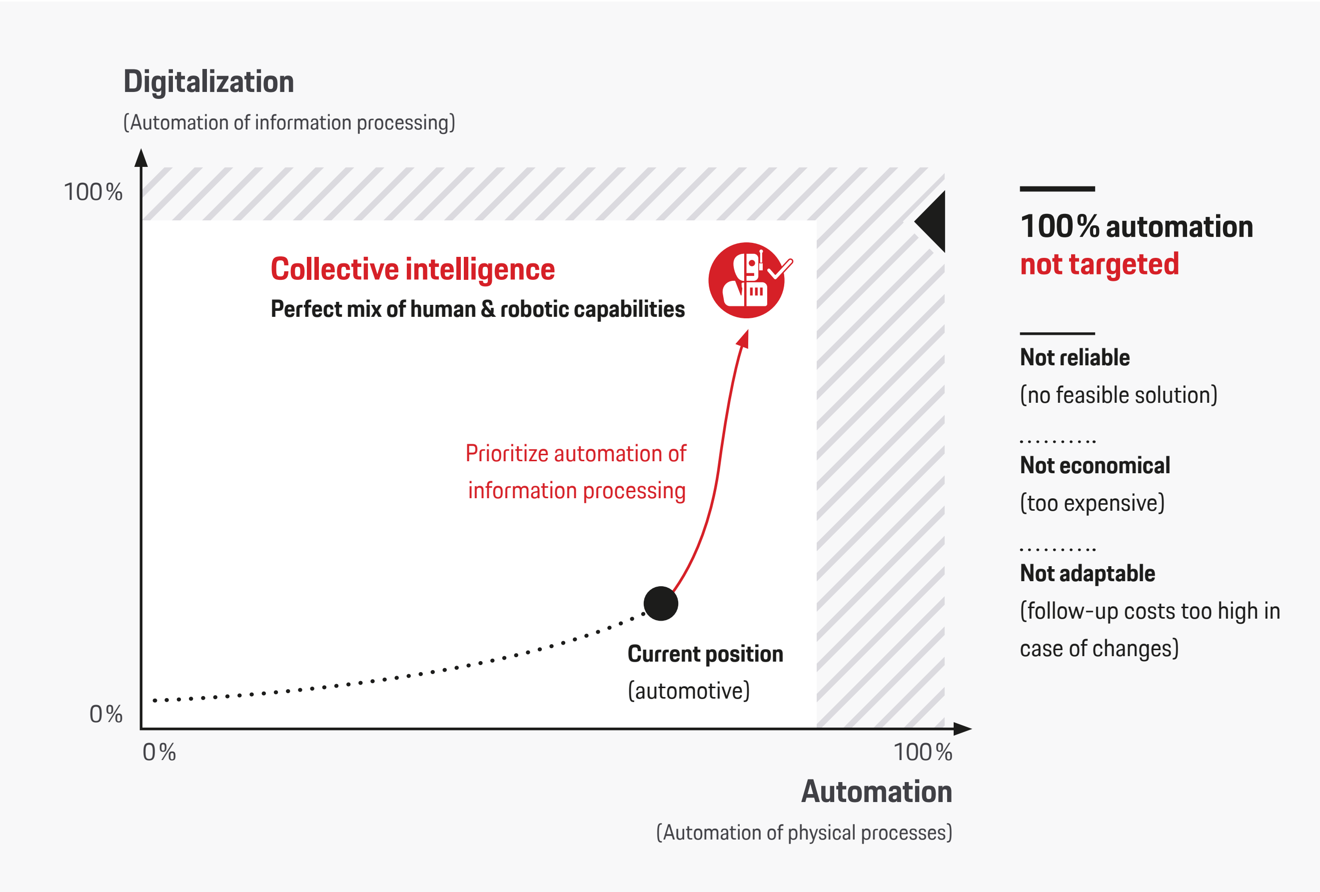


Fig. 1. Smart factory focuses on the perfect mix of automation and digitalization.

Porsche Consulting's global cross-industry survey* shows, that 96 percent of the participating companies have set out on the path to smart factory transformation by planning and designing solutions. However, only a few of them have achieved the desired impact, and the reason for this lack of success is mostly due to internal challenges. Furthermore, supply chain disruptions, the semiconductor crisis, the Covid-19 pandemic, and regional conflicts currently focus increased efforts on maintaining standard operations and delivery capability. These external influences reveal the value and need for information transparency in factories as well as the end-to-end value stream, further motivating the need for smart factory transformations to better manage similar situations in the future. But as the survey also reveals, smart factories must go beyond digitalization and have to contribute to mastering multiple challenges. Some challenges that can currently be seen across all industries are:

- increasing deglobalization calls for more efficiency in high-cost countries
- frequent product launches requiring flexible and adjustable processes
- skilled labor shortages forcing companies to create attractive work environments in order to succeed in the war of talent across all job types, and lastly
- society, politics, and customers requiring companies to make progress in line with ESG criteria towards sustainable production through efficient and circular use of resources.

OPERATING SYSTEM FOR FUTURE FACTORIES

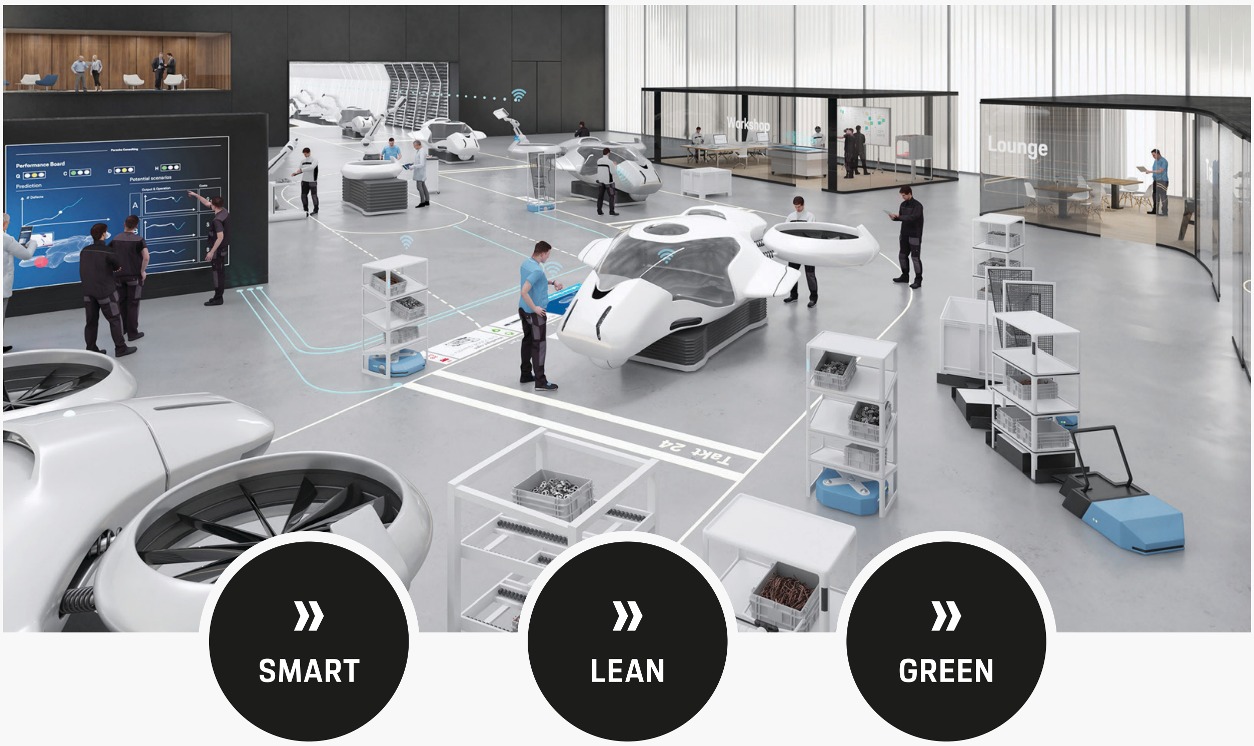


Fig. 2. Vision for smart factories: smart, lean, and green.

* Porsche Consulting's insights presented in this document were created from a survey conducted between May and October 2022 with participation of 48 industry top managers. The detailed methodology of the survey is attached in the appendix.

In line with this comprehensive understanding and aspiration for the next leap in the performance of factory operations, Porsche Consulting manifested the understanding of the fundamental paradigm shift and smart factory principles early on in a vision picture as the North Star for the transformation. This vision reveals the smart factory as an operating system in which humans leverage AI support to make predictive and improved decisions that can be implemented more quickly and reliably due to versatile processes and structures as well as adaptive factory control. Assisted and ergonomic workstations enable the employees for flexible assignment to workstations and tasks in a factory, in which the means of production, processes and technologies are not only connected and communicating with one another, but also resource-saving. Besides revealing the broad understanding in paradigm shift, targets, and principles, this vision picture clearly nails down the overall scope of the smart factory: Industry 4.0 covers the whole supply chain from supplier network to sales and after-sales, while the smart factory focuses on the factory operation within a production network.

The following two sections will first outline the top objectives and expectations of a successful transformation and then focus on the identified reasons that expected impact may fall short of these expectations.

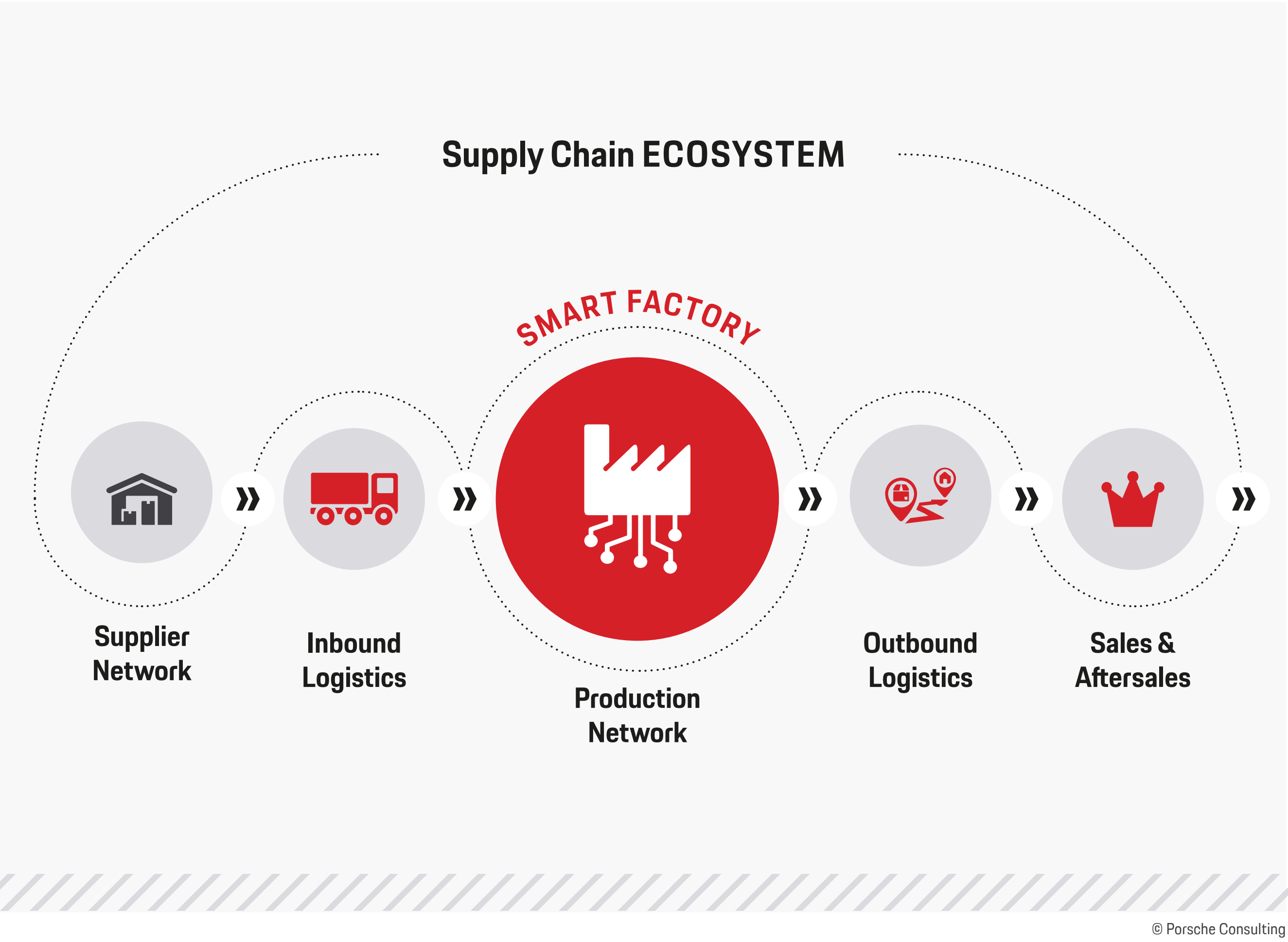


Fig. 3. Generating substantial benefits with Smart Factory within the connected supply chain.

Top objectives and expectations of a successful transformation

To master the various challenges from supply chain disruptions to skilled labor shortages as outlined above, all corporations must be willing to work across functions towards a common vision. The smart factory is the contribution of operations to ensure overall business competitiveness in the long term. The optimization of a company's own production network can influence various target objectives. In summary, five strategic target objectives can be derived for a smart factory transformation: 01 productivity, 02 reliability, 03 flexibility, 04 sustainability, and 05 attractiveness.

Fig. 4. Top objectives of smart factory implementations.

The importance of these target dimensions is determined individually by a variety of company-, product-, process-, industry-, and market-specific factors. For example, the transformation to e-mobility forces automotive OEMs to have flexible production lines to master the current coexistence of conventional, hybrid, and electrified powertrains. Automotive suppliers also need their production and assembly facilities to be versatile so that they can react to product modifications for individual powertrain components in series production with minimum effort and be able to fit in and ramp up new variants quickly. A variety of factors can also bring attractiveness into focus as an important target dimension; for example, for companies that face high employee turnover in low-cost countries or companies that struggle to fill positions with skilled labor. However, our top management survey revealed a high importance of traditional production-related objectives focusing on productivity, reliability, and flexibility. In contrast, the dimensions of attractiveness and sustainability tend to be of secondary importance internally within the business but provide much higher value externally as important pillars of the brand as seen by consumers.

