Industry 4.0
Is your ERP system
ready for the digital era?

Industry 4.0 stands for disruptive change caused by the expansion of the Internet of Things and by Cyber-Physical Systems in production and logistics. The term includes innovations such as intelligent products and processes, a deeper integration along the supply chain, and digital technologies in production. The aim is a faster reaction to increasingly variable customer demand, resulting in increased competitiveness in dynamic, volatile markets. This study assesses available SAP® technologies in the area of enterprise resource planning, illustrates the successful implementation of Industry 4.0 in an integrated concept with the help of use cases, and makes recommendations.

Deloitte in the Digital Era

Deloitte is one of the largest audit and consulting companies in the world. Unlike other consulting companies, we offer a broad variety of consulting services in different areas. These span the conceptualization of future-oriented strategies, the establishment of optimized processes, the transformation of a whole organization, and the implementation of innovative technologies. We always strive for the best solutions and we therefore make use of our network – which consists of more than 250,000 experts worldwide – to respond in an optimal way to clients' requirements.

Industry 4.0 as a cross-functional topic: our strength

As all business functions and processes are affected by Industry 4.0, Deloitte is the ideal partner for mastering this theme. Disruptive technologies such as the Internet of Things (IoT), Big Data, and Analytics provide an opportunity to improve current processes or to develop processes which have not been realizable up to now. Processes change but so do the roles and responsibilities of employees: rather than being machine operators they become shapers and controllers of smart, connected systems. Companies that engage in Industry 4.0-oriented process changes are constantly communicating with their business partners. Hence, new products and services can be offered which influence the company's strategy and business model.

Enterprise Resource Planning: still the company's backbone

In recent years, Enterprise Resource Planning (ERP) systems such as SAP® ERP ECC and SAP S/4HANA® have become the central instance for the planning, control, and execution of all business processes, due to the advantages of depicting all business-relevant data in, and accessing it from, one system. Industry 4.0 is not going to change this, but the role of ERP systems will change. The focus will shift from central data collection to the support of mobile, role-based user interactions. Thanks to real-time data access and intelligent data analyses, the efficiency and transparency of process execution can be increased significantly.

Our competencies in Enterprise Resource Planning and Industry 4.0

But this does not happen automatically. Every company needs a tailored concept to make optimal use of its data. It is only then that the company will be able to adapt flexibly and dynamically to the changes demanded by the market. Innovative data management – which will be presented later on in this paper – must therefore be developed. Deloitte represents a reliable and competent partner in designing and realizing such data management as we have more than 12,000 experts in the area of enterprise applications, especially SAP, who assist in implementing and enhancing ERP systems.

We want to share with you the ERP and Industry 4.0 expertise we have developed. In the following sections we outline the challenges as well as process-related and technical requirements for ERP systems in Industry 4.0 and present the ERP systems best suited to supporting Industry 4.0.

Our understanding of Industry 4.0

Owing to the growing uncertainty in the market and the customer's desire for more individualized products, companies are coming under pressure to make their production and logistics processes more flexible. The key word is Industry 4.0. The entire IT infrastructure must therefore be redesigned – this includes systems for the planning, control, and execution of production and logistics. The key to process integration is innovative data management with an Enterprise Resource Planning (ERP) system as central planning instance. First, the term Industry 4.0 and its relation to a company's EaRP system will be defined.

The path towards the fourth industrial revolution

After mechanization with the help of water and steam power in the late 18th century, the standardization and division of labor that enabled mass production in the early 20th century, and the electrification and further automation of production in the 1970s, we are now experiencing another change: the fourth industrial revolution – Industry 4.0. Industry 4.0 presents opportunities and challenges but it represents a change that companies need to come to terms with in order to stay competitive in the market.

The Internet of Things in production and logistics

Our understanding of Industry 4.0 is the application of the Internet of Things (IoT) to industrial processes. This refers especially to the representation of physical objects such as machines, tools, workpieces, and workpiece carriers and their equipment in the digital world, with the ability to communicate with other objects. These resulting smart objects are connected with each other and together they build a system which allows for more flexible, more efficient, and more transparent planning, control, and execution of production and logistics. This also requires changes along the supply chain and in work organization and adapting business models and services.

Technical pillars of the development

The interconnectedness of physical objects facilitates innovative, decentrally controlled production systems which permit the production of small lot sizes and a range of product variants. This development is mainly enabled by the miniaturization and increased performance of microelectronics, communications, and information technology. But technologies which can be linked to Big Data are just as important for the implementation of Industry 4.0. This affects the storage, exchange, and effective use of large amounts of data arriving at high speed from different data sources. Moreover, technologies for data input and output such as 3D scanners, virtual reality glasses, and mobile devices are needed.

Technical integration of Cyber-Physical Systems

Cyber-Physical Systems (CPS) are frequently mentioned in connection with Industry 4.0. Sometimes Industry 4.0 is even used as a synonym for the technical integration of such systems in production and logistics. CPS refers to the involvement of computational logic in physical processes. Embedded, connected computers monitor and control physical processes in a closed-loop control in such a way that the physical process and the computational logic influence one another. Machines and products are therefore equipped with sensors, actuators, and a connection to the company's communications network. The embedding of the products as active components in the CPS is essential. This way workpieces and workpiece carriers hold all necessary information for executing and controlling their production themselves.

The ERP system as an essential part of a Cyber-Physical System

The purpose of ERP systems is to serve as the central instance for master and transactional data in all business-related processes in companies. With the help of interfaces, ERP systems are connected to input and output devices such as scanners, illustration and communication devices and also to other hardware-software-systems within and across companies. Consequently, the ERP system can be seen as an essential part of the CPS network and therefore needs to be taken into account in integrated Industry 4.0 concepts. However, new, flexible processes and especially the dissolution of the paradigm that all company data has to be stored centrally pose a challenge to ERP systems. This is why the study examines how different SAP technologies can support Industry 4.0.

Goals for strategy, organization, and processes

Industry 4.0 aims at making production and logistics processes (which are currently planned, controlled, and executed statically) more dynamic. Industry 4.0 therefore also has an impact on all performance levels and processes which companies deal with to create value for the customer. Such performance layers – which will be later used to illustrate use cases – are for example the IT infrastructure, operational processes, planning, and controlling. On the other hand, knowledge, capabilities, the company's culture, organizational structures, and strategic targets also present areas for change. Thus the goals of Industry 4.0 can be divided into three categories: strategy, organization, and processes, as shown in Figure 1.

Industry 4.0 has implications for all performance areas and business functions of a company.

Fig. 1 – Goals of Industry 4.0

Strategy	• New business models and services through digitalized products • Shorter time-to-market for a fast reaction to new customer demands • Higher robustness to volatile customer demand
Organization	• Increased quality of work through an improved work-life-balance • Diversified tasks through the automation of routine jobs • User-centric work environment through innovative man-machine-interaction
Processes	• Saving of time through more efficient and more transparent production processes • Higher flexibility through dynamic planning, control, and execution • Higher productivity and resource efficiency for individualized products • Shorter lead times through the application of intelligent analyses • Different work organization through mobile process control and execution • Increased quality through predictive error avoidance

Demands on ERP Systems made by Industry 4.0

If the ERP system is to be used in a CPS environment to support Industry 4.0, it must fulfill a variety of technical and process-related requirements which are described below.

Technical requirements

Data becomes more and more the key to the planning, control, and execution of all activities along the supply chain. That is why companies must handle all data with care and make wise use of them. Companies must look for new ways of using data and need to exploit the opportunities of their data security to create an effective basis for decision-making. The main challenge here is innovative data management. For us, innovative data management is a comprehensive, long-term concept which maximizes the value of data for the business and includes the storage, exchange, and use of data. The development and implementation of such concepts must be encouraged, as only data which is error-free, up-to-date, accessible, and usable can contribute to the company's success. In conclusion, technical challenges lead to technical requirements (TR1, TR2, and TR3) for ERP systems which are shown and described in Figure 2.