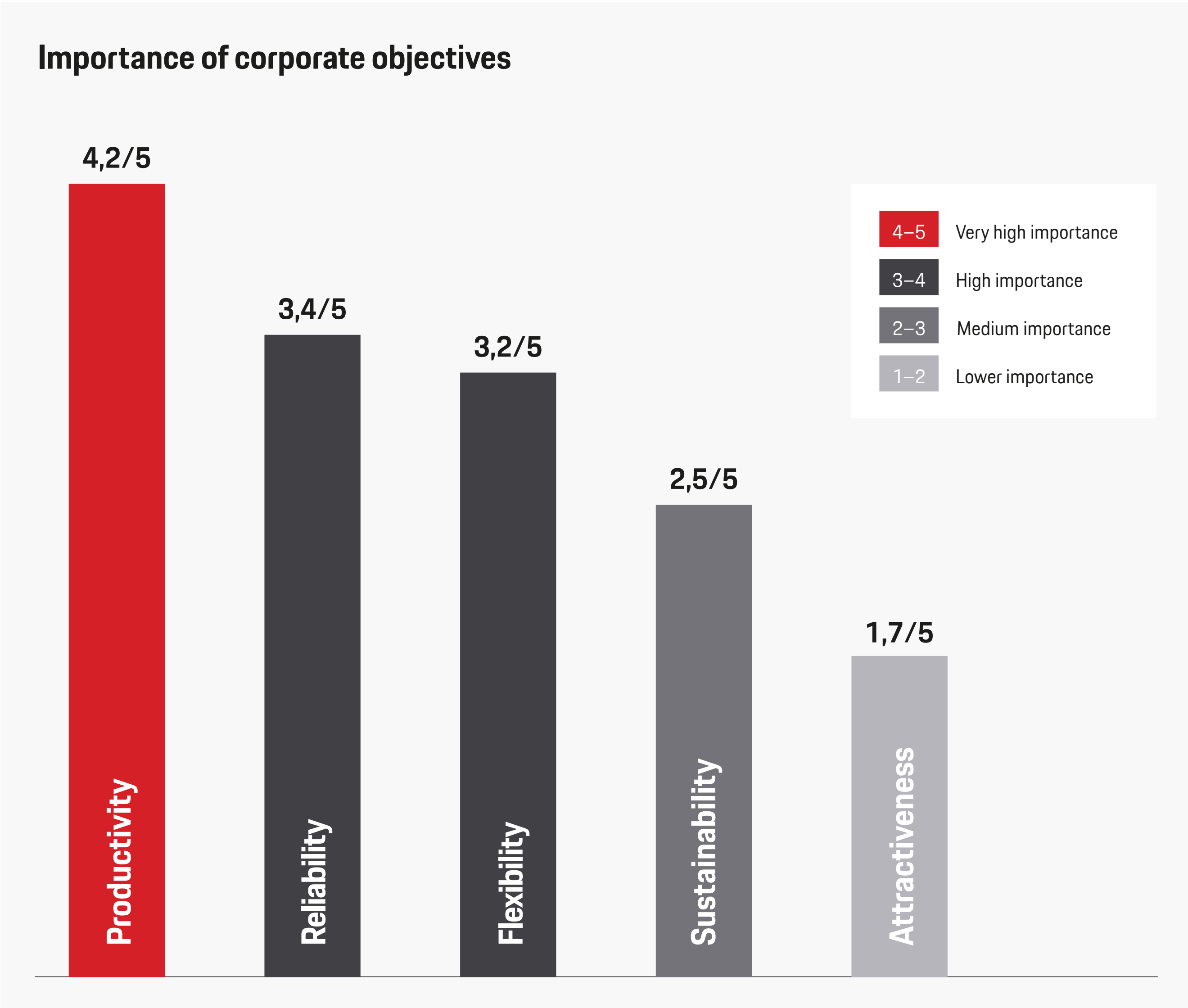


Fig. 5. Top smart factory objectives ranked by importance (5 = high importance to 1 = low importance).

01 Productivity

Increasing productivity remains the top target of factory operations. By utilizing opportunities presented by digitalization and automation they strive to increase efficiency and thereby achieve significant reduction in factory costs. Our survey reveals that the expected annual factory cost reduction by using smart factories varies depending on the industry:

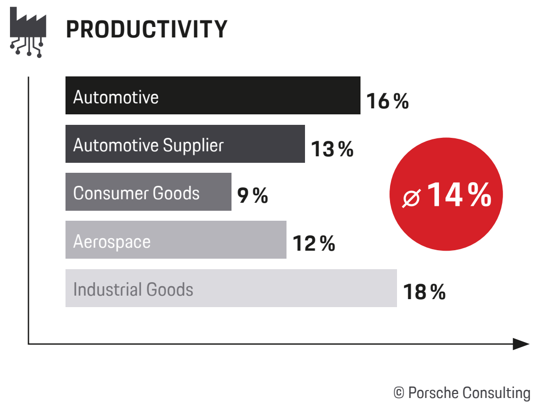


Fig. 6. Expected annual factory cost reduction due to smart factory transformation.

02 Reliability

For manufacturing companies, reliability is defined by the stability of speed, quality, and time availability of production and logistics processes. Increasing automation and digitalization have made the availability and robustness of automated systems and shop floor IT/OT the critical success factor for reliability, as downtime and disruptions affect all three dimensions. Reliability is the second most important goal in the implementation of a smart factory:

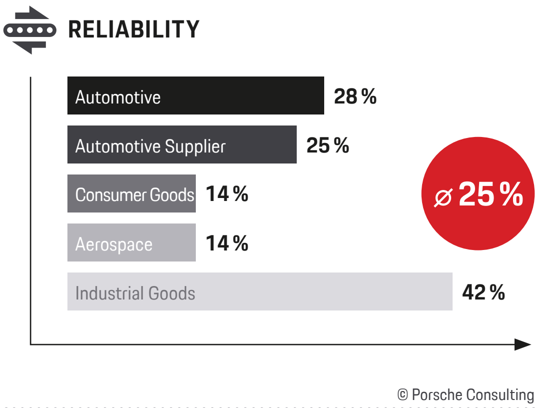


Fig. 7. Expected downtime reduction due to smart factory transformation.

Our top management survey revealed a high importance of traditional production-related objectives focusing on productivity, reliability, and flexibility.

03 Flexibility

A flexible production system is designed to easily adapt to changes in product variants and volume being manufactured. The desired degree of flexibility goes beyond pre-planned corridors, is often also referred to as versatility, and enables the low-cost integration of new variants into existing production lines, rapid layout and value stream adjustments or quick system modifications. The smart factory approach helps to significantly increase flexibility in all industries. This is demonstrated, for example, by connected production systems that synchronize changeover processes with raw material inspection data in real time and thus significantly reduce the time required for a machine changeover. Flexibility was named the third most important goal in smart factory implementation.

04 Sustainability

Today, both social and environmental sustainability requirements such as labor rights or decarbonization are often woven into contractual terms leading to the disqualification of a supplier if they do not adhere to the minimums. But sustainability in terms of a zero impact factory is more than that. It starts with a fundamental change of the environmental impact assessment. The entire consumption of natural resources like energy or water and emission of waste, carbon dioxide or any other pollutant are weighted to global and local scarcity. That quantitative perspective is accompanied by a holistic as well as a certified criteria catalogue for sustainable industrial sites. Factories nowadays need to be in balance with their environment and foster biodiversity, creating space for other species to fulfill and prove sustainability requirements to society and customers. Although it seems that higher investments for sustainability are threatening profitability, the cost-benefits regarding a total cost of ownership approach pay back in the long term.

Expected targets for the reduction of greenhouse gas emissions per industry:

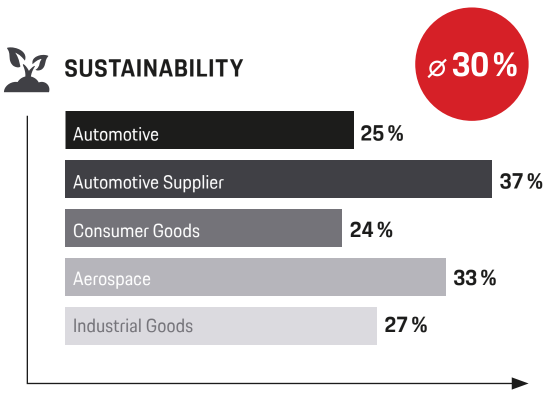


Fig. 8. Expected reduction of greenhouse gas emissions due to smart factory transformation.

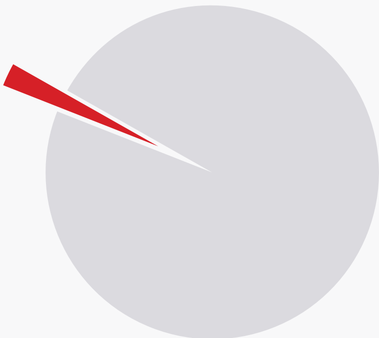
05 Attractiveness

Factories must offer an attractive, safe, and ergonomic working environment for all employees. This includes the entire organization: from the shop floor to the developers and engineers and up through the management team. Creating an attractive place to work fosters motivation, loyalty, well-being, and health. A smart factory can also positively promote brand perception in the direction of a future-oriented and innovative company. Especially in production environments where there is a constant skill shortage, it helps in attracting young talent, ensuring employee satisfaction, and retaining professionals in the long term.

The dimensions of attractiveness and sustainability tend to be of secondary importance internally within the business but provide much higher value externally as important pillars of the brand as seen by consumers.

Impact falls short of expectations

It is easy to set ambitious targets for smart factory visions, but most organizations struggle to achieve their target state. Only 8 percent of surveyed organizations state that their defined expectations of a smart factory are fully achieved.



Only 8 % achieve expected targets implementing a smart factory

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Fig. 9. Target achievement rate of smart factory implementation.

This gap between expected outcome and actual degree of realization can be seen by managers across all addressed objectives. The survey revealed that reasons for missing the overall expectations can largely be traced to eight common pitfalls:

- Insufficient translation of theoretical concepts into practical solutions
- Brownfield IT/OT environments are slowing down the smart factory transformation
- Insufficient collaboration between business units and IT
- Missing competencies
- Opportunistic start without a clear target vision
- No dedicated deployment organization
- Limited scaling of solutions
- Lack of organizational acceptance

If one or more of these pitfalls is not considered in a smart factory transformation, the expected impact can only be partially realized. In general, we have deduced from our customer experiences that eliminating even one field of action leads to massive implementation difficulties. Therefore, multidimensional goals can often not be fully addressed.

A surprising outcome of the survey is that a lack of organizational acceptance and change management is in our opinion underestimated. Various projects across different company sizes and industries confirm this: a successful smart factory transformation often fails because of a missing transformation and change approach.

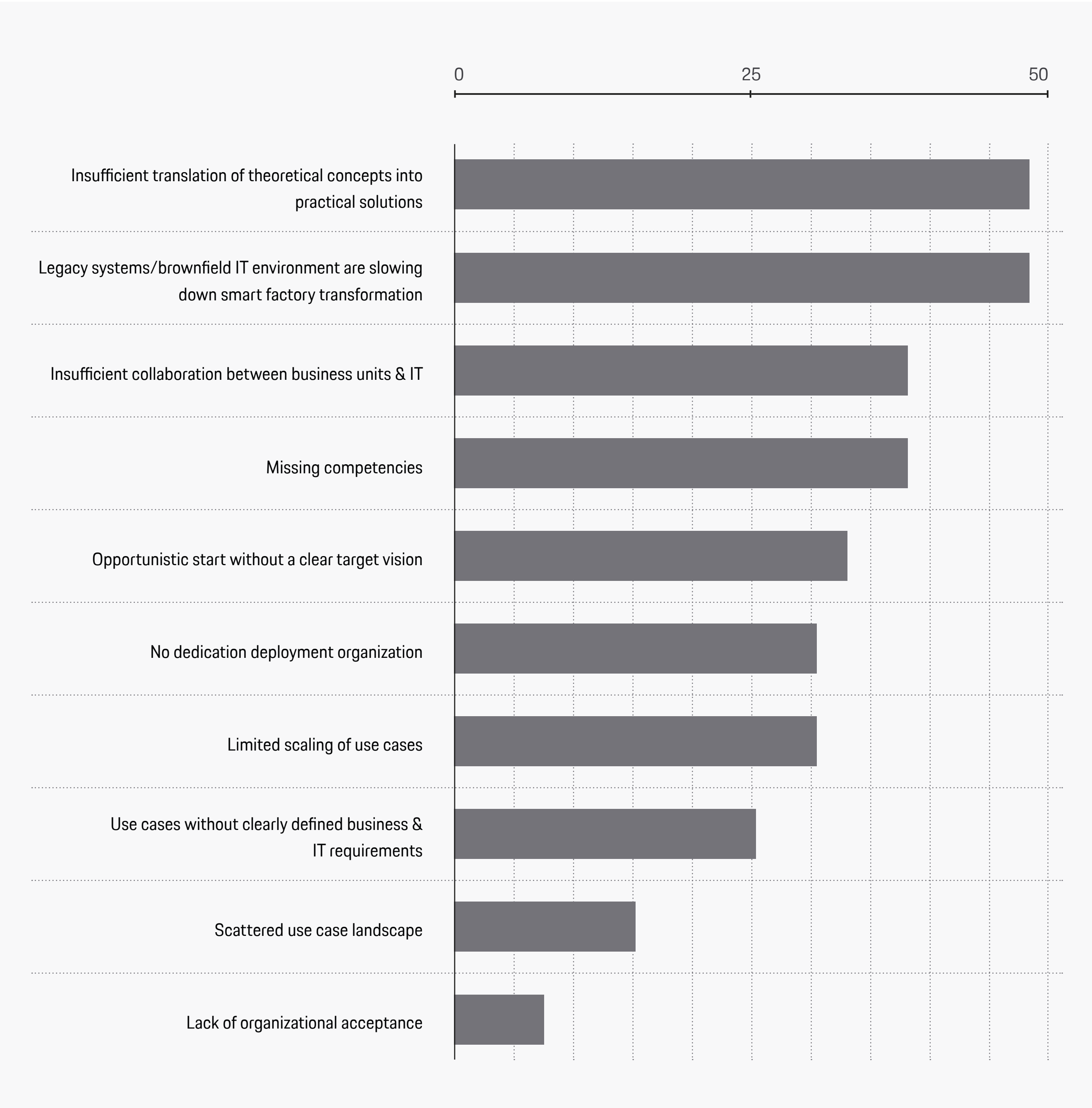

Fig. 10. Importance of common smart factory pitfalls.

02

8 PITFALLS

to avoid in the smart factory transformation

01 Insufficient translation of principles and concepts into practical solutions

The global cross-industry survey reveals that translating theoretical concepts into practical solutions is a major challenge for the majority of companies. 80 percent of the participating companies state that this pitfall is one of the top three transformation hurdles.

All too often, companies do not achieve the intended impact with their smart factory transformation. Instead of operationalized and functioning solutions that provide financially measurable improvements, companies are stuck with highly polished strategy papers that promise immense cost savings through Industry 4.0. In addition, use cases are only described roughly without actionable implementation plans, supplemented by a colorful collection of future technologies that are apparently needed for future smart factories. As a result, technologies such as 5G or AR/VR are pushed into plants and processes – as an end in themselves – without solving specific business problems. Solutions are presented as showcases, with a lack of scaling and measurable improvements for the employees – leading to frustration and skepticism towards the transformation.

Mitigation approach

To avoid this pitfall, it is crucial to always base digitalization and automation on a concrete business need and solve a relevant problem. The approach developed and used by Porsche Consulting achieves this through a specific sequence of clearly defined steps that make it possible to proceed from vision to actionable projects in just a few weeks, whose impact can be measured in concrete numbers.

01

Vision & design guidelines

Clear vision with descriptive design guidelines for internal and external communication

02

Process target pictures

Clearly defined process target pictures for future process including use cases

03

Impact estimation

Estimated potentials based on evaluation of factory cost savings and business improvements

04

Implementation road map

Prioritized use cases including dependencies allocated in an implementation road map

05

Lead plant implementation

Implementation and scaling of use cases according to implementation road map

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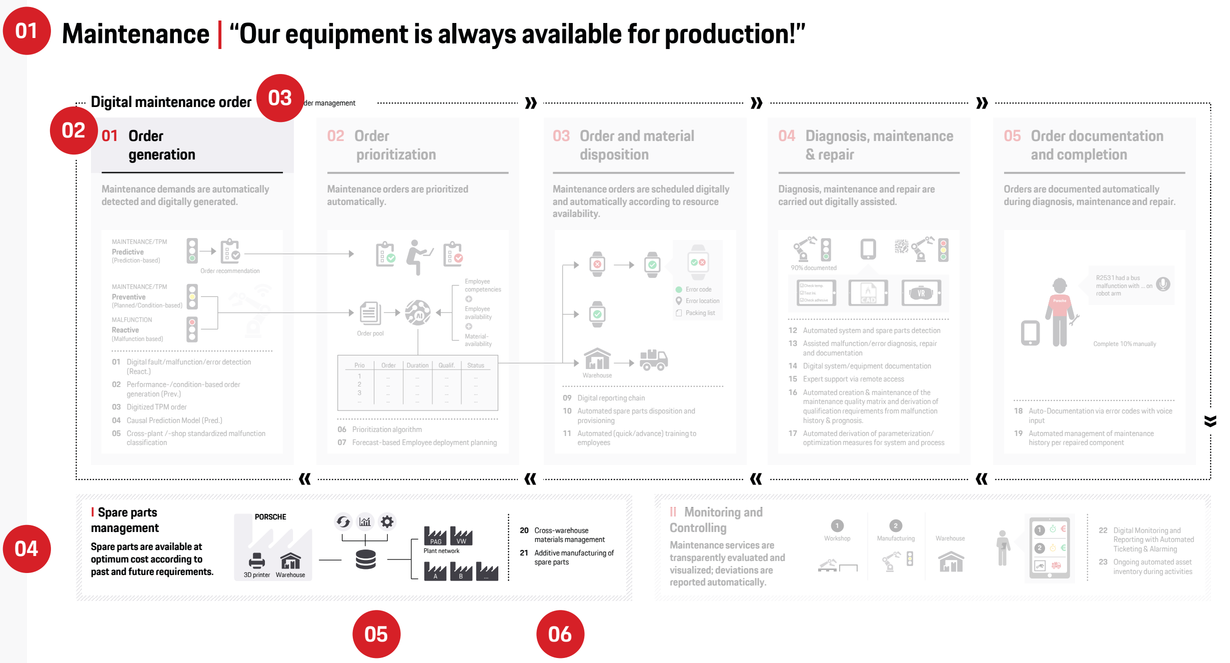
Fig. 11. Five-step approach to ensure impact.