Fig. 2 – Technical requirements for ERP Systems

TR1
Data storage

Simplification of data model:
- Simple table structures for the logical data model of ERP systems
- Goal: abandonment of intermediate results (timeliness of data)

Decentralized data management:
- Distributed storage of data in different systems
- Goal: dynamic, bi-directional (ERP-MES-PLC) loading of data to control processes flexibly

TR2
Data exchange

Connection to legacy systems:
- Exchange (vertical and horizontal) and processing of data with and from different hardware-software systems
- Goal: integration of systems for a flexible planning, control and execution

Speed of data access:
- ERP system should deliver requested data within short response times
- Goal: fast reaction to changes which are on short notice

TR3
Data use

Visualization:
- The user interface of the ERP systems should display information adequately (i.a. display on different devices), understandingly und intuitively
- Goal: improvement of human-machine interaction

Integration and Intelligence:
- ERP system should connect data from different sources and hence create new information
- Goal: generation of new information

Automation:
- ERP system should use the data to trigger automated processes
- Goal: reduction of errors and increase in efficiency

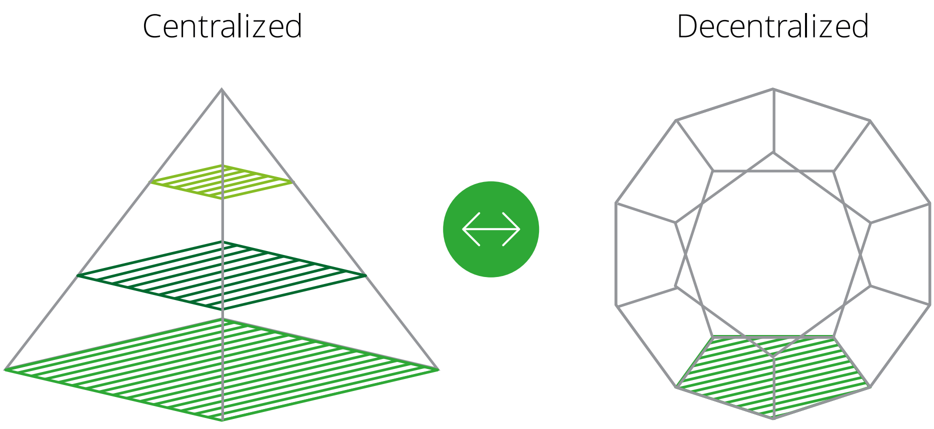
TR1 – Data storage: logically simplified and physically distributed

There are two perspectives on data storage, the logical and the physical. The logical perspective describes the data model and hence the structure of the database which serves as the central instance for the company's data management. Typically, an ERP system is based on a number of tables which store fundamental data as single entries, aggregated intermediate results, and condensed data. For classic ERP systems these condensed data are based on computation routines which can be executed at predefined time intervals only. This is due to a lack of performance which leads to data not being up-to-date. An example would be the posting of inventory between storage locations. The flexibility which is necessary for Industry 4.0 is only achievable if the planner is able to access the most current data from all business functions. This requires the development and implementation of a simplified data model which allows access to a current, single set of data at all times and which also updates upstream results.

The physical perspective of data storage is the physical place where data is stored and managed. There are two opposing ways of storing data, namely completely centrally and completely decentrally. The centralized approach represents the main idea of ERP systems where all important company data are stored in one place in order to avoid redundancies and inconsistencies. Nevertheless, this increases the size of the centralized database which requires novel technologies for efficient data processing. Thinking about flexibly controlled production reveals that not all data are available in advance and thus cannot be stored centrally. For example, when it is not desirable to assign an order sequence, the workpiece has to be identified dynamically. Then some data such as the workpiece's identifier and in some cases also work instructions have to be stored decentrally on the workpiece itself.

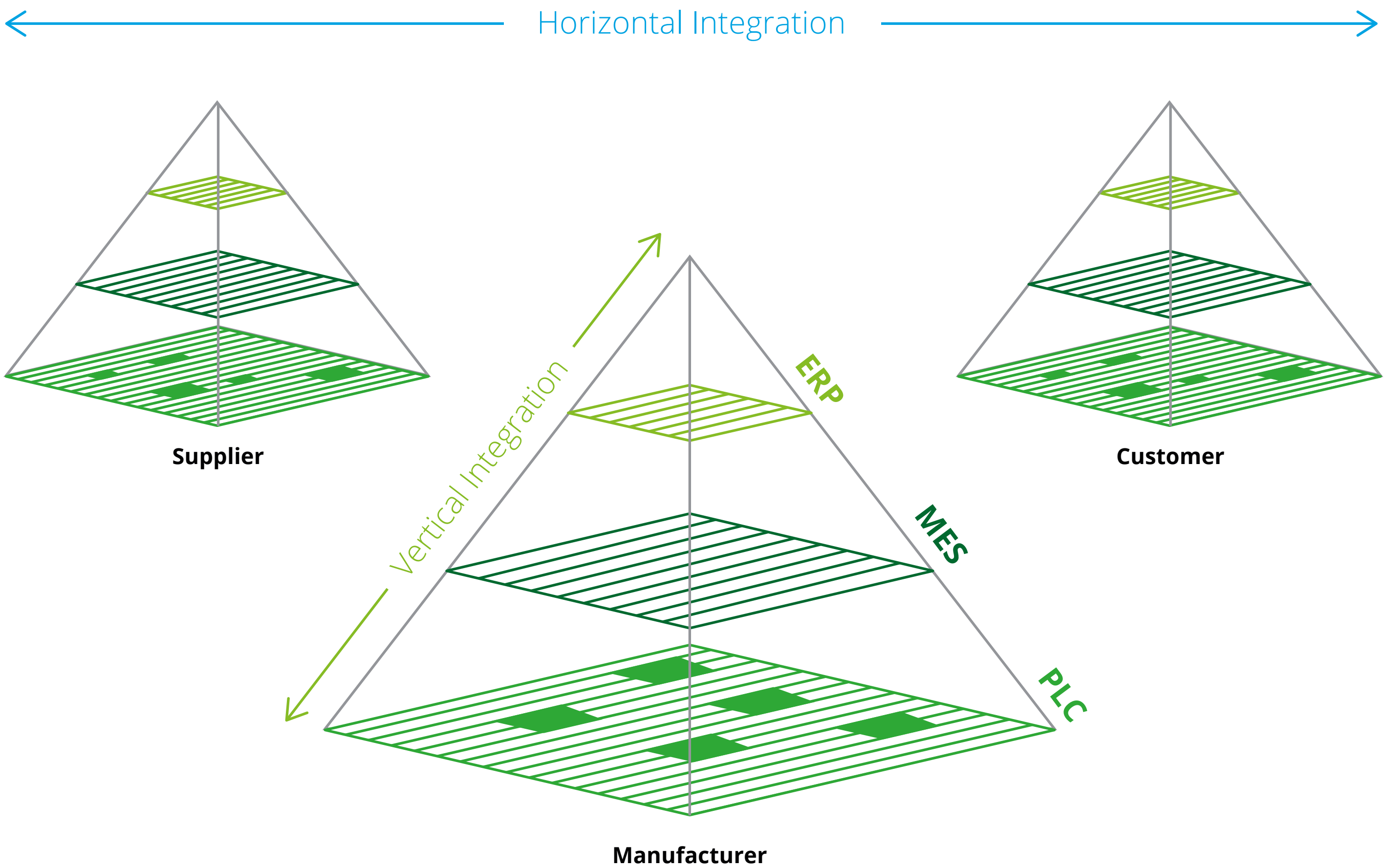
On the other hand it is possible to store data decentrally where there is no hierarchy of IT systems. In such a scenario, the independent systems start communicating with each other when there is the need to solve temporary tasks such as finding the next work station for the processing of the work piece. This theoretically achieves the desired flexibility. Nevertheless, there is no way to avoid redundancies and inconsistencies in that case. General data such as, e.g., the organizational structure and material master data have to be managed centrally. Moreover, it is also important for flexible production to plan sequences in advance in order to have sufficient resources (personnel, budget, etc.) available. This is why it is a challenge in Industry 4.0 to balance centralized and decentralized data storage to avoid redundancies and inconsistencies, allow for planning, and realize the desired flexibility. This is summarized in Figure 3.