The transformation approach starts with the development of a clear smart factory vision and the definition of design guidelines for future factory operations. Both are derived from the overall corporate strategy. The smart factory vision and guidelines are used for internal and external communication and serve as the basis for developing process target pictures that flesh out the vision for core manufacturing and support processes of factory operations with specific use cases per process step.

Process target pictures are powerful within the smart factory transformation. At a glance, they translate the vision into future process descriptions. The process target pictures are created for core manufacturing and support processes and usually represent a target vision of five to ten years out. During the transformation they remain relatively stable but are not carved in stone and so they may be adjusted over time when new business needs come up. For companies that have already developed use cases, they also offer the possibility of integrating existing use case ideas and aligning them towards a defined target state.



01 Overall vision statement

02 Process steps

03 Leading object

04 Guiding principles

05 Sketches of principles

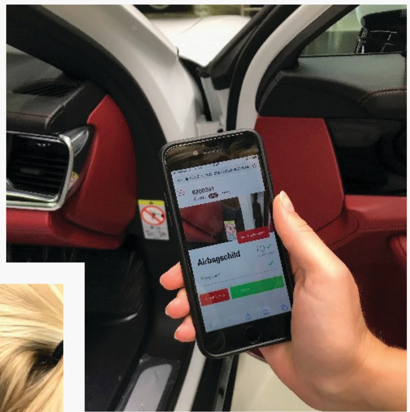
06 Use cases

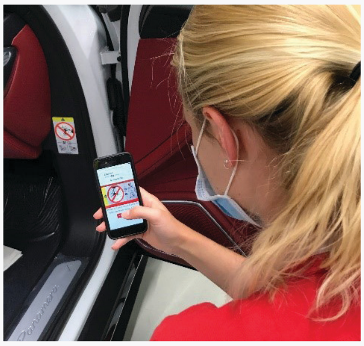
KEY OBJECTIVES

- Ensure link to business needs by tackling pain points in current process
- Create a single source of truth for digitalization efforts
- Generate acceptance in the plants and central divisions through joint development
- Build the basis for use case prioritization and implementation road map

Fig. 12. Key elements of a process target picture.

Use cases within the process target picture address existing and relevant business problems and describe the path from the current "status quo" to the future process vision. An example of a use case in the quality process target picture is sign and label recognition. In the past, labels with information had to be checked manually, which was highly error-prone – imagine checking a label in a foreign language. With this use case, the workers are supported by computer vision technology, which makes the match for them and checks via image recognition if it is the right label and if it is placed at the correct position. This reduces reworking costs and ensures conformity of labels.





USE CASE

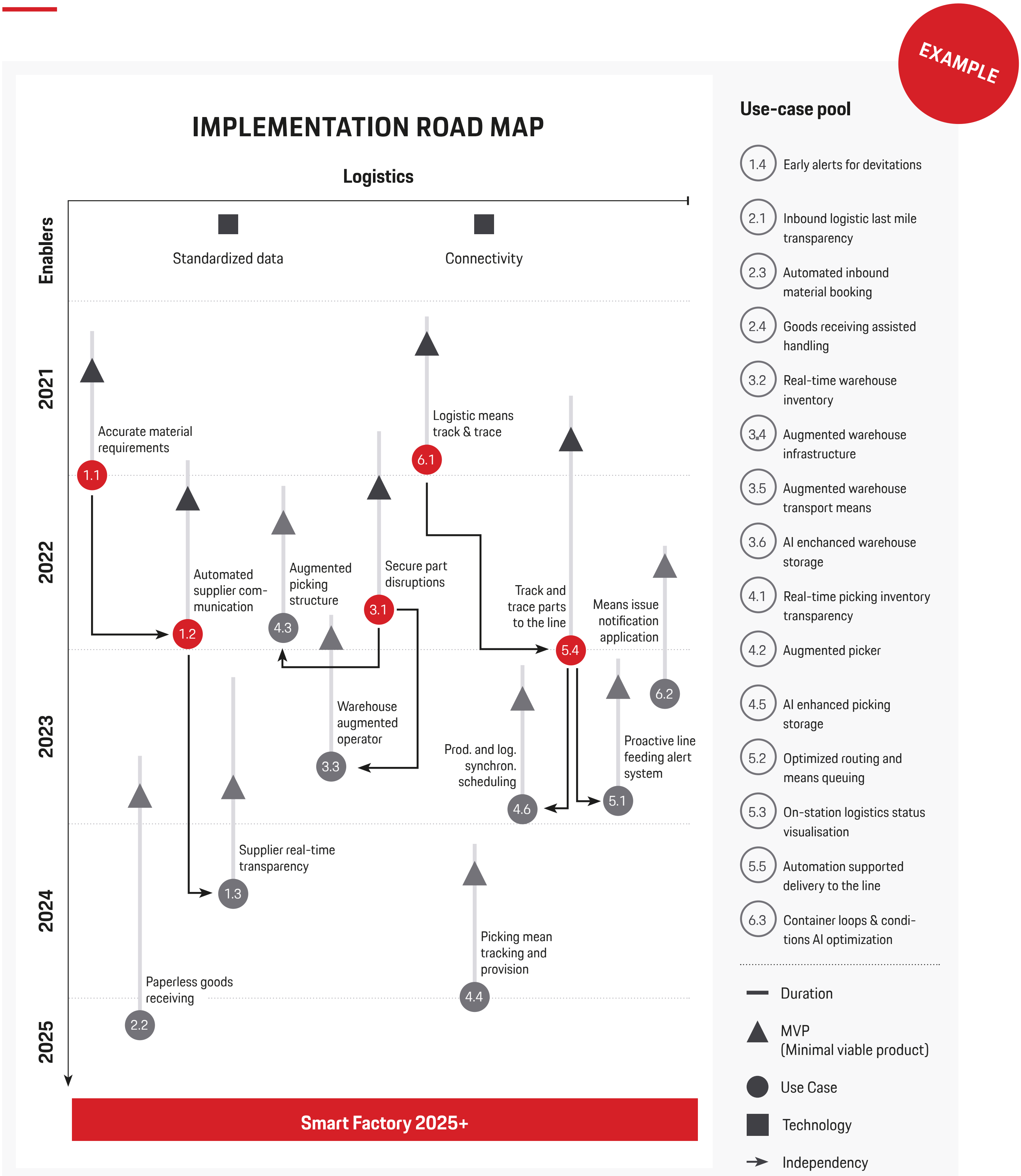
- **Support for visual control whether all labels have been added correctly**
- **Automatic label check inline and manual label check involving mobile devices**
- **Documentation of the glued labels for traceability**

Fig. 13. Use case example of automated label inspection through industrial computer vision.

After the definition of the process target pictures and use cases, an evaluation of the business impact and the effort of each use case is crucial. The financial impact is evaluated as it relates to a reduction in annual factory costs as well as in terms of its impact on key performance indicators (KPIs) like overall equipment effectiveness (OEE) or inventory. Strategic impact is also evaluated quantitatively by top management. This is necessary because use cases that address employee attractiveness or sustainability often have a lower direct impact on the factory cost structure. The effort is calculated as a combination of the initial investment, the operating costs per year, and the development effort. Every use case that is implemented during the smart factory transformation must have a positive business case. Otherwise, it will not be pursued further.

After evaluation, use cases are transferred to an implementation road map. In addition to the business impact and prioritization of the use cases, particular attention is paid to the sequence and dependencies. The scope of the implementation road map covers a period of approximately five years. Depending on the structure of the organization, it can be created on a group level or per plant.

Every use case that is implemented during the smart factory transformation must have a positive business case.



Focusing on

- Implementation sequence and prioritization
- Use case interdepencies
- Business case
- 3–5 year scope

Fig. 14. Smart factory implementation road map.

The lead plant approach is used to implement the first use case at a primary plant location. In this approach, use cases are first developed and implemented in one plant and then transferred to another plant in a second step. The lead plant that is selected should have the necessary resources and qualified employees to implement a use case. To ensure fast impact, it is necessary that representatives of the lead plant are involved in the target picture and use case creation from the very beginning.

A proven approach is to use target pictures and a catalog of defined use cases. The target pictures cover the core processes of production with a clear vision of how the processes should be executed in a smart factory. To enrich these target pictures, a use case catalog provides structured guidance for selecting the most suitable smart factory use cases.

Fig. 15. Porsche Consulting compendium consists of 221 use cases.

KEY TAKEAWAYS

- Companies should not use technology for technology's sake. It is crucial to always ensure that there is a meaningful use for technology, solving a specific business problem for people in factory operations.
- Process target pictures create the single source of truth for digitalization and automation activities and thereby serve as blueprints to transform the processes from status quo to the future state.
- An essential factor is to create a road map based on clear priorities, e.g., business case including dependencies between use cases and needed enablers.

02 Brownfield IT/OT environments are slowing down the smart factory transformation

A brownfield IT/OT environment* is named by one-third of the companies surveyed as the greatest challenge in implementing a smart factory. The reason for this is that IT applications in companies are historically grown over decades, which leads to very complex, individualized, and therefore partly redundant IT landscapes. Studies show that only about one-fourth of the IT systems used in current production plants are deployed across the entire plant network. The rest are individual, plant-specific solutions.

* The term "brownfield" plant is used to describe a factory or manufacturing plant that has already been built and is in operation. Accordingly, the brownfield approach in the context of Industry 4.0 is the digital transformation of an existing information technology (IT) and operational technology (OT) infrastructure.

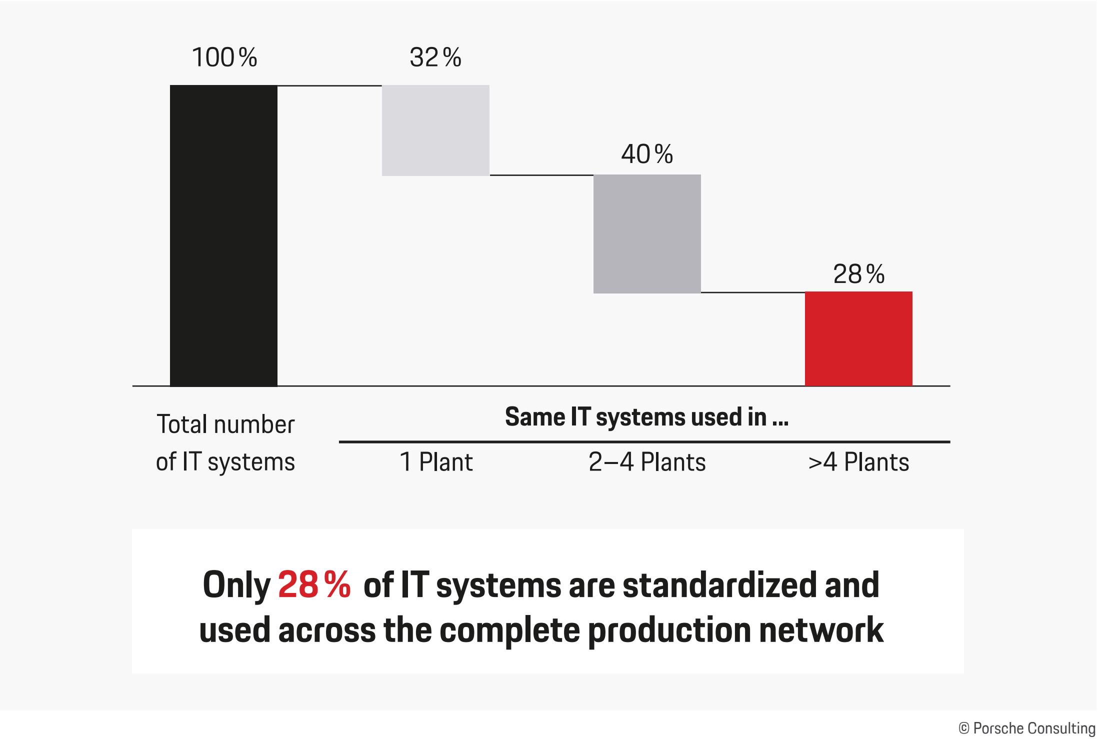


Fig. 16. Distribution of IT systems by the number of plants in which they are used [%].

Maintenance and improvement efforts, such as implementing the latest cybersecurity requirements, are significant cost drivers given individualized software complexity. Spending on enterprise software has more than doubled in the last 10 years and this trend will continue in the coming years.[1] In addition, improvement efforts are often purely technically driven by the plants and rarely aligned to overall corporate goals. Companies face a high risk that existing IT systems will utilize their entire IT budget due to high operation costs and that there will be insufficient resources for future investments.

In addition to this financial dilemma, brownfield systems often do not meet technological requirements for new automation needs. This forces companies to develop individual solutions that fail to realize the expected business benefit at scale. However, legacy systems cannot simply be switched off. Often there is limited transparency about whether, by whom and for what the systems are still being used and how they are linked to other systems. Shutting down one system can have a negative impact on the system as a whole. Past experiences have shown that taking a seemingly unimportant tool/server offline can have a significant impact on larger parts of the business that was unknown beforehand.

Improvement efforts are often purely technically driven by the plants and rarely aligned to overall corporate goals.

Mitigation approach

To overcome this complexity and to build an IT landscape that supports the smart factory transformation, an integrated approach between business and IT is needed. This approach consists of two main parts: a current state analysis of the IT landscape and the derivation of the business and technical demands from the smart factory process target pictures.

Demands from the smart factory process target pictures are derived from the use cases and the corresponding capabilities. By deriving and comparing these required capabilities of the use case with the existing capabilities of the IT landscape, matches, redundancies, irrelevancies, and gaps are identified.

STRATEGIC PROCESS FIT

01

MATCH

Application matches target capability of (several) use case(s)

02

REDUNDANCY

More than one application provides the same capability

03

IRRELEVANCE

Application does not match any target capability

04

GAP

New capability needed in existing or new application

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Fig. 17. Elements of the strategic process fit.

From the IT side, the applications are assessed in terms of their technical health and quality of their process support. IT health evaluates the status of the system and determines whether it can meet the technical requirements of the future and can be operated economically with existing resources and know-how.

IT health condition

Strategic process fit

<table>
<tr><th></th><th>Obsolete</th><th>Ineffective</th><th>Legacy</th><th>State-of-the-art</th></tr>
<tr><td>MATCH</td><td>Rebuild or replace*</td><td>Retain & extend or replace*</td><td>Refactor or rebuild or rehost*</td><td>Retain</td></tr>
<tr><td>REDUNDANCY</td><td rowspan="3">Retire</td><td rowspan="2">Retire or retain & extend*</td><td rowspan="2">Retire</td><td>Retain & extend</td></tr>
<tr><td>IRRELEVANCE</td><td>Retire or retain & extend*</td></tr>
<tr><td>GAP</td><td>Retain & extend or replace*</td><td>Replace</td><td>Retain & extend or replace*</td></tr>
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FRAMEWORK

The measures for applications in the existing system landscape depend on:

01 Process strategic fit

02 IT health condition

03 Business case

04 Internal resources and know-how

Fig. 18. Framework to derive application specific actions.

* Decision is based on business case and internal resources and know-how.

The combination of these dimensions results in different measures for IT systems. Six different measures can be derived: rehost, refactor, rebuild, replace, retain (and extend), and retire. Depending on the internal resources, cost per measure and know-how of the company, the decision about the measure in the different fields of the matrix must be made individually.

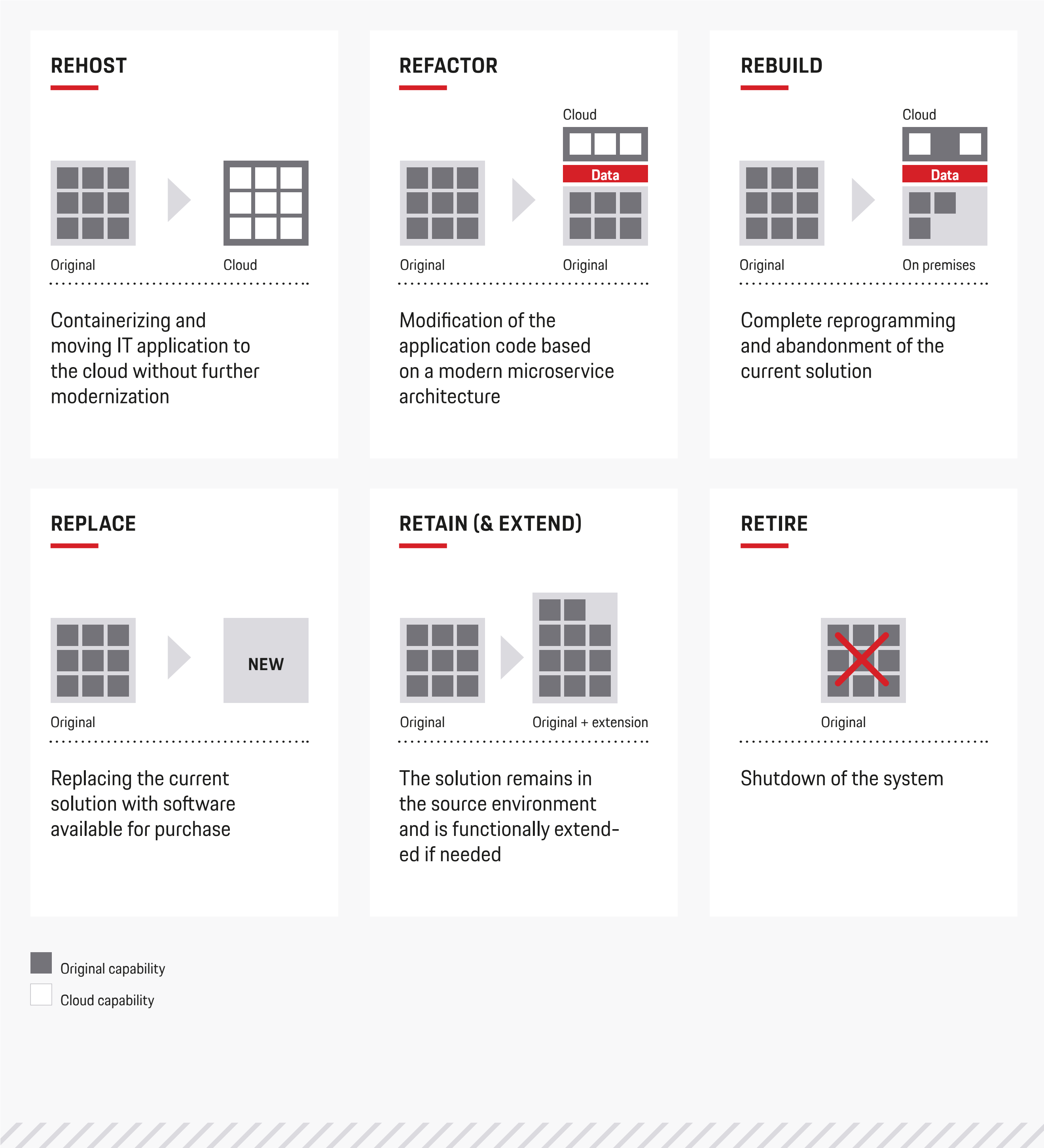


Fig. 19. Overview of actions to optimize your IT application landscape.

Leading practice

To reduce operating costs, companies are increasingly following the "stick to standard" strategy. This means that standard systems are purchased from the software providers. This significantly reduces maintenance and development costs. Customization only takes place for selected applications and with the use of cloud technologies.

KEY TAKEAWAYS

- Companies must address rapidly rising IT costs by implementing state-of-the-art systems to improve processes in a future-oriented manner and not to maintain increasingly outdated existing systems.
- To meet the requirements of a factory of the future, a structured approach to analyze and transform your IT landscape is needed.
- A proven methodology to modernize the IT landscape is, to break down current IT applications into capabilities and match them with the demand from future use cases to derive a transformation road map.

03 Missing competencies

The World Economic Forum has shown that 40 percent of core skills will change[2] over the next five years. This generates a massive need for reskilling and upskilling measures to ensure the long-term demand for a skilled workforce. This is also confirmed by roughly 50 percent of companies surveyed, who see missing competencies as a top priority for a successful implementation.

Key challenges are not limited to the selection and acquisition of necessary skills, however. Increasingly, the situation of many industries is exacerbated by the tight and costly market situation well known as the "war for talent." Furthermore, challenging strategic decisions in attaining new competencies demonstrates internal weaknesses, e.g., within HR departments as central enablers of workforce transformations.

Therefore, steps need to be taken to proactively prepare the workforce of the future for a long-term paradigm shift. Faithful to the motto "work smarter, not harder" and replacing old habits with new competencies without denying the fundamental approaches of a lean organization.

Mitigation approach

The strategic relevance of a clear ambition by linking processes and technologies within target pictures was discussed in detail in the first pitfall. Based on a visionary target state, a need for certain new roles and competencies can be derived for every manufacturing organization.

Future roles can be abstracted from three generic target groups that are directly affected by a smart factory transformation:

// **Leaders** – initiate and push relevant points of action

// **Digital solution facilitators** – bring innovative solutions to life while continuously enhancing them to reduce losses and improve daily operations

// **End users** – execute processes with the use of provided solutions

Within these three target groups, a variety of roles and competencies can be identified, which are required for the implementation as well as operation of a smart factory (e.g., product owner, manufacturing data owner, digital innovator, etc.).

Particularly needed competencies must be derived from the overall process target pictures and selected use cases. Based on internal experiences a categorization into "digital core" and "enabling competencies" helps to cluster and equip competencies with chosen role profiles.

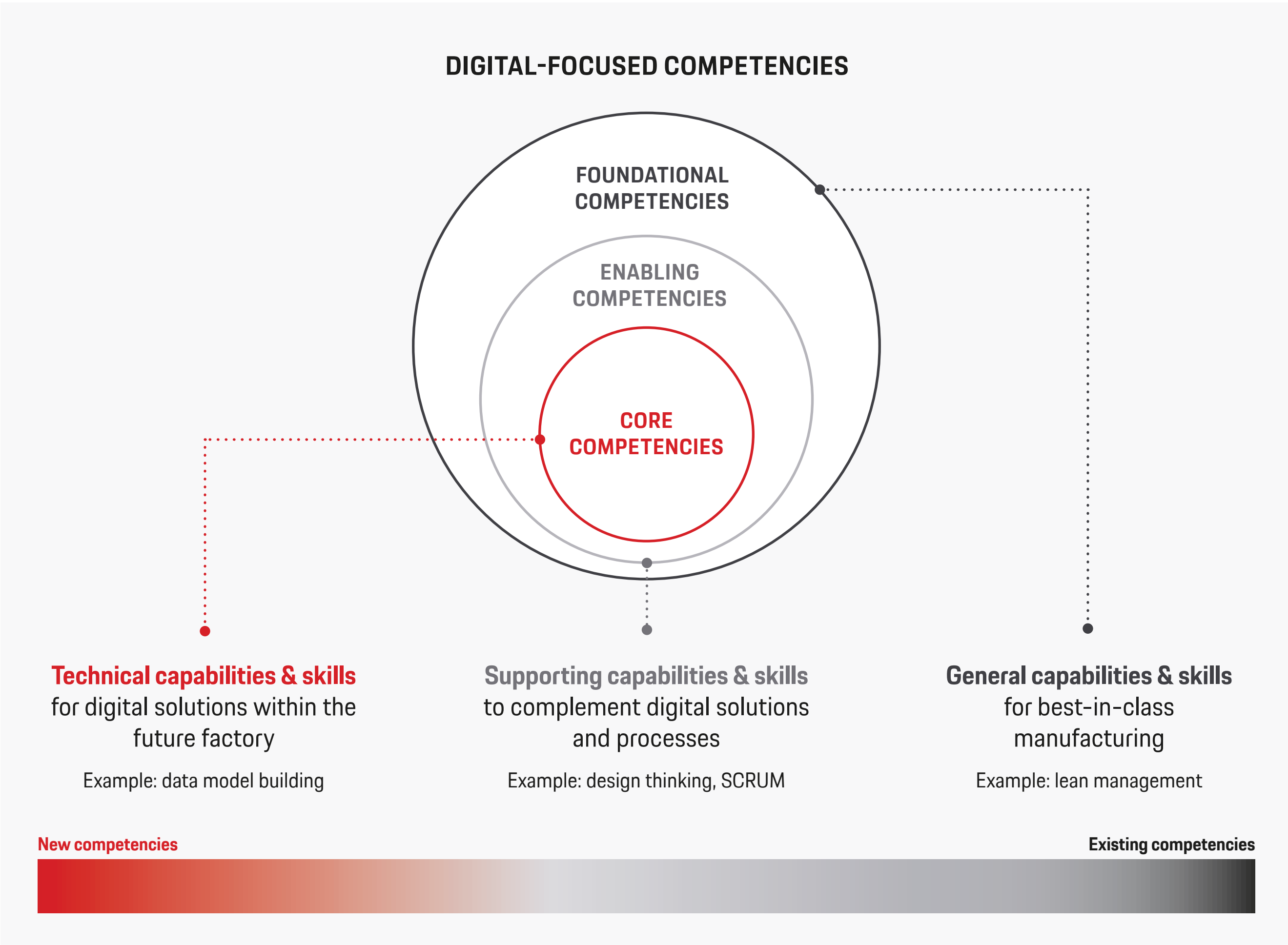


Fig. 20. Digital-focused competencies enabling smart factory transformations.

The number of competencies needed is essentially determined by the identified business demand. Companies should, on the one hand, orient themselves to the time frame for implementing their targeted use cases and, on the other hand, take into consideration the effort required to close their existing skill gaps. Since it cannot be assumed that there is a uniform skill gap across all three target groups, an individual analysis of the existing skill gap is necessary. However, the essential requirement for facilitator roles, as well as a critical mass of leaders, should be available at the onset of any transformation. This is because the implementation of technologies and organizational role models takes center stage in every company's transformation endeavors.

Once an organizational skill gap has been identified, a build-buy-borrow assessment must provide answers as to how the necessary competencies can be attained. At this strategic tipping point, HR and related business departments need to focus on exemplary questions such as:

Who? How many people are affected by training?
When? How quickly and for how long are the necessary resources needed?
What? What is the amount of training required in order to take strategic action?

Individual decisions regarding attainment can be made for each specific role. However, when the demand is smaller and the need for competencies becomes more complex, "buy and borrow" strategies are more suitable for fulfilling the necessary capacity planning

If a company decides to pursue a "build strategy," it will be necessary to define a structured approach for developing training formats and executing the training phase.

Leading practice
An American multinational company in the consumer goods industry serves as an excellent example. The need for future competencies was identified after the establishment of a smart factory vision and the corresponding process target images. In response to the significant demand for new digitally focused positions throughout the manufacturing organization, the company opted for a specifically defined internalization strategy to acquire nearly 80 percent of the total demand for 14 roles and more than 34 new digital competencies.

The cornerstones of the centrally developed acquisition strategy involved combining an externalization and internalization approach with a global skill owner organization. As a result, training formats and internal skill owner qualifications were primarily provided through a partner network that included centers of excellence and universities. The internalization of created content was facilitated through a "train-the-trainer" concept, enabling the

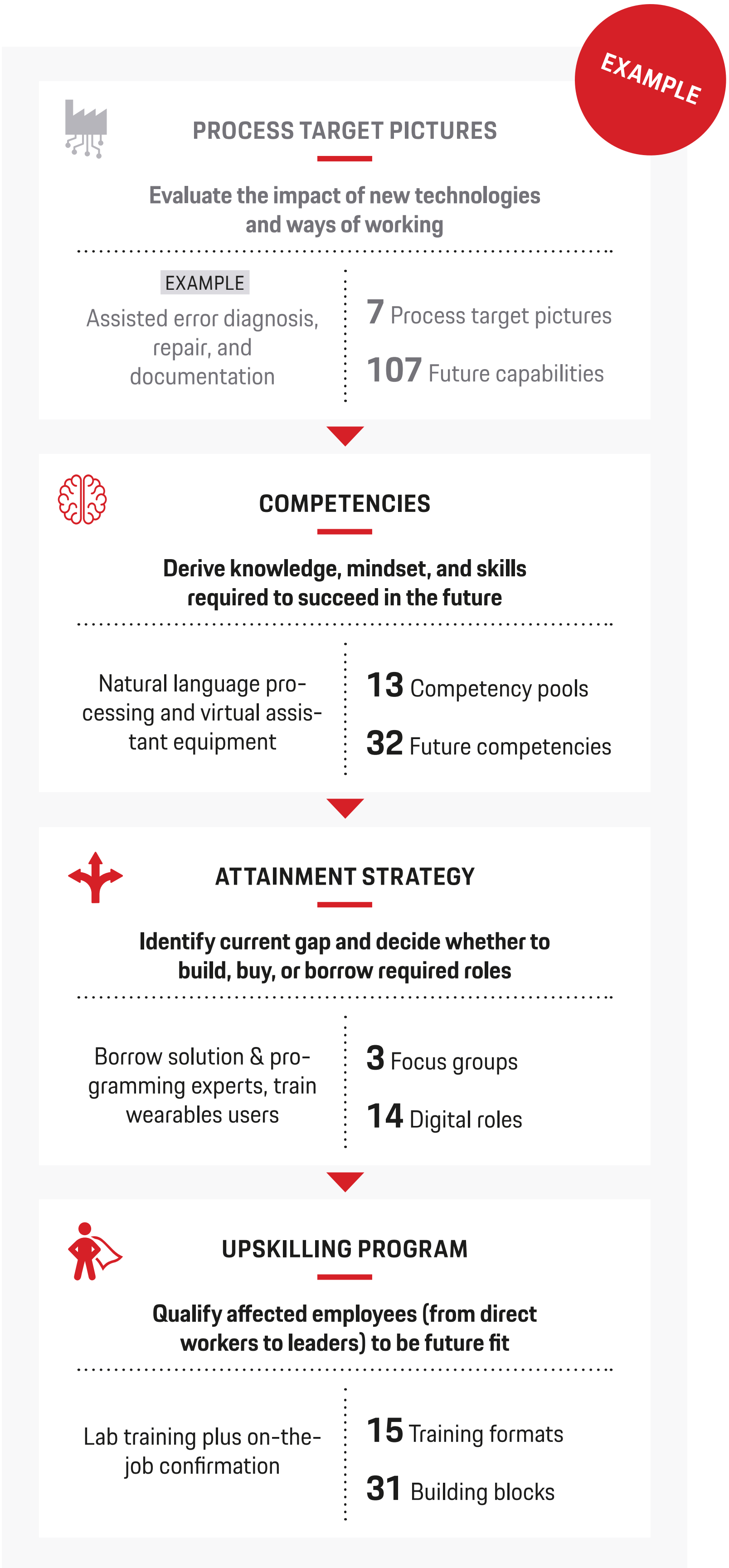


Fig. 21. Link between process target picture and upskilling program.

implementation of a learning development plan within the manufacturing organization at each affiliate level and ensuring global control over competency attainment.