Fig. 3 – Data storage



The main component of innovative data management is the smart combination of centralized and decentralized data storage.

Fig. 4 – Data exchange



Vertical Integration: Exchange of data between the ERP system, the MES, and the shop floor
Horizontal Integration: Exchange of data along the supply chain through the integration of customers and suppliers

TR2 – Data exchange: integrated and immediate

As companies interact with other parties such as suppliers, institutions, and customers beyond their boundaries, an ERP system has to be able to support end-to-end processes and to exchange data with these external parties. This horizontal integration facilitates the consistent availability of customer and supplier data. Horizontal integration is one of the strengths of ERP systems, thanks to their existing interfaces.

A vertical integration of the planning, control, and execution levels in the company additionally enables flexible control of production and logistics processes. For example, production orders are exchanged between the planning level, ERP system, and the execution level, manufacturing execution system (MES). The latter then exchanges data with the machine's programmable logic control (PLC). The challenge that arises is hence the connection of the ERP system in two directions – horizontal and vertical (see Figure 4).

The flexible planning, control, and execution of production requires vertical and horizontal connection of data generated by different systems.

For horizontal integration beyond the company's boundaries it is vital to define and establish communication standards for data security and to avoid data manipulation. As the IT systems of the different supply chain partners communicate using a number of interfaces it has to be ensured that the technologies are capable of being integrated.

Apart from the possibility of connecting different systems with each other, the speed of the data access of ERP systems and connected data sources is another challenge that presents itself. As mentioned earlier when discussing logically simplified data storage, the planner has to be able to access the most up-to-date data to supervise and, if necessary, influence production and logistics processes. This is why ERP systems need to have minimal response times. If data is stored in different places, data exchange is essential for process execution and immediate data access is even more important. It is thus obvious that a concept for innovative data management must integrate the storage, exchange and – to be explained next – use of data.

TR3 – Data use: intuitively displayed, integrated and automated

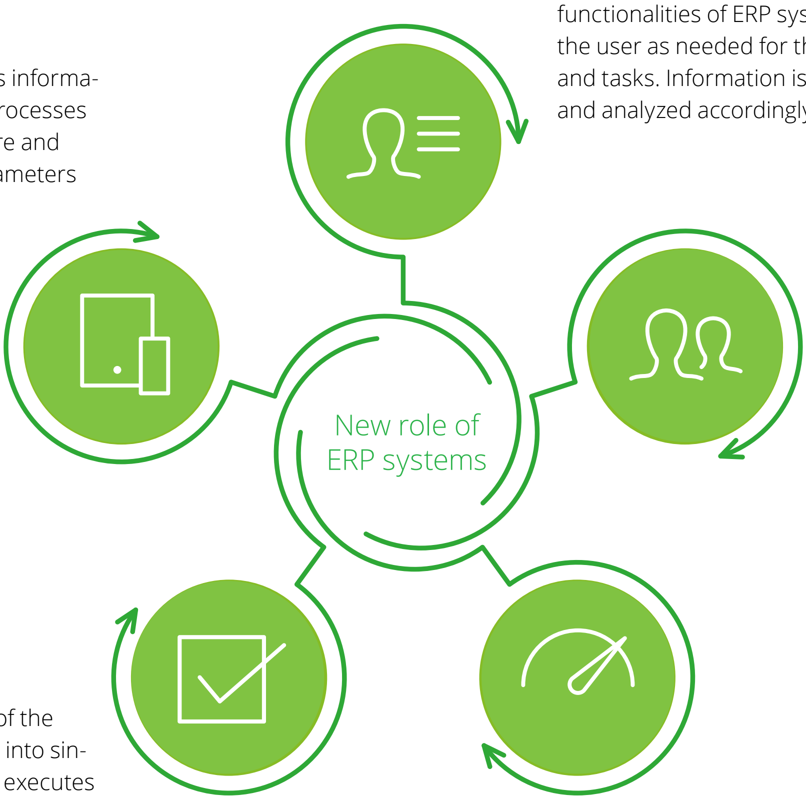
To maximize the potential of company data it is important not only to store and exchange data but also to use them effectively and efficiently. Such advanced data use has to be applied to all data, independently of their storage location – but especially to the data which are physically distributed. For us, advanced data use also considers user-friendly human-machine interaction, data connection among different companies, and the automation of business processes. The challenge is the realization. Over recent decades, companies have collected large amounts of data but they are still at an early stage of using it wisely. The reason for this is that the existing data have to be connected intelligently to new information. Only if large amounts of data are connected can Big Data become Smart Data.

An example is the collection of data from the various machine tools with the help of sensors. These collected data are then enriched with technical data such as threshold values and historical data, commercial data such as costs, and external data such as demand forecasts, to create new business-relevant information. The resulting key performance indicators (KPIs) serve as a basis for analyses and reports. Automation, either partial or complete, can take place on the basis of these processes. For example, imagine the automated procurement of material based on the expected demand in the next planning period and the current inventory level. When projected stock falls below a threshold, purchase requisitions are automatically generated and purchase orders are sent out to the supplier.

Apart from using data to trigger automated execution or at least other processes, the visualization of data is important for involving the user. The user therefore needs to have the possibility to interact with the ERP system, using an adequate user interface. The design and configuration of such user interfaces which are based on self-explanatory elements for the visualization and the mobile use of data on different devices such as smartphones and tablets provides an enormous potential from a process-related point of view. The easier it is for the user to work with ERP systems, the more efficient and more transparent process execution will be and the fewer errors will be made during data input. To exploit the full potential of such interfaces they should have the following five characteristics:

Role-based –
the user interface provides the functionalities of ERP systems to the user as needed for the job role and tasks. Information is displayed and analyzed accordingly.

Mobile –
the user is able to access information about production processes at any time and anywhere and may change control parameters promptly.



Personalized –
the user interface provides the user with modern functionalities which give the impression that the work is supported according to individual needs. This way a bond between the user and the working medium is established.

Simple –
complex functionalities of the ERP systems are divided into single steps which the user executes one after another. The simplification of the user interface increases the efficiency and reduces the probability of errors.

Agile –
the user interface enables the user to work quickly and without delays with an ERP system. Information is called, processed, and visualized immediately.

New role of ERP systems in data storage, data exchange, and data use

In Industry 4.0, ERP systems will fulfill a new role. Typically, an ERP system is the central instance for data storage in a company to plan, control, and execute business processes. This is the ERP system's strength which continues to exist. But the ERP system has to be embedded into an upstream, connected system consisting of intelligent components. It will still be the central part of this entire system but for example not all data will be stored in the ERP system's database any longer. Moreover, the connections to other IT systems become more and more important and so does data use. The planner receives intelligent analyses based on real-time data which can be accessed on various devices with a modern user interface replacing access to tables with the help of transactions.

All dimensions of innovative data management – data storage, data exchange, and data use – are affected by the new role of ERP systems. An adequate concept has to be developed individually for each company to maximize the benefits of Industry 4.0. For example, it has to be decided which data should be stored centrally in the ERP system and which data it is advisable to store decentrally on the workpiece itself. Static data such as material master data could be stored centrally to avoid redundancies and inconsistencies while dynamic data such as transactional data for orders could be stored decentrally to allow for flexibility. Data exchange with all IT systems has to be planned carefully and there is a need to assess which novel technologies such as sensors, analytic algorithms, and data glasses are able to make the use of ERP systems even more efficient.

Process-related requirements

To achieve the goals of Industry 4.0 listed in Figure 1 (higher flexibility, increasing quality, etc.) processes along the supply chain have to be adjusted. In particular, the increased flexibility in production is of great importance to enabling the manufacture of individualized products at low cost and with high resource efficiency. The idea of a flexible and adaptable production is not a new one. Nevertheless, Industry 4.0 changes the way of achieving the desired flexibility compared to frequently used management methods.