After piloting, four factories were able to participate in the initial training formats through virtual and instructor-led classroom sessions. In the long term, the objective is to ensure the training of over 17,000 employees at more than 30 locations in diverse core and enabling competencies throughout the global smart factory transformation.

KEY TAKEAWAYS

- Companies must invest in the empowerment of their organization. Otherwise, they will face a high risk that technological investment within the smart factory transformation will not pay off and cannot be leveraged by sufficiently available human capabilities.
- The need for new roles and competencies should be derived from current and future business requirements. Process target pictures serve as a clear indication of the future roles an organization should adopt in order to activate its vision for the future.
- It is recommended to focus development efforts on the management team first to be able to draw on a critical mass of change agents right from the top level of the organization.
- A appropriate attainment strategy should address questions regarding the number of new roles and competencies required, the timing of their implementation, and the duration for which they will be needed.

04 No dedicated deployment organization

A missing deployment organization slows down many companies in the smart factory transformation. The implementation and rollout of use cases is delayed and the expected business impact cannot be realized. All too often, the smart factory is perceived as a short-term project rather than as a long-term multi-year transformation program. Roles and responsibilities are not consistently defined and provided with the necessary resources. In addition, the needed roles cannot be filled due to a lack of competencies.

Further inefficiencies in the smart factory transformation arise from the fact that the deployment organization is not staffed cross-functionally between IT and business units. IT is not involved in the transformation, or too late. However, the complex development requires close interaction between all parties involved right from the beginning.

The need for a deployment organization is first recognized when the transformation is on the verge of failure and must then be pursued in a resource-intensive manner.

Mitigation approach
Three factors are crucial for a successful smart factory deployment organization

01

Defined roles and responsibilities on a global and local level

02

Lead plants, which carry out the initial implementation of a use case

03

A close integration between business and IT through agile methods

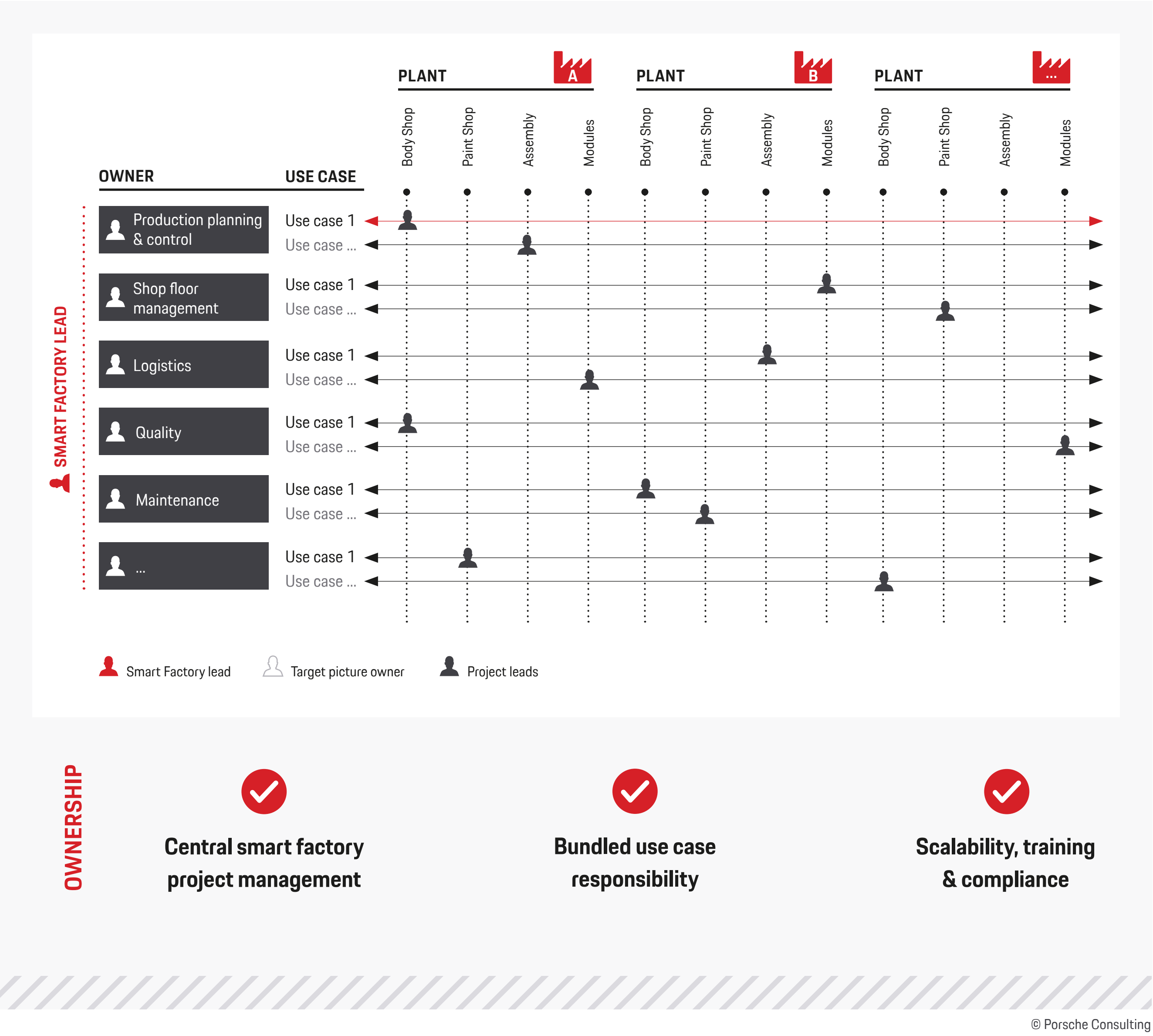


Fig. 22. Smart factory deployment organization.

To steer the transformation, a smart factory lead is needed who has the overall responsibility for the transformation. The smart factory lead coordinates between the respective process target pictures and keeps an eye on the achievement of the defined strategic goals.

For each process target picture (see chapter "Insufficient translation of theoretical concepts into practical solutions"), there must be a target picture owner. This person is responsible for defining future processes, iterates, and revises the target pictures together with key stakeholders and end users. Furthermore, they coordinate the implementation of the respective use cases within a process.

The development and implementation of the use cases takes place in agile cross-functional project teams. Each project team includes representatives from the business department, IT and, depending on the organizational structure of the company, representatives from the plant in which a use case is being deployed. In order to avoid redundancies and double work as well as to be able to realize synergies and economies of scale, companies need to answer a decisive question before starting to develop use cases: which plant and/or shop is best suited for the initial development and first implementation in such a way that the use case can subsequently be implemented in other plants of the production network without major adaptation efforts while providing all required functionalities?

The goal is therefore to select a lead plant for each use case. Manufactured products, installed manufacturing or assembly processes, degree of automation, digital maturity, greenfield or brownfield are among the key selection criteria for choosing a lead plant. Depending on the number and diversity of factories, clustering into archetypes makes sense here for complexity reduction and structuring. The lead plants and the above-mentioned cross-functional project team are responsible for ensuring that the requirements of the other plants are also considered during the initial development. Nevertheless, depending on the company and the design of the initial implementation, the subsequent scaling of a use case may still require refactoring, in which the IT/OT architecture and components of a use case are reengineered from lead plant-specific systems and software components to cloud platform-based systems and software components so that the use case can be deployed to the other plants via a production cloud platform (see Chapter 06 "Limited scaling of solutions").

Which plant and/or shop is best suited for the initial development and first implementation in such a way that the use case can subsequently be implemented in other plants of the production network without major adaptation efforts while providing all required functionalities?

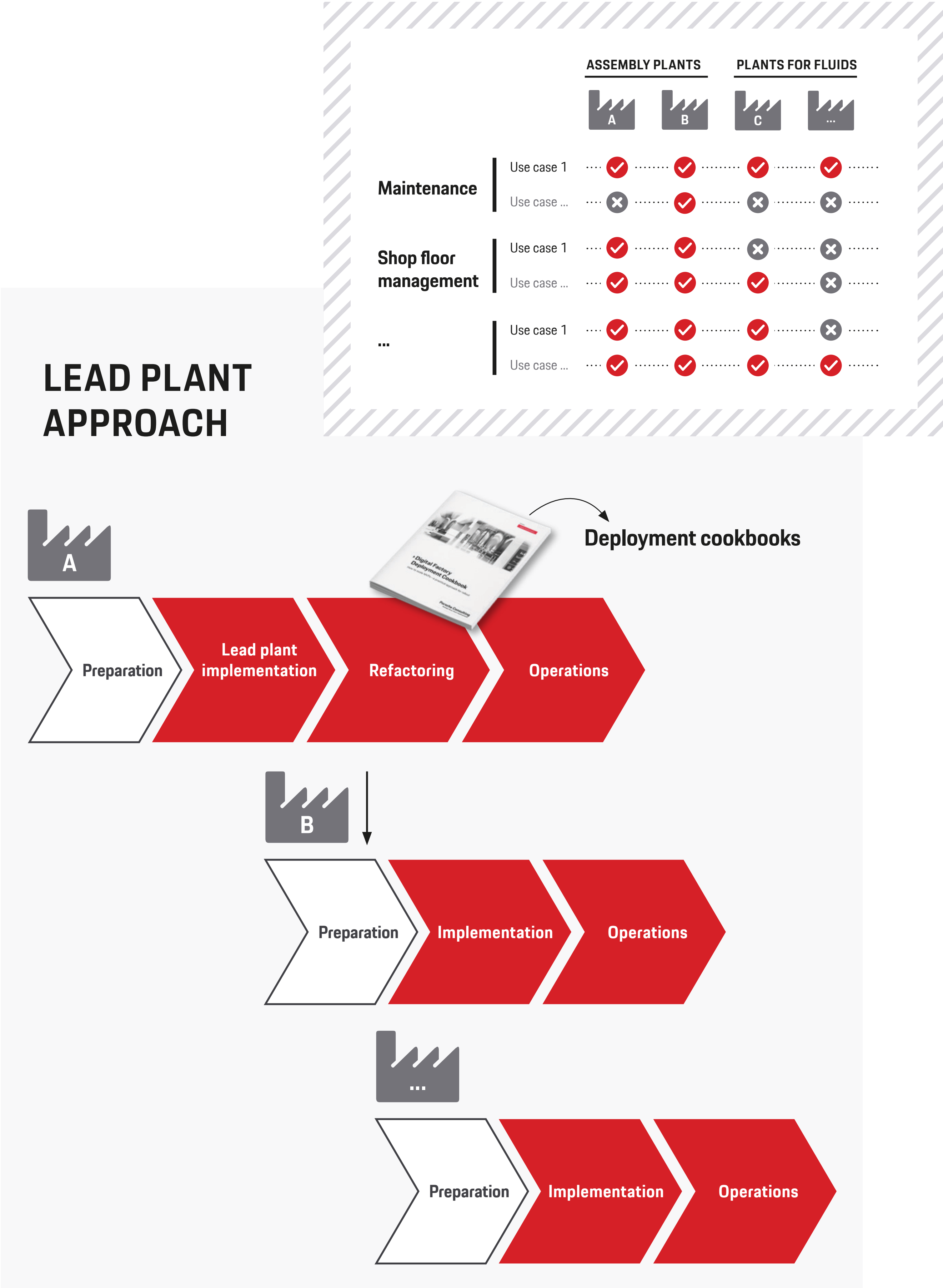


Fig. 23. Lead plant approach leveraging deployment cookbooks for knowledge sharing across plants.

To make the transfer from one factory to another as efficient as possible, knowledge sharing is essential. In this regard, deployment cookbooks have proved to be a knowledge-sharing tool. This easy-to-use documentation serves as a guide to implement and scale use cases. The cookbooks describe a standard procedure with the respective deployment steps, from organizational to technical requirements and contain chapters dealing with organizational readiness; transformation of daily operation, including new processes and ways of working; security and validation; detailed implementation instructions; and upskilling methods.

For a successful deployment, it is important that business units and IT work together in agile cross-functional teams. How the collaboration can be organized is described in pitfall 07 "Insufficient collaboration between business units and IT."

Leading practice
A succusses story of using deployment cookbooks can be found at a global healthcare company with a production footprint of over 70 plants. Each use case within this company is developed and first implemented in a lead plant and then scaled in a standardized manner according to the specifications and processes of the step-by-step guide within the deployment cookbooks. The cookbooks are developed by central use case owners together with lead plant project teams and are implemented within the group-wide intranet. This speeds up use case scaling and knowledge transfer significantly.

PURPOSE OF DEPLOYMENT COOKBOOKS

01

Easy-to-use documentation as single source of truth to implement and scale use cases.

02

Accelerate rollouts and improve operational outcomes by utilizing standard approaches.

03

Identify and close gaps in the industrialization of innovative solutions.

Fig. 24. Purpose of deployment cookbooks.

KEY TAKEAWAYS

- An efficient deployment organization is characterized by clearly defined roles and responsibilities, a structured lead plant approach, and a close collaboration between business and IT.
- The rollout of use cases is best carried out via lead plants and with the use of deployment cookbooks, describing the milestones and activities to successfully implement use cases in a factory.

05 Opportunistic start without a clear target vision

Past experiences have shown that over 40 percent of industry companies start their transformational journey by launching technologies or hiring experts in various fields of digitalization without having a corporate-wide vision. Therefore, companies often get in trouble when they opportunistically jump onto a single singular solution without being clear about their own why and how they want to transform their factories.

Especially during long transformations, a clearly defined vision statement collaboratively aligned across the leadership team prevents a lot of implementation trouble from the beginning and engages all relevant stakeholders to move in the same direction. However, the definition of a strategic vision requires extra efforts in terms of time and expertise across several organizational stakeholders. Therefore, a structured vision must contain three key elements which are cross-functionally developed: measurable objectives, leading design guidelines, and a visualization of future operations.

Mitigation approach
Setting the initial course is guided by ambitious, measurable objectives. Companies need to agree on which quantitative improvement targets the transformation program aims to deliver. Typically targets deliver substantial benefits within a connected supply chain and focus on different target dimensions, e.g., overall factory costs, sustainability, or delivery targets.

Those objectives can be defined by breaking down each target dimension into individual cost drivers. Once cost drivers are identified, suitable target settings can be defined according to a company's corporate strategy. Outside of just strategic objectives based on defined cost drivers, key performance indicators can also provide operational ways to measure if our implementation efforts pay off.

» The definition of a strategic vision requires extra efforts in terms of time and expertise across several organizational stakeholders

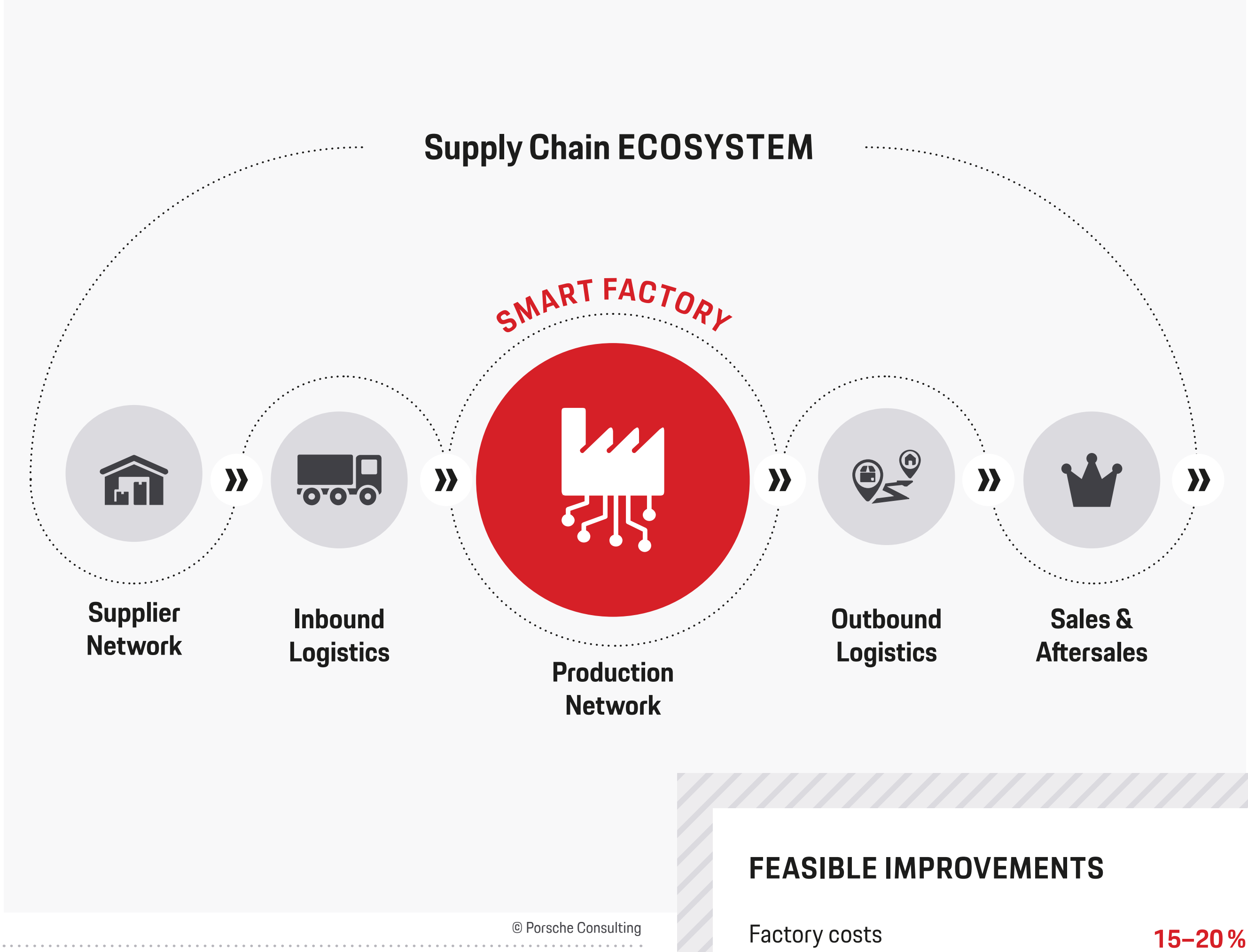


Fig. 25. Benefits of smart factory.

FEASIBLE IMPROVEMENTS

Factory costs	15–20 %
Delivery	5–10 % Reliability
Time-to-market	-6 months Ramp-up
Sustainability	-20 % Energy
Additional revenues	+2 % Sales

Once quantitative objectives have been established, it is essential to formulate design guidelines that will shape future operations. These guidelines encompass process-agnostic and overarching principles, describing the intended paradigm shift in factory operations. They serve as a guiding light, acting as a North Star for all design efforts.

Usually design guidelines refer to all core areas of factory operations. They define the framework for the creation of process target pictures per factory area and contribute to a holistic view on end-to-end factory processes.

10 Design Guidelines describe Future Factory Operations

01 DECISIONS
Data-driven decisions

02 PROCESSES & STRUCTURES
Versatile processes and structures

03 FACTORY CONTROL
Situationally adaptable factory control

04 STAFF ASSIGNMENT
Self-reliant and flexible staff assignment

05 WORKSTATIONS
Assisted and ergonomic workstations

06 MEANS OF PRODUCTION
Connected, communicating means of production

07 RESOURCES
Resource-saving processes and technologies

08 PROBLEM SOLVING
Problem solving with new technologies

09 QUALIFICATION
Proactive qualification and active regeneration

10 CUSTOMER INTEGRATION
Transparent and tangible production for customers

Fig. 26. Design guidelines for future factory operations.

Once the leadership team has defined measurable objectives and design guidelines, it is crucial to consolidate all outcomes into a comprehensive visualization. The purpose is to demonstrate the future way of working rather than presenting a detailed factory plan. A holistic visualization involves connecting easily understandable images that serve as a foundation for the transformation narrative. Along the production value chain, these visualizations provide a clear and understandable explanation of the defined objectives, design guidelines, mission, use cases, and process elements. When creating the vision and design guidelines, companies should ensure both clarity and reflect the unique identity of the company. The resulting visualization serves as a company-wide narrative for the smart factory transformation, embodying the vision within the management team through sounding boards and sprints.

Leading practice
A leading global automotive supplier shows a best practice for the consistent alignment of the smart factory transformation to an overarching vision with clearly defined goals. The entire transformation is consistently aligned with the guidelines for future factory operation defined jointly by top management. The guidelines are the North Star of the smart factory transformation and are reflected in all process target pictures and their use cases. The developed vision and guidelines also serve as the foundation for internal and external communication.

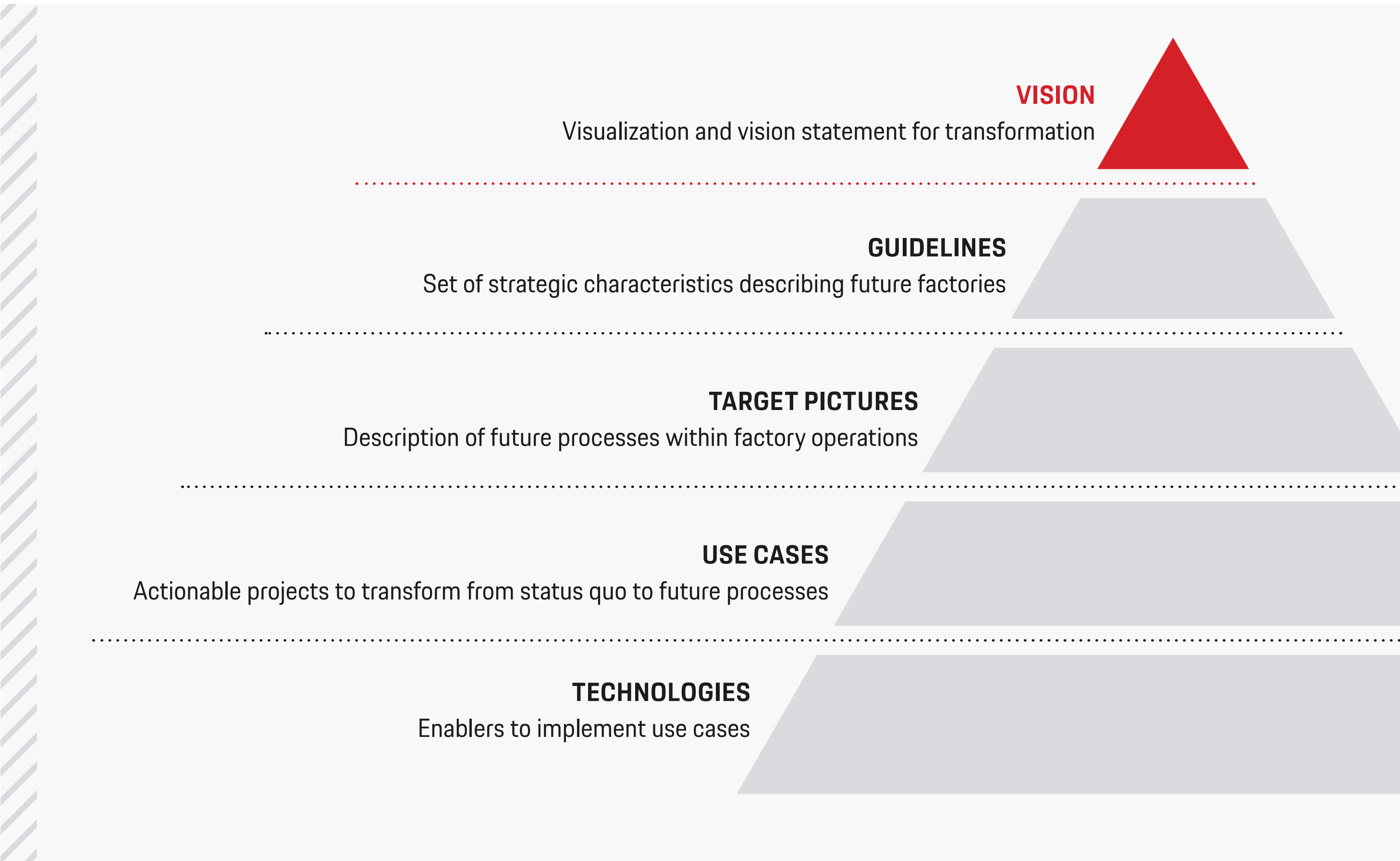


Fig. 27. Smart factory transformation layer.

KEY TAKEAWAYS

- Top management must prioritize key challenges to be addressed through smart factory transformation and establish a clear ambition level for the required performance leap in terms of key performance indicators to be.
- A leap in performance requires a paradigm shift in factory operations. This paradigm shift must be described in a comprehensive, i.e., process-agnostic manner with a compact set of guidelines that can be communicated quickly and easily.
- The visualization of these guidelines in a holistic vision picture, describing future factory operations, serves as a means of communication both internally and externally.
- The overarching process-agnostic guidelines and visions must be fleshed out in a structured manner into process-specific target pictures and use cases as well as utilized technologies.

06 Limited scaling of use cases

Companies struggle with the scaling of smart factory solutions. All too often, projects do not make it beyond a minimum viable product (MVP) or proof of concept (POC), and the intended potential impact at scale is not achieved. That is also stated by our global cross-industry survey: 25 percent of the companies say that limited scaling of solutions is one of their main challenges. Without scaling, the expected impact cannot be realized and synergies cannot be leveraged. In addition, duplicate developments occur within the factory networks.

In most cases, the goal is to quickly deliver a reasonable result that provides short-term impact in a specific area. However, this does not meet the technical requirements needed for scaling. This results in use cases that prove beneficial in one area but cannot be scaled without fundamental technical adjustments. At worst, the basic functionality of these solutions is developed separately and technically differently. Often, they don't fit together afterwards or cannot be transferred to other factories. Common examples are incompatible equipment connectivity or the use of different data models. This is also promoted by a lack of incentivization to develop use cases in a scalable way.

Another illustrative example of the need for solution scaling is provided by the use case "Automated label inspection through industrial computer vision" presented in pitfall 01. This use case represents a negative ROI when considered in terms of a single plant. However, if the solution is scaled to a large number of plants, the business case becomes very positive.

» If the solution is scaled to a large number of plants, the business case becomes very positive.

Mitigation approach
In general, there are two ways to scale a solution within a production network. Either each factory uses standardized IT systems and architecture, or one uses an IT platform to which existing heterogeneous systems and architecture are connected.

Standardization and harmonization of IT in all plants of an existing production network require considerable investment and is therefore to be considered wisely.

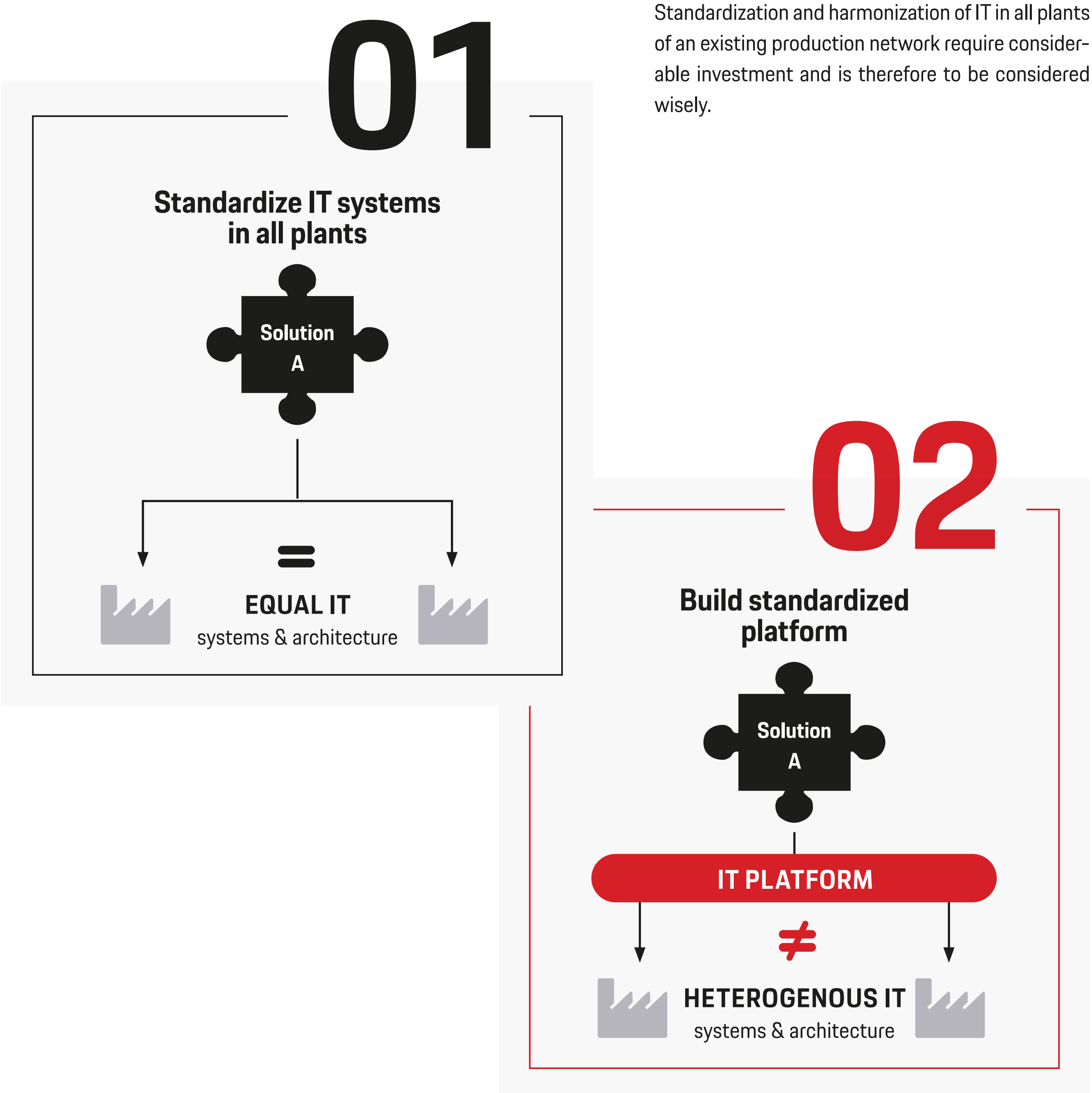


Fig. 28. Strategies for scaling solutions effectively within the production network.

Scaling use cases from one factory to another by using cloud and platform technologies are an efficient way to unlock the smart factory at scale. The platform provides the technological basis and defines the standard for data exchange within the production network and with external suppliers. Furthermore, the platform enables seamless connectivity of production equipment. In addition, use cases and services can be provided on the platform, enabling the plants to use them through a kind of app store. Once a use case has been developed, it can then be scaled to all connected plants with manageable implementation effort.