In Industry 4.0 ERP, systems will still play a central role but it has to be evaluated how they should be used to maximize their potential for Industry 4.0. It is obvious that new requirements for ERP systems exist. Apart from the technical requirements described in the previous section, there are also process-related challenges to cope with. These challenges lead to new process-related requirements (PR1 to PR6) which are listed and described in Figure 5.

Lean Management and Industry 4.0: lean and still flexible

The focus in both concepts for all planning and controlling activities is the customer and their need for individualized products. This is why production models which are based on requirements are used. The reduction of inventory which is a form of waste in lean management is also aimed for in Industry 4.0. It should facilitate the steadily growing range of variants at low cost. A lot size of one is also requested in Industry 4.0.

The main differences between Industry 4.0 and Lean Management are the following: the static sequencing and release of production orders and the worker, in additionto the machine, as central instance for production execution, e.g. for quality assurance. In Industry 4.0, production orders may be adjusted frequently and are released just before executing the task that was changed. This way the rough-cut and detailed production planning becomes less important as customer orders and requirements can be committed directly to the production line.

Moreover, the approach to avoiding errors differs in Industry 4.0 from the one in Lean Management. In Lean Management, quality is created throughout the process. It is the worker's duty to identify errors and correct them cumulatively. This leads to a continuous improvement for the company. But the process is a reactive one and this is why Industry 4.0 uses technologies proactively to identify errors. With the help of continuous data collection, data consolidation and the use of analytics, errors are detected before they interrupt production (predictive maintenance).

The goals of both concepts are similar. Nevertheless, the focus of production means changes from the worker to self-optimizing production machines.

Fig. 5 – Process-related requirements for ERP systems

PR1 **Suitability for dynamic planning, control, and execution**	**Technical connection of ERP Systems to MES and PLC:** • Vertical integration to make the production planning and execution more dynamic • Bi-directional exchange and usage of decentralized stored data • Goal: cost-efficient production of a higher variety of variants
PR2 **Support for an integrated end-to-end process**	**Technical connection of supply chain partners:** • Horizontal integration e.g. with suppliers and customers • Goal: integrated information and process flow along the supply chain
PR3 **Progressiveness of the human-machine interaction in the process**	**Modern user experience:** • User-friendly, personalized and intuitive human-machine interaction • Role-based and graphical data input and output • Goal: fewer errors and more efficiency in the process execution
PR4 **Location-independent control and execution of processes**	**Use of innovative mobile applications:** • Horizontal integration e.g. with suppliers and customers • Goal: integrated information and process flow along the supply chain
PR5 **Efficiency of process steps supported by the system**	**Performance of processes supported by the system:** • Faster data processing based on current data • Goal: ad-hoc processing of requirements which changed on short notice
PR6 **Process improvement through intelligent data analyses**	**Effective usage of connected data:** • Use of all existing data from different data sources • Generation of intelligent reports • Goal: decision support for predictive planning and control of processes and/or the trigger of automated, subsequent processes

PR1 – Suitability for dynamic planning, control and execution: vertically integrated and interconnected

PR1 consists of two main criteria: the possibility of technically connecting ERP systems to MES and PLC and its support of decentralized planning, control, and execution.

The connection of the ERP system to the MES and PLC creates a vertical integration of different organizational levels. This facilitates a dynamic release of production orders that aims at manufacturing a large range of variants at low cost. Changes to the production order can be transmitted to the MES immediately through the integrated data exchange between the ERP system and MES. The MES sends the changes to the PLC of the machine which adjusts the execution of the production order at once.

The decentralized planning, control, and execution of production is supported by the ERP system when it is able to exchange data that is stored in different places bi-directionally. This aims at making production even more flexible (see paragraph on data storage in section 2.1).

PR2 – Support for an integrated end-to-end process: horizontally integrated and flexibly adjustable

The technical connection of all business functions and all external supply chain partners creates horizontal integration that aims at an integrated information and process flow along the supply chain. This way a supplier can react more swiftly when facing changes in the customer order or supply bottlenecks. Process parameters can be adjusted flexibly according to changing requirements, while taking cost efficiency and quality goals (on-time delivery performance) into account.

An example that illustrates the benefits of the horizontal integration of different supply chain partners is the SAP Asset Intelligence Network. It is a secure network which automates asset data exchange between OEMs, operators, and service providers using a collaboration platform based on cloud technology where metadata is stored. This way manufacturers profit from customer feedback and can improve their machines. Operators can take over the asset master data and spare parts information provided. Moreover, they can reduce their maintenance costs and times, among other things by shortening issue response times with the service providers.

Horizontal integration is vital for implementing Industry 4.0 as it permits the exchange of data easily and efficiently between different business functions and supply chain partners.

PR3 – Progressiveness of the human-machine interaction: efficient and error-free

Process execution can become more efficient and less error-prone if it provides a modern user experience. A user-friendly, personalized, and intuitive human-machine interaction and role-based and graphic (instead of transaction-based) data input and output supports the worker's daily activities.

An example would be the collection, processing, and visualization of stock data with the help of modern devices. Stock information does not have to be written down on a piece of paper and entered into a stationary system any longer. It is now possible to enter and send the data to the ERP system on-the-fly using an app. This reduces manual work and minimizes errors during data collection. Additionally, the data in the ERP system reflect the current stock situation at all times.

PR4 – Location-independent control and execution of processes: whenever and wherever

The ERP system should provide innovative, mobile applications for user interaction, for example via smartphones and tablets, ideally out-of-the-box. These applications should be applicable to all business-relevant processes and aim at flexible control and the execution of processes from anywhere at any time.

This way the production manager can supervise the manufacturing from afar, since operating figures are displayed on a mobile device. If there is any abnormality or the need for adjustments the manager can also intervene using a mobile device.

Another example is the support of maintenance workers. Intuitive applications can be configured for their tasks so that the worker receives e.g. part and maintenance information on a mobile device.

PR5 – Efficiency of process steps supported by the system: fast and adaptive

The performance of processes that are supported by the system contributes significantly to the flexibility of production. Faster data processing based on current data helps to achieve the goal of a fast reaction to changing requirements.

If there is any change in data it is important that all systems which have access to these data are always synchronized. Only in this way can it be ensured that all business functions work with current and consistent data. If this is not the case, the repetition of work is an inevitable consequence. For example, a change in the bill of materials in the ERP system which is caused by poor quality influences not only the procurement process where new parts have to be purchased but also the production process as different components have to be used for the assembly. Consequently, the new bill of materials has to be transferred to the MES which does the detailed planning for production steps and resources.

PR6 – Process improvement through intelligent data analyses: effective, predictive, and automated

An ERP system has to be capable of using connected data effectively. All available data, especially those from different data sources, have to be used. The aim is to create intelligent reports which serve as decision support for predictive planning and execution of processes and/or trigger automated, downstream processes.

Some procurement tools are able to analyze the stock and consumption information of materials themselves. When stock falls below a certain threshold they can automatically generate purchase requisitions. The buyer will be alerted and can accept or reject the purchase requisition. In some cases the system can automatically send out purchase orders to a supplier (sometimes even previously chosen among a number of offers by the system itself) to guarantee materials availability.

Assessment of existing SAP technologies

SAP SE supports the trend towards Industry 4.0 with technical innovations which can be differentiated between technologies for data storage, data exchange and data use (see Figure 6). In the area of data storage SAP SE offers the in-memory database system SAP HANA, which speeds up data access. The integration software SAP Plant Connectivity (PCo) in combination with SAP ME and SAP MII can be used to exchange data from the underlying ERP system down to the machine control level. An example for an innovation with regards to data use are SAP Fiori and UI5 Apps with built-in analytical functions.