To fully leverage the potential of the platform and cloud, use cases must be developed in a service-oriented manner. This means that they should consist of scalable and – as far as possible – equal building blocks of (micro) services. One modular service can enable a wide range of use cases. An example is the computer vision service. As an image recognition service, it enables automatic detection of information from pictures using artificial intelligence. It can be used by various stakeholders across production, logistics, and quality. Examples include label recognition, crack detection on components, and control of picking tasks.

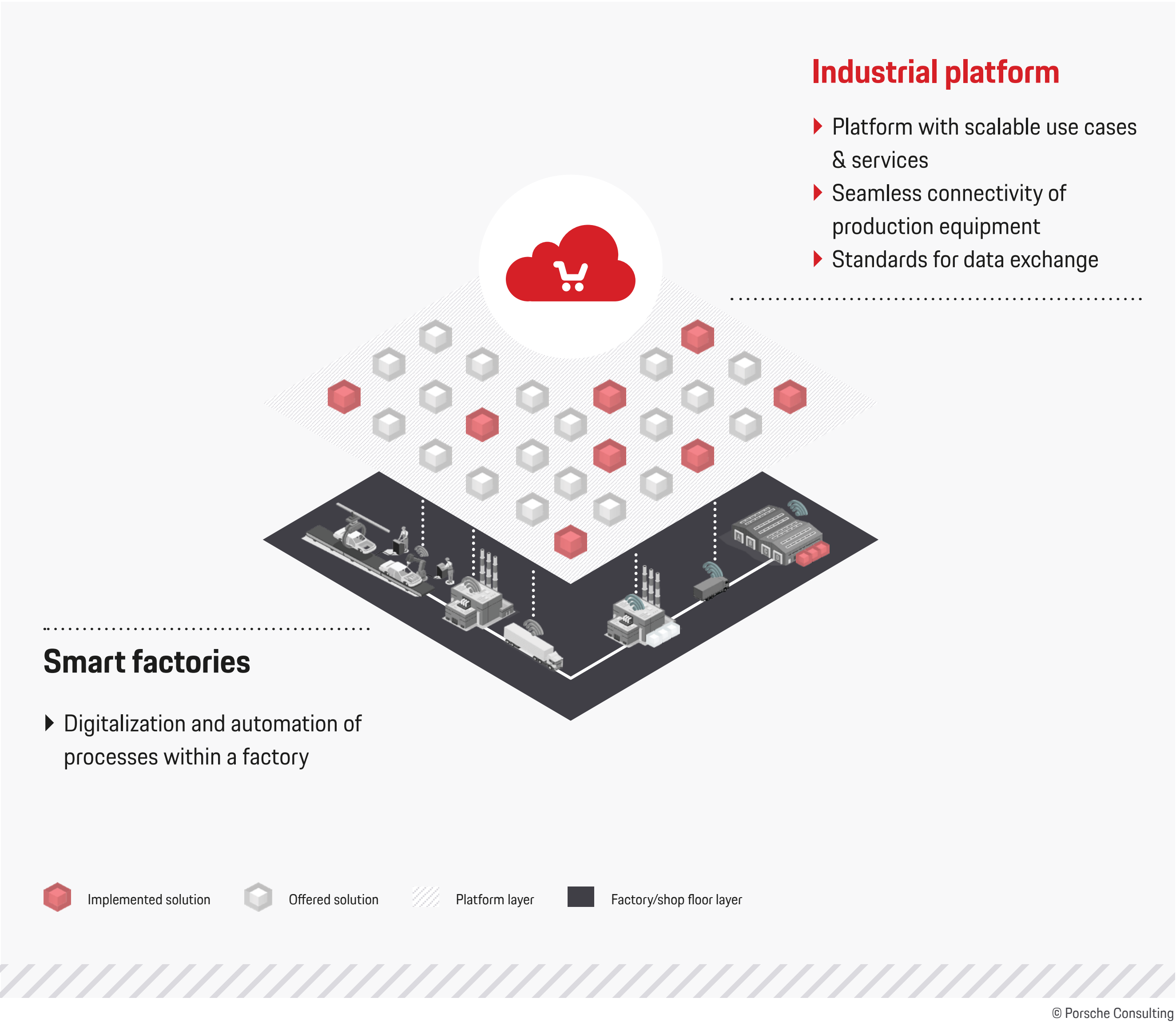


Fig. 29. Key enabler to unlock the smart factory at scale.

In addition to these technical requirements, organizational aspects must also be considered for successful scaling. It is important to focus on scalability of solutions right from the very beginning. This is done by setting the right incentives and goals. It must become a top priority for companies that solutions are developed in a scalable manner, and do not just generate short-term impact.

A scaling framework helps to holistically map the topic aspects for successful scaling. This covers all aspects from objectives and ambition to platform and architecture.

Fig. 30. Use case scaling framework.

Case study

In a cooperation with Amazon Web Services (AWS), the Volkswagen Group is developing the Industrial Cloud. It forms the technical foundation for networking all machines, plants, and systems within the Group. Processes can thus be better analyzed and use cases scaled through efficient platform use. The integration of partners and their software solutions will also be possible in the future.

Other companies also rely on cloud and platform solutions to connect their plants and supply chains. One successful example is the collaborative data ecosystem Catena-X, which is an open data ecosystem for the automotive industry, linking global players to an end-to-end value chain. The shared goal is a standardized global data exchange based on European values.

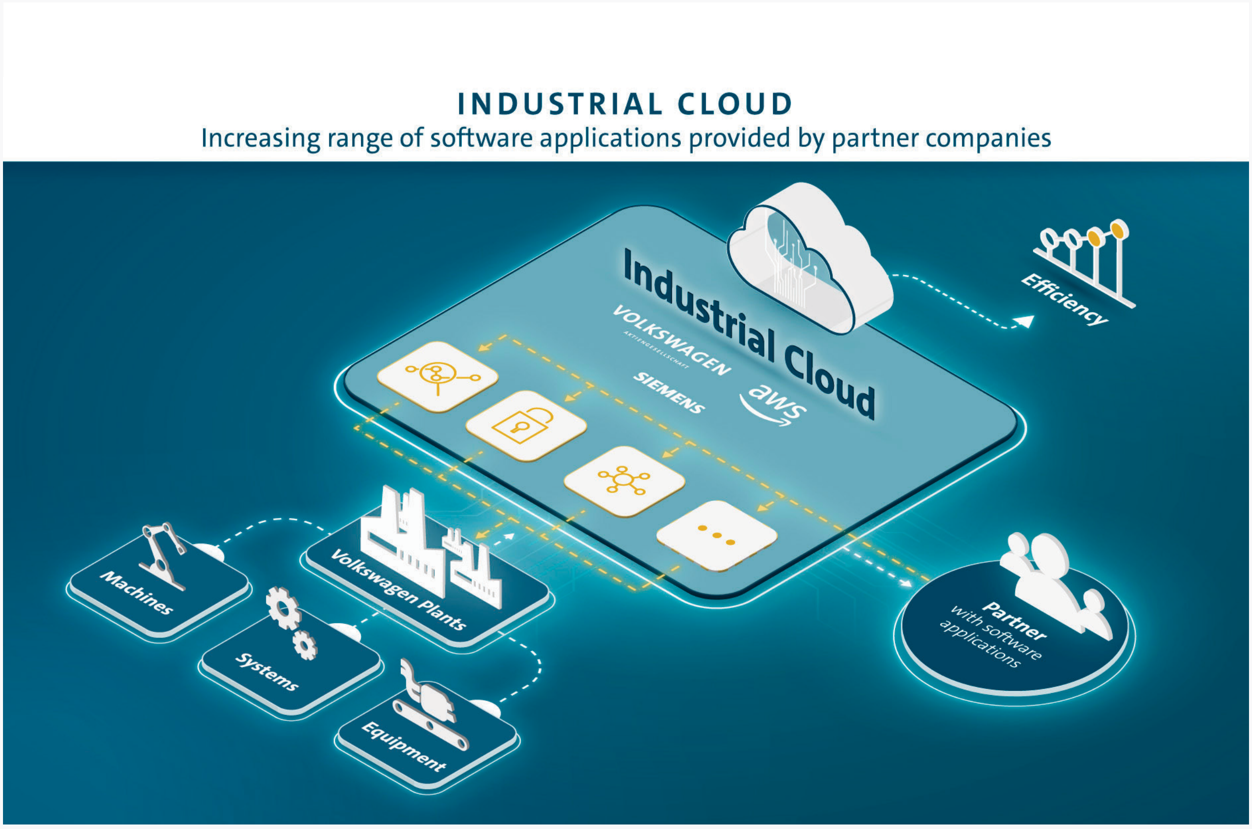


Fig. 31. Example: Volkswagen Group Industrial Cloud.

KEY TAKEAWAYS

- Cloud and platform technologies are essential enablers that facilitate the standardized provision of use cases to numerous plants, resulting in economies of scale during the smart factory transformation of large production networks.
- Regardless of the technological basis, the scaling of use cases across multiple plants can only succeed with a clear scaling strategy and dedicated design of the required organization and processes.

07 Insufficient collaboration between business units and IT

Insufficient collaboration between IT and business units manifests itself in a variety of problems that cause frustration for both business and IT sides. Collaboration is often not at eye level; instead, IT is perceived as a service provider that slows down the implementation of use cases rather than actively driving them forward. A result of missing or poor collaboration is a disconnect of digitalization road maps for IT and the business and diverging requests for project funding.

Other aspects that lead to hardened fronts between business and IT are inadequate communication and different understandings of the business. Requirements are not clearly communicated, and there are no regular meetings to discuss adjustments. The result is a prolonged time-to-market and a product that does not fully meet the requirements.

Mitigation approach

Approaches to sustainably improve collaboration lie primarily in fostering improved cooperation and communication. The goal is to break the silos between IT and business departments by aligning organization and methodology of joint work. One opportunity is the formation of agile cross-functional teams for the implementation of smart factory use cases. The teams work on jointly defined customer value and support each other in their work as they strive towards a common goal.

The goal is to break the silos between IT and business departments by aligning organization and methodology of joint work.

The teams are composed according to product-driven organization with agile working methods link Scaled Agile Framework® (SAFe®) or Large-Scale Scrum (LESS). Each project team includes representatives from the business department, IT, and – depending on the organizational structure of the company – representatives from the plant of the first implementation. This ensures a close collaboration with the user of the digital solution. To efficiently deliver digital solutions, companies also need to rethink today's way of collaboration in IT projects. Today, they work in projects and programs. In the future, business and IT will meet in product-oriented organizations such as agile teams, agile release trains (ART), and solution trains, which promote agile and iterative work. The extent to which these elements are established depends on the size and complexity of the organization.

An efficient deployment organization is shown in the following illustration. It shows the link between the process-oriented business side and the delivery and operations-oriented IT side. The latter develops and operates digital solutions leveraging agile working methods such the Scaled Agile Framework (SAFe). The linking element is the joint portfolio management, which controls and steers when use cases are developed and integrated. Agile teams always build the baseline.

In addition, a clear portfolio management framework accepted by both sides is another important element for effective cooperation between IT and business. The prioritization as well as the decision about the solution development must be based on clearly defined and transparent criteria. Business value is often the most important criteria, but the development of enablers must also be considered. It is important to note that not all decisions have to be made by a centralized portfolio management team. Based on the prioritization criteria, development teams can also make independent decisions to speed up development.

Successful collaboration between business units and IT can be summarized by the following elements:

Leading practice
In modern software development, agility is very common to ensure speed and customer centricity. The already named agile teams, agile release trains, and solution trains are the basic organizational elements of the Scaled Agile Framework (SAFe). SAFe is the leading methodology and is used across all industries.

Through agile project work, the performance (financial and product view) can be increased by 29 percent compared to the normal project work, the process speed and transparency can be increased by 36 percent and the cooperation within the team can be improved by 25 percent.[3]

Fig. 32. Measures to improve collaboration and break down silos between business and IT.

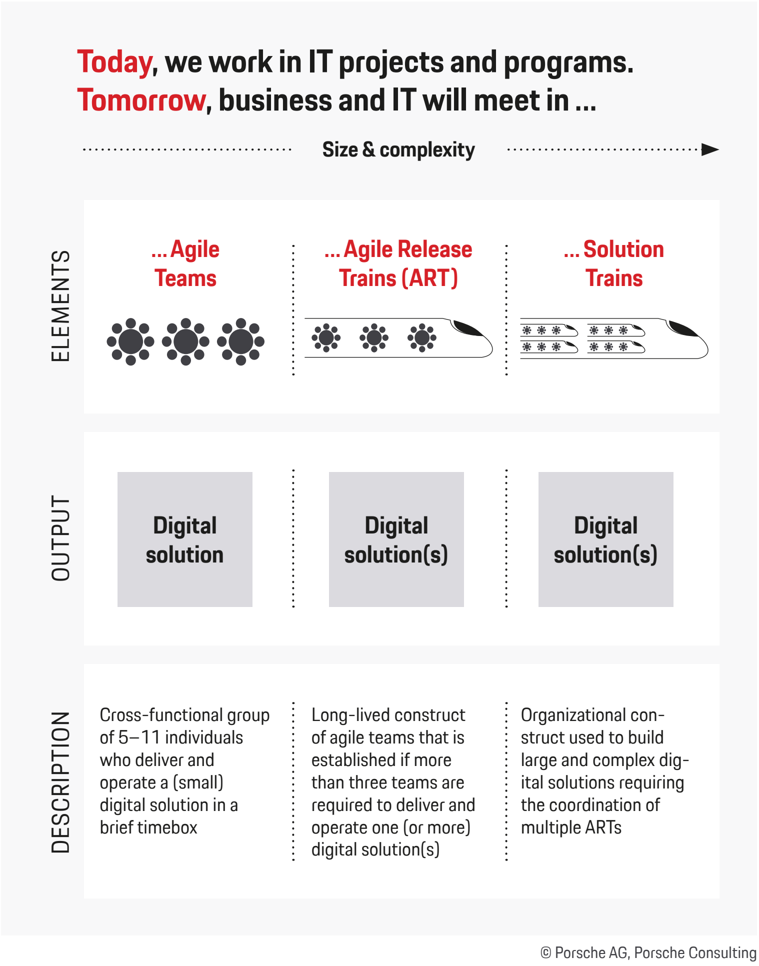


Fig. 33. Ways of collaboration in IT projects to deliver digital solutions efficiently. Source: Scaled Agile Inc.

KEY TAKEAWAYS

- Cross-functional collaboration between business and IT is critical to the success of the smart factory transformation. Therefore, break down existing silos by agreeing on common goals as well as new, agile ways of working to achieve a solution- and delivery-focused organization.
- Improve the performance of solution development by at least 25 percent by reorganizing IT to a product-driven organization with agile working methods like SAFe or LeSS.

08 Lack of organizational acceptance

The active participation of employees is one of the biggest challenges for a successful smart factory transformation and at the same time a main reason for failure because it is often underestimated.

Many corporate communication campaigns of big transformations are built on "explanation" rather than on the "activation" of employees. Based on smart factory target visions and objectives, responsible parties might easily formulate narratives as a core element around their communication initiatives. However, the mere formulation and communication of narratives does not provide insights into how an organization best processes information, translates it into acceptance for change, and converts it into active participation. This leads to a significant loss of implementation power and acceptance when transforming organizations are unable to fully engage and activate their people.

A survey in the "Change Management Compass 2023" published by Porsche Consulting states that only 20 percent of all good strategies successfully pass through a transformation program. In other words, over 80 percent of all strategic efforts fail.[4] The study confirmed that the human factor in transformation is the main reason for failure of most management efforts. A large part of the workforce, from shop floor to middle management, shows a reduced willingness to change and is neither able nor willing to actively tackle proposed changes.

The human factor in transformation is the main reason for failure of most management efforts

Given this, it is surprising that most of our respondents do not see employee activation as a challenge in their smart factory transformation. Reasons for this may vary from a misinterpretation of the questions to a general reprioritization of change management and communication itself. Nevertheless, our experiences have shown that a significant number of surveyed managers are unable to explain why many employees do not share the same level of enthusiasm as top management in actively embracing a smart factory transformation.