Fig. 6 – Process-related requirements for ERP systems

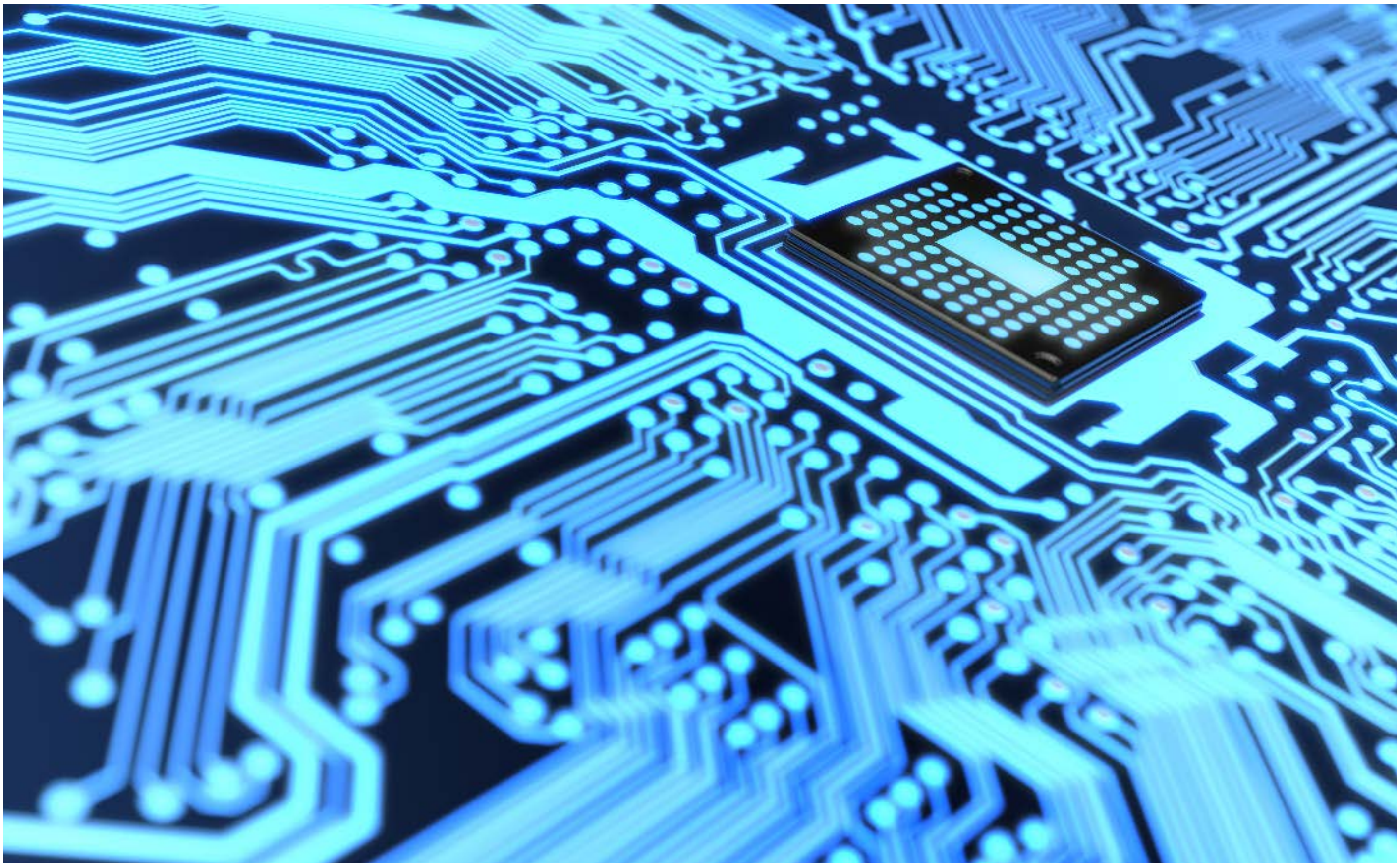
Data storage | **Data exchange** | **Data use**

SAP HANA DB Architecture
The HANA database supports almost instant data access by storing data in fast memory, column-oriented data management, and the shift of program code from the application level to the database level.

SAP ME, SAP MII and SAP PCo
SAP ME, SAP MII and SAP PCo facilitate data exchange between the ERP level and the machine control level. As a result, the program can incorporate dynamic information.

SAP Fiori & UI5 Applications
SAP Fiori and SAP UI5 offer role-based applications and interfaces on mobile devices. With the help of alerts, the attention of the user is directed to critical situations, while suggesting possible solutions.

SAP SE supports the increase of flexibility in production by offering different technologies in the area of data storage, data exchange, and data use.



ERP system classes: status quo, evolution and revolution

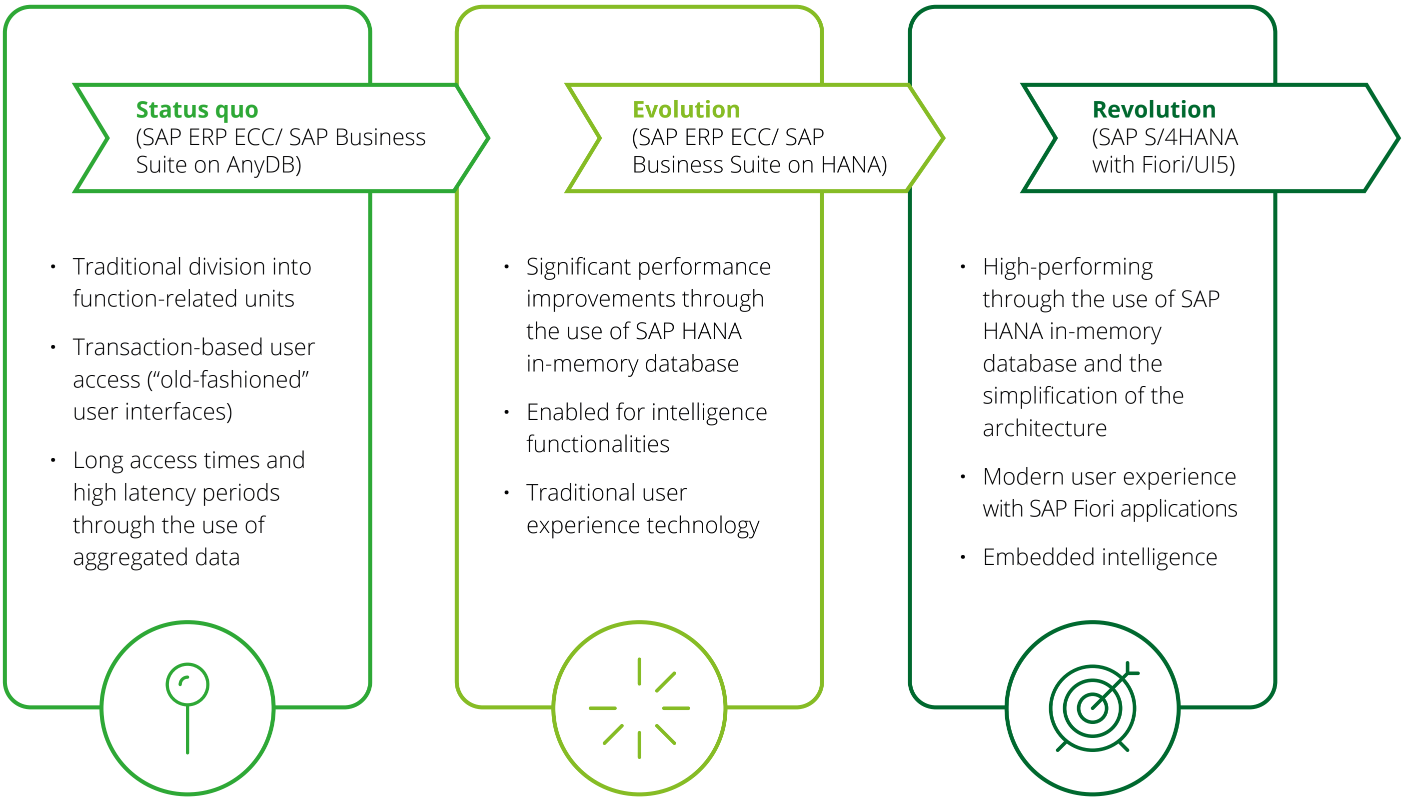
The technology stack of existing ERP systems can consist of one or even several of the technologies described above. According to their technical characteristics, it is possible to classify various ERP installations into the three following groups based on their level of innovation (see Figure 7):

1. **Status quo:**
   ERP systems which offer classic ERP functionalities on the basis of DB2 databases (SAP ERP® ECC on AnyDB, Business Suite on AnyDB).

2. **Evolution:**
   ERP systems which offer classic ERP functionalities on the basis of the in-memory database SAP HANA (SAP ERP® ECC on HANA, Business Suite on HANA).

3. **Revolution:**
   ERP systems which offer classic as well as new ERP functionalities that are technically and functionally designed for the use of the underlying database technology SAP HANA (SAP S/4HANA Enterprise Management with SAP Fiori/UI5 applications).

Fig. 7 – ERP system classes



Status quo: a matter of time

ERP systems which run software applications such as SAP ERP ECC on classic DB2 databases currently constitute the status quo for the majority of companies. For several generations these systems were implemented as a central planning element in most companies. Business processes in the area of logistics, production, and finance were designed interactively sector- and industry-wide around different modules (procurement: SAP MM, logistics: SAP WM, plant maintenance: SAP PM, production: SAP PP, finance: SAP FI, controlling: SAP CO). The end-user is able to access these functions by means of different transaction codes which are mostly not connected to a special business role. In order to extend the business processes beyond a company's borders SAP SE launched the SAP Business Suite which covers next to the core ERP modules functionalities for Customer Relationship Management (CRM), Supplier Relationship Management (SRM), Product Lifecycle Management (PLM) and Supply Chain Management (SCM).

The programs enabling the proper functionality of these ERP systems such as postings and reports are based on data which are mostly selected from aggregated tables or index tables that in turn derive data from a larger variety of basic tables. This leads to an increased complexity of the system landscape which in particular causes negative effects on the availability of data (e.g. blocking of objects through users) and access to data (e.g. no parallel postings) and on the overall performance of the entire system. Long access times, long latency periods, and an inevitably high degree of data redundancy are the consequences of the technical characteristics of these systems.

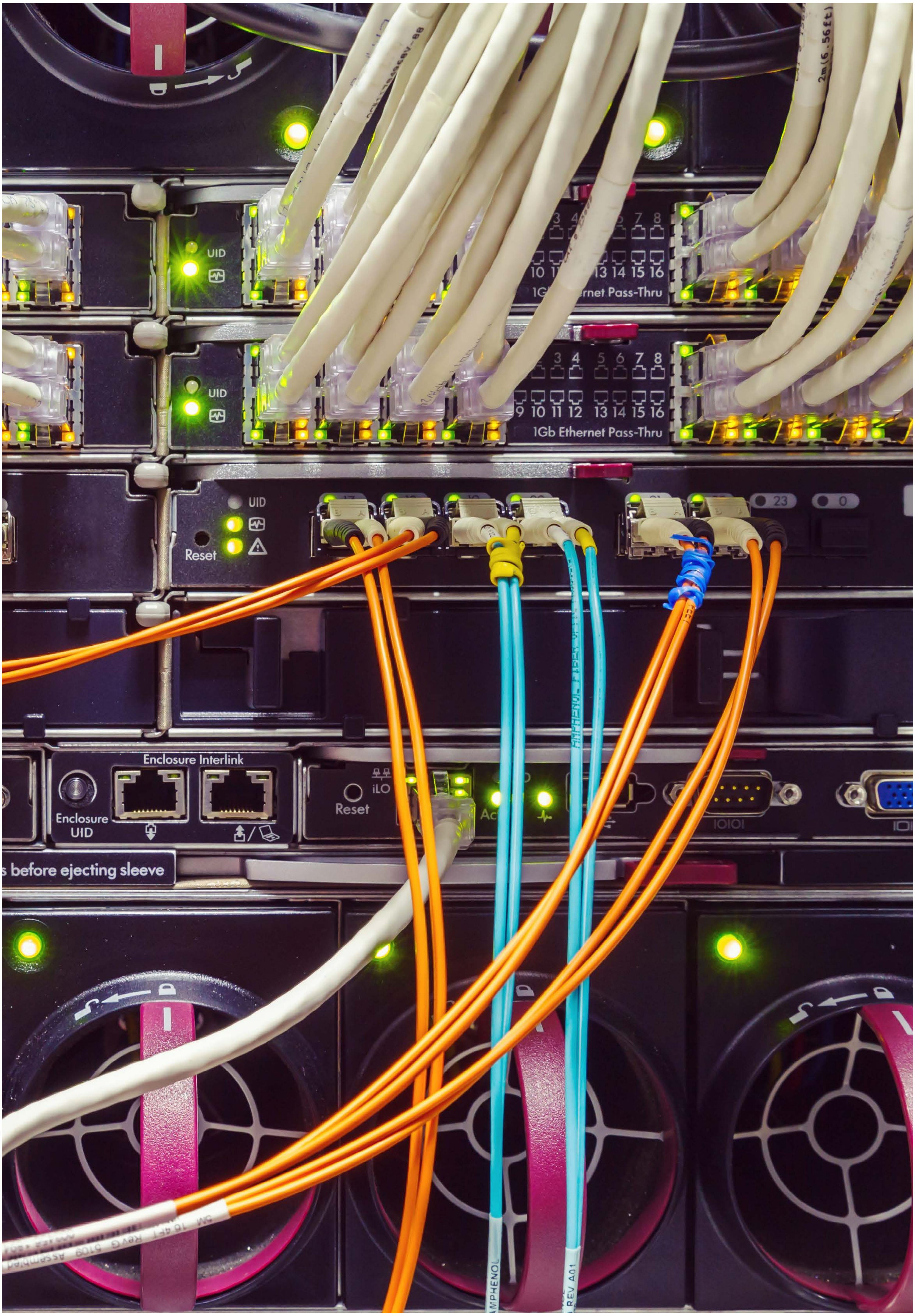
The interconnectivity of an ERP system with boundary applications which is perceived as a necessary requirement for a digitalized company from a holistic point of view is often only achievable at high cost and with high configuration and development effort. A digital reflection of the operational processes and of the product itself, which can foster the adaptability of the entire production as a consequence of the increasing volatility, is difficult to realize with those technical installations. In the medium and long term, these ERP systems will face significant challenges to meet Industry 4.0 requirements.

Evolution: on the way to digitalization

Evolutionary ERP systems facilitate significant performance improvements in the execution of business processes which have not been possible with the classic systems so far. The SAP HANA database architecture combines different innovative software-related and hardware-related technologies. A hardware innovation is the hybrid of the very common column-oriented access functionality of an in-memory database and the classic row-oriented technology that is popular for relational databases. An essential characteristic of SAP HANA is its consequential in-memory platform design which basically promotes the analysis and processing of data directly in random access memory instead of using the traditional hard-drive-based mode of operation. This enables the execution of transactional (Online Transaction Processing, OLTP) and analytical procedures (Online Analytical Processing, OLAP) in the same system aiming at processing Big Data practically in real-time. The partial relocation of programs from the application layer directly into the database layer also increases the performance of the system which is seen as inevitable on the way towards digitalization.

Having mentioned the technical benefits, however, on the software side the new database architecture does not even differentiate which business processes have to be executed. The classic core ERP functionalities and the extended functionalities of the SAP Business Suite on HANA (see previous section) are equally enabled to make use of the advantages.

Using SAP HANA requires a technical migration of the existing data set from a traditional database to the new database technology. This system conversion is an initial but essential step towards a complete conversion to SAP S/4HANA which can then be implemented later on. Through the use of in-memory technology, Industry 4.0 requirements can be met to a certain extent by reducing the reaction time and hence increasing adaptability.


UID
1Gb Ethernet Pass-Thru
UID
Reset
Enclosure Interlink
Enclosure
UID
Reset
iLO
before ejecting sleeve

High performance, modern user experience, and the usage of embedded intelligence pave the way towards a digital company, which increases overall production flexibility.