A practical mitigation approach is strategic change management. It complements a traditional tool kit for processing and disseminating information with the continuous change process of an organization, and actively involve employees in the process. To ensure a sustainable implementation, it becomes crucial to integrate a holistic change management approach within the framework of a smart factory transformation. This approach should consider a multi-dimensional perspective to mitigate the risks associated with a lack of acceptance.

Mitigation approach
Porsche Consulting points out five target dimensions of strategic change management that show how acceptance problems can be anticipated at an early stage.

Fig. 34. Porsche Consulting strategic change management framework.

Leadership
Executives must actively animate people to passionately drive the change. Their enthusiasm will serve as a gravitational force for employees across the entire organization. It pushes towards more acceptance of new technologies or the willingness to acquire new skills.

One effective approach to achieve this is by fostering structured dialogues at various departmental levels in everyday situations. This enables managers and employees to regularly discuss and align with the actual objectives, empowering them to define their own paths for accomplishing these objectives.

The leadership communication must be guided by the overall smart factory vision and objectives. They need to accept controversial dialogues with employees to engage them by accepting emotional discussions at the right time. Here, completely new behaviors within the organizational culture can be implemented. For instance, a moment of recognition for a successful use case pilot shares enthusiasm and provides motivation through small success stories.

Communication
During a smart factory transformation process, communication must originate from the top. To truly activate teams, executives need to be an integral part of the communication measures to fascinate all employees for where the company is headed. Only the C-level executives possess the necessary credibility, authority, and influence, along with an aligned vision and communication strategy within the leadership team, to effectively accomplish this.

Talking points – precise and easily understandable statements – must be derived for all further communication levels. These help responsible smart factory transformers to cascade, e.g., process target pictures across different organizational levels without losing essential aspects in the communication process.

Guidelines and policies

To create the necessary organizational framework for the visionary goals, executives need to adjust the regulatory context to encourage favorable new behavior patterns. This means restructuring the deployment organization in such a way that no additional bureaucratic hurdles arise in the implementation process of a smart factory. At the same time, they need to answer the question "What's in it for me?" which means to define measures how to compensate affected employees.

Changes in the organizational structure or compensation model necessitate the implementation of concrete key performance indicators (KPIs) or incentive systems. Relevant measurement systems include performance-related KPIs, such as the adoption rate of use cases or overall satisfaction measured by net promoter scores. These traditional KPIs can be complemented by metrics based on diverse team structures or the number of decentralized decisions. Rewards associated with the transformation should be provided at clearly measurable and defined intervals to enable the measurement of long-term implementation success.

New ways of working

Executives should evolve current modes of collaboration into more agile work methods and design the facilitating physical and digital workspaces accordingly.

In terms of a smart factory transformation, this implies that the business environment for project-based work must also adapt to the processual and technological changes. Thereby, deployment teams for use cases should be put together cross-functionally and be given flexibility according to business priority. These patterns enable a form of collaboration in which experts with different perspectives can actively participate in innovation work and rapid decision-making (see chapter "No dedicated deployment organization").

Future skills

Obviously, the most innovative collaboration model and work environments are worthless if employees don't know how to put it into practice. "Do-competencies" are the foundation upon which every transformation needs to be built. Thus, executives must up- and reskill their workforce (see chapter "Missing Competencies") to build up the required competencies.

Leading practice

A globally operating consumer goods manufacturer is working on a holistic change management and communication strategy following the development of their smart factory vision. The managerial discussion was focused on several core questions: How transparent should our communication be, and at which levels? How can trade unions be informed? How should we address the reality that not every factory in the network undergoes the same transformation? What is the optimal balance between centralized and decentralized information sharing?

A proven method involved collaborative work with the global leadership team to determine the appropriate level of transparency. In this process, cascading and information building blocks were defined, based on the smart factory process target pictures, and evaluated by the team. This approach ensured that simple and understandable information blocks were internalized by the top management team from the very beginning.

Together with the global program team, a smart factory blueprint including talking points answering the "why, what, and how of the transformation" and a road show for global lead sites were defined. After a detailed onboarding in the course of a global smart factory roadshow, the local organization was responsible for translating the globally formulated standards (e.g., video material, interactive games) into action.

How transparent should our communication be and at which levels?

How can trade unions be informed?

How should we address the reality that not every factory in the network undergoes the same transformation?

What is the optimal balance between centralized and decentralized information sharing?

KEY TAKEAWAYS

- Business success is threatened by stalling smart factory transformations – change activities based on scientific evidence are key.
- The five forces of change need to be optimally composed to align behavior and mindset with transformational goals and address both instinctive and rational thinking with the objective to maximize the activation rate of the workforce.
- Different types of transformations necessitate a specific balance of forces within the change architecture. As a result, strategic change management represents a win-win situation where both business goals are achieved and staff members are empowered at every level.

03

PORSCHE CONSULTING

implementation framework

Implementing a smart factory is often underestimated; it is seen as a project and not as a holistic program. Thereby, it occurred that the majority of company initiatives are carried out in a completely fragmented manner, resulting in small projects with high costs and low benefits.

To move from fragmented approaches to a holistic program approach requires a process-based methodology that follows a clear implementation road map. These aspects have been integrated into the Porsche Consulting smart factory framework, which shows from a process perspective how to implement a smart factory without losing focus. It starts from a clear vision of the transformation of processes and technology to the empowerment of people and organization.

01 STRATEGY	**Awareness**	Understanding // Assessment // Action fields
	Ambition	Objectives // Design guidelines // Vision
	Master plan	Process target pictures // Use case evaluation // Business case // Road map
02 PROCESSES & TECHNOLOGIES	**IT architecture**	Data management // Cloud strategy // Legacy systems // Connectivity
	Use case design & implementation	Specification // Modular design // Solution development
	Solution scaling	(De-)centralization level // Platform // Scaling process // Rollout approach
03 PEOPLE & ORGANIZATION	**Deployment organization**	Performance management // Transformation governance // Agile organization
	Roles & competencies	Competency attainment // Partnering
	Cultural & mindset transformation	Change management // Communication

Fig. 35. Porsche Consulting Smart Factory Framework.

The surveyed pitfalls have proven that the majority of companies are focusing on the right topics but lack a comprehensive implementation road map with top management commitment. An analogy from race driving explains why one cannot be successful by acting in a small-scale, fragmented way. Good drivers cannot compete without a comprehensive plan. The success formula is always defined by a bold race strategy, a powerful engine, and a winning team uncompromisingly convinced of victory. The ideas of the transformation framework follow a similar concept.

A bold race strategy sets the perfect implementation course:

Every transformation program starts with a clear strategy. This means a smart factory transformation must define at the very beginning of the journey a clear understanding about the current situation and the main fields of action. In a second step the management team defines the objectives to be achieved as well as an understanding about the target vision of future capabilities. Finally, process target pictures with business relevant use cases as integral part of an overarching deployment road map set the course to start the smart factory transformation.

A powerful engine contains reliable technologies to run streamlined processes:

Since smart factories are driven by decentralized, available, and processed information a structured IT architecture builds the baseline for all applied use cases. Most companies do not start their IT architecture on a greenfield design from scratch. With current infrastructure in place, one must define the future architecture needs up front along with the use cases; if one waits until mid-stream it will be too late. Second, the method used to collect, structure, and process data as well to connect data points between cyber and physical systems defines the next important building block. All activities in terms of IT infrastructure and use case development are managed by agile development teams. They are responsible for design, implementation, and scaling of use cases.

A winning team is formed out of an empowered organization:

An ideal program setup contains the definition of a comprehensive deployment organization. This means to assign clear ownership, establish a performance monitoring system, and prepare the organization for an agile program release. As soon as the deployment team runs and first successes in the development of use cases and technical layout have been celebrated, the program switches gears and focuses on people capabilities. In this step the gap of missing future competencies must be closed by acquiring necessary skills internally via upskilling activities or externally on the market. Finally, in order not to jeopardize the overall success of the program, a holistic communication and activation approach must be established to continuously gain commitment across all levels of the organization. This lays the foundation for a high-performance team that runs the smart factory and puts people in the center of the transformation.

This experience in combination with the top management survey gave deep insights regarding the cross-industry smart factory level of maturity. A comparison of various industries reveals both similarities and substantial differences. The survey shows room for improvement across all phases and industries. In particular, the professional setup of a deployment organization, the scaling of use cases, and the attainment of the required competencies offer clear potential for further improvement.

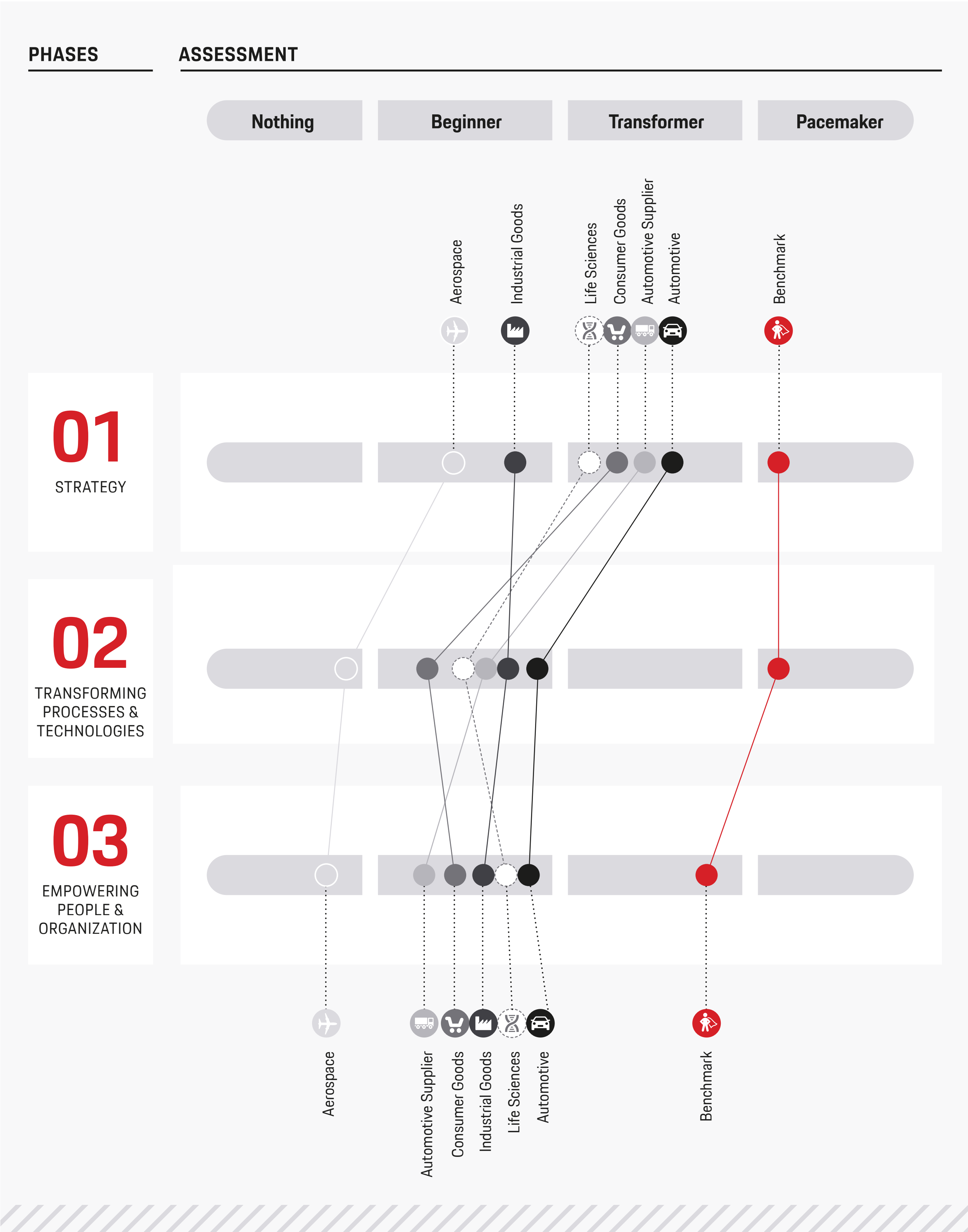


Fig. 36. Smart factory maturity across different industries.

IN BRIEF

01 The objectives for a successful implementation and operation of a smart factory must be derived from the overall corporate strategy of a company.

02 Top objectives for a smart factory transformation can be classified into five dimensions, including productivity, reliability, flexibility, attractiveness, and sustainability.

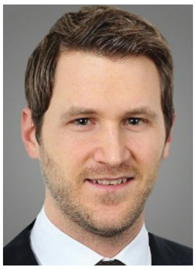
03 Most companies do not meet their own expectations since they fall short in achieving defined smart factory goals through their own transformation efforts.

04 To attain the expected impact, companies need to actively manage the eight common pitfalls and cover all topics from undefined vision and objectives to missing use case implementation.

05 The smart factory must be understood and treated as a holistic transformation program and journey, not as a single project.

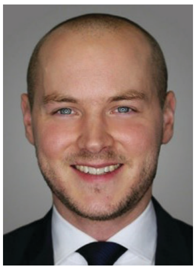
Authors

Markus Uellendahl
Senior Partner

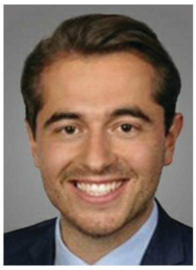


Tobias Helberg
Partner

Julian Zawila
Manager



Hendrik Thyssen
Senior Manager



Dominik Hilpert
Manager

Contact
+49 170 911 5146
markus.uellendahl@porsche-consulting.com

Co-Authors

Adrian Schöning, Titus Loss

Porsche Consulting

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Appendix

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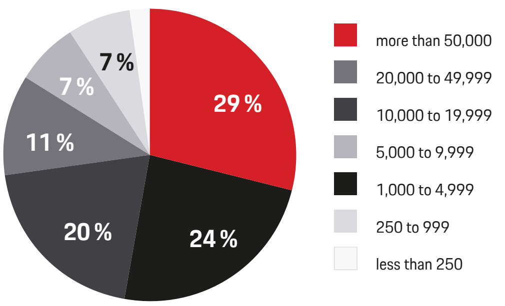
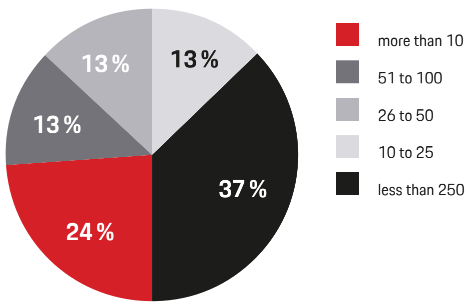
Survey background and methodology

Porsche Consulting's insights presented in this document were created from a survey conducted between May and October 2022. The survey leveraged experiences from 48 top managers who were positioned from CEO/COO to senior manager within their respective companies. Forty-eight top managers from international companies were asked to share their experiences with smart factory activities. A sample of the industries surveyed are aerospace, consumer goods, industrial goods, automotive, and life sciences. 73 percent of the companies represented were greater than 10,000 employees with 67 percent having 10 or more factories, and 68 percent with a revenue greater than $1 billion. To complement our clients' estimations, we from Porsche Consulting compiled our cross-industry project experiences from >100 projects over the past five years within this paper.

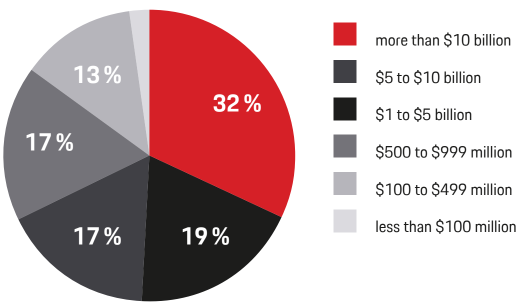
Size of Employer



Number of Factories



Revenue



Seniority