Revolution: well prepared for digitalization

A complete new generation of ERP functionalities of the Business Suite is brought to the market with the software package SAP S/4HANA Enterprise Management. Through a variety of Simplifications – primarily in the traditional areas of finance and logistics – the transition from a purely transactional system which collects data, towards an active decision-supporting system for the end-user based on real-time internal and external data is prepared. In the core of SAP S/4HANA Enterprise Management, the "Digital Core", all business-related functionalities which have formerly been divided into modules are designed for the technical characteristics of the underlying SAP HANA in-memory database. This range of functionalities can easily be enhanced through other components of the enhanced SAP S/4HANA Suite (SAP S/4HANA Suite: Non-S/4HANA-branded solutions, SAP S/4HANA Products: S/4HANA-branded solutions). The SAP S/4HANA Suite components for example encompass the procurement software SAP Ariba as well as the Human Resource tool SAP SuccessFactors. Among the SAP S/4HANA products, the Extended Warehouse Management (EWM) can be listed as an example which is optimized and innately, technically integrated into the SAP S/4HANA architecture.

SAP S/4HANA is mainly characterized by three key technical innovations:

- modern architecture,
- a modern design facilitating mobile use of SAP software and
- the technical integration of embedded intelligence.

In the course of an upgrade or a new installation of SAP S/4HANA, the underlying database model is simplified. Applications from now on will use live data instead of data that is temporarily stored and aggregated, enabled by the fast access speed of the in-memory database. However, the fundamental database structure will not be changed. A finance or sales document will still have its importance. Merely through the elimination of aggregates and index tables (see Figure 8), which were inevitable before to permit different views of documents, performance will increase about ten times by reducing the redundancy of data and the nearly complete elimination of latency periods.

Fig. 8 – Simplified table structure

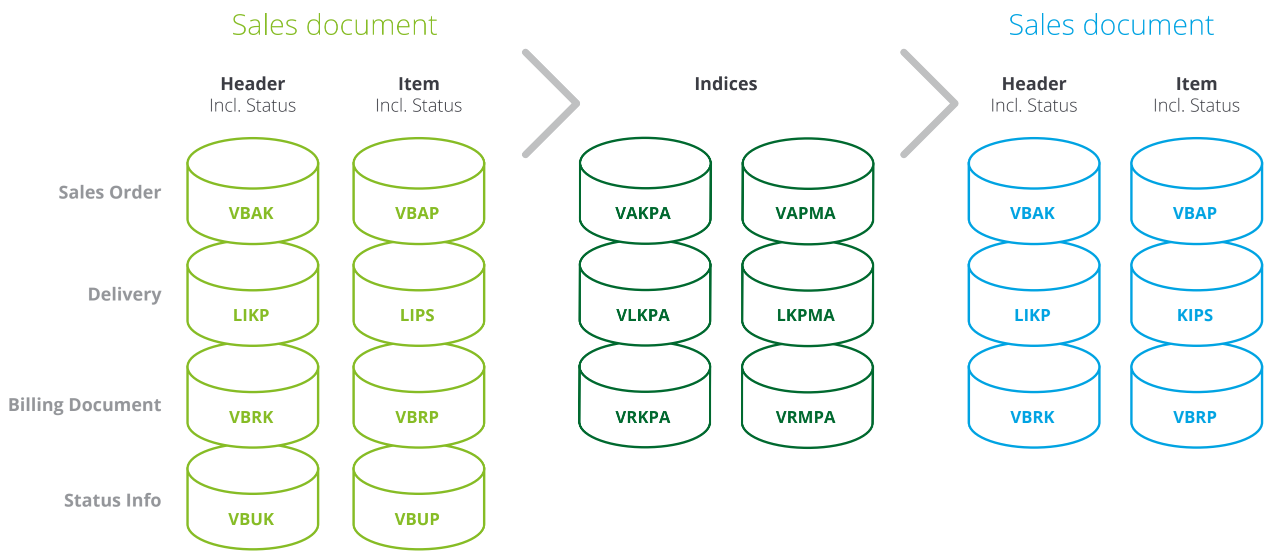


Fig. 9 – From transactional to role-based user interfaces

In the area of human-machine interaction, SAP SE promotes its SAP Fiori UX strategy in which the transactional operating model is transformed into a role-based user experience. SAP Fiori is expected to steadily replace the "old-fashioned" SAP GUI (Global User Interface) with the aim of facilitating transition into a new era in the field of client-centric user experience. Modern user interfaces which are currently popular in the consumer industry (e.g. smartphone applications) enable this transmission by replacing existing transactions with several smaller individual SAP Fiori applications designed for a specific business role as shown in Figure 9.

These technical innovations on the one hand define a completely new working experience and on the other permit the restructuring of production landscapes from scratch. The related organizational changes will be even further-reaching than simple migration to a new database would be. The new human-machine interfaces require in-depth training of staff in the use of these systems, since existing knowledge can only be transferred to a limited extent.

In addition, SAP SE will increase the intelligence of future generations of ERP systems. Embedded analytics functionalities will be implemented in the core of SAP S/4HANA Enterprise Management. These context-based analysis and reporting functionalities basically consist of virtual data models which by nature are designed for use by role-based SAP Fiori applications. Thus, for example, a material or production planner can be provided with particular information in the form of alerts when critical situations such as material shortages are about to happen. In a next step the staff will be actively provided with decision-supporting recommendations based on algorithms that have been programmed beforehand. In turn, the recommendations can be simulated to evaluate the effects of execution and finally can be used to make the best possible decision.

Connection of ERP systems to the shop floor

Conventionally, production is planned top-down from the production planning level (ERP system) to the execution level (MES) down to the machine control level (PLC). SAP SE responds to this requirement by connecting the ERP system with the MES and hence enabling the exchange of information between the top floor and the shop floor in real time. That is what is called 'connected manufacturing'.

All ERP system classes presented in the previous section can be used to vertically integrate with the production control and execution levels and to dissolve the automation pyramid. The ERP system's reach needs to be expanded towards the machine layer. The machine layer itself has to be programmed more openly so that the middle control layer which integrates the various data sources can manage the production process more autonomously.

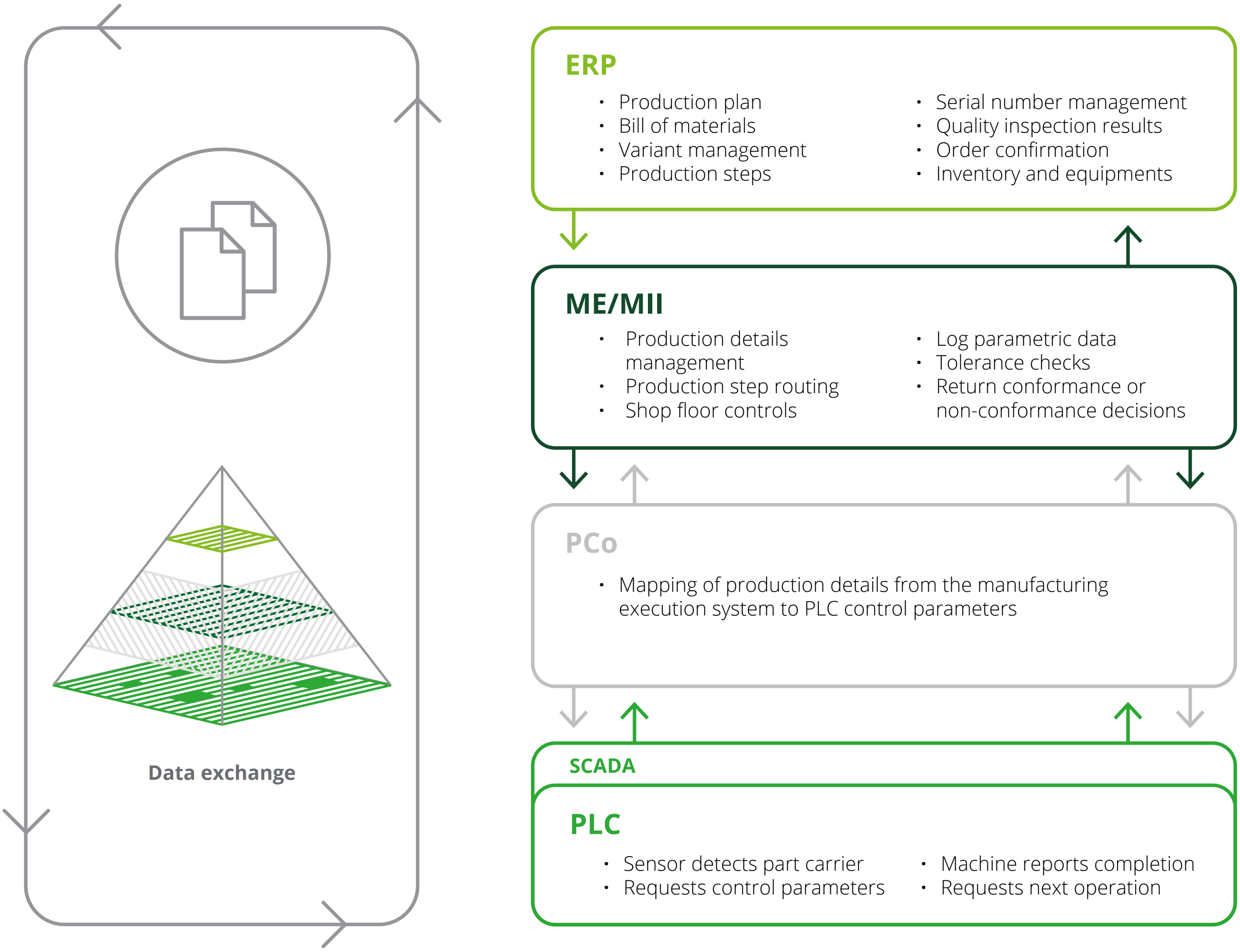
There are many reasons for performing the orchestration of production execution in a separate MES such as SAP Manufacturing Execution (SAP ME) or equivalent. If there is a downtime in the ERP system's connectivity for whatever reason, production has to keep running. Manufacturing processes usually need more detailed execution operations than planned in the routing by ERP systems. It is not desirable to track every state of work in progress (WIP) for every production step. Regulatory compliance and the imperative of a lot size of one require a traceability and a product genealogy at the unit level. For that purpose parametric data need to be connected to the units.

In individualized production scenarios, consistent data exchange between product engineering and manufacturing execution plays an essential role as the interconnection of these functions forms the start of solid manufacturing processes. Conventionally, the Engineering Bill of Materials (EBOM) is handed over to the manufacturing department, where mostly the system (background job) based on the requirements from engineering develops the Manufacturing Bill of Materials (MBOM). These routings are then a fixed pattern. With the aim of being more flexible, SAP launched the SAP Visual Enterprise Manufacturing Planner (VEMP), which permits the manufacturing engineer to create these MBOMs by re-grouping the parts and components and be able to add other parts that are needed for assembly/packaging processes. With regard to the imperative of a lot size of one, the SAP VEMP is a beneficial implementation.

SAP Manufacturing Integration and Intelligence (SAP MII) and SAP ME use the data from the EBOM or rather the routing from the MBOM. Both systems complement each other. On the one hand, SAP MII integrates shop floor solutions such as SAP ME and other data sources with the ERP system for production, quality management, plant maintenance, and materials management. On the other hand, it is used to visualize KPIs calculated by analyses of the data extracted from the integrated data sources. SAP MII offers an alert framework monitoring the threshold values for any machine and creates preventive maintenance work orders for each threshold breach.

SAP Plant Connectivity (PCo) enables the exchange of data between the MES level, supervisory control, and data acquisition (SCADA) services, human machine interfaces (HMI) or programmable logic controls (PLC). SAP ME offers full integration with SAP ERP systems out-of-the-box. Non-conformity management is supported by in-line sampling and system-guided manual rework processes.

Fig. 10 – Vertical data exchange



SAP ME/MII and SAP Plant Connectivity enable vertical data exchange between the planning, control, and execution levels.

It facilitates vertical integration from the ERP system to the machine level such that the control program for machines does not have to be determined in advance any more as usual. PCo is based on standardized communication interfaces which enable fast and easy configuration. It can be dynamically fed with freely defined parameters from superior levels which permits a fast adaption of the production process to the customer's needs as desired in Industry 4.0. PCo enables communication between a source and a target system using OPC Unified Architecture (OPC-UA) and other common protocols for machine communication. Target and source systems can be SAP ME, SAP MII, SAP ERM, SAP ERP, SAP S/4HANA, SCADA, PLC, plant historians, 3rd party MES and sensors.

SAP ME uses shop orders created from production orders to control and track production. Materials and serial numbers are represented by shop floor control (SFC) numbers. The production process when using PCo looks like this: when the material arrives at the machine, the PLC asks the ME for material- and workstation-specific control parameters. SFC-related data required for the next production steps will be transmitted from the ME to the PLC using PCo.

The material will be processed at the workstation according to this information. As soon as the production step is executed the results will be sent back to the ME. The ME now executes the check and decides whether the production step can be set to complete or not. If the conformity check is successful, the next work step for the material will be identified dynamically. The material will be sent to the next work station where the PLC asks for control parameters and the MES sends these using PCo. When all production steps are successfully executed, the order conformation is sent to the ERP. This process of exchanging data is shown in Figure 10.

With the help of vertical integration and dynamic data exchange by means of PCo, different products can be manufactured without a rigidly defined production sequence, i.e. the production is now flexible. Moreover, production benefits from the advantages of mass production while manufacturing individualized products.

Conclusion: an initial but very essential step

Fig. 11 – Assessment regarding technical requirements

Technical requirements	Status quo	Evolution	Revolution
TR1 **Data storage**	◐	◐	◕
TR2 **Data exchange**	◐	◕	◕
TR3 **Data use**	◔	◔	◕

○ Does not meet requirements
◔ Meets requirements to a small extent
◐ Meets requirements partially
◕ Meets requirements to a large extent
● Fully meets requirements

No matter whether the technologies presented in the area of ERP can be categorized as evolutionary or revolutionary, it makes sense to assess them according to the technical and process-related requirements described in section 2. Apart from the system's technical degree of innovation, the decision to invest in a suitable ERP system is mainly driven by its benefits from a process-related point of view.

Based on the classification into three categories – classic, evolutionary, and revolutionary – the ERP system's degree of fulfillment of the requirements mentioned in Figure 11 will be assessed with the help of Harvey Balls.

Assessment with regard to technical requirements

Figure 11 shows the result of the system's assessment regarding the technical requirements data storage (TR1), data exchange (TR2), and data use (TR3).

Traditionally, ERP systems are based on centralized data storage (TR1). Thus, decentralization in terms of Industry 4.0 is a criterion which is hard to achieve. This is why classic and evolutionary ERP systems (SAP ERP® ECC or Business Suite on AnyDB/HANA database) only meet these criteria to a small extent. Nevertheless, revolutionary ERP systems (SAP S/4HANA) benefit from the simplification of the data model which leads to the possibility of using current, non-aggregated data. This leads to an improvement in the area of data storage.

Evolutionary and revolutionary ERP systems have an advantage in the area of data exchange (TR2) compared to classic ERP systems. They facilitate fast data access by means of the SAP HANA database. The horizontal and vertical integration of internal and external IT systems is a feature that all ERP systems support by nature.

Fig. 12 – Assessment regarding process-related requirements

Process-related requirements	Status quo	Evolution	Revolution
PR1 Suitability for dynamic planning, control, and execution	◕	◕	◕
PR2 Support for an integrated end-to-end process	◕	◕	◕
PR3 Progressiveness of the human-machine interaction in the process	○	○	◕
PR4 Location-independent control and execution of processes	◔	◔	◕
PR5 Efficiency of process steps supported by the system	○	◑	●
PR6 Process improvement through intelligent data analyses	●	◔	◕

○ Does not meet requirements
◔ Meets requirements to a small extent
◑ Meets requirements partially
◕ Meets requirements to a large extent
● Fully meets requirements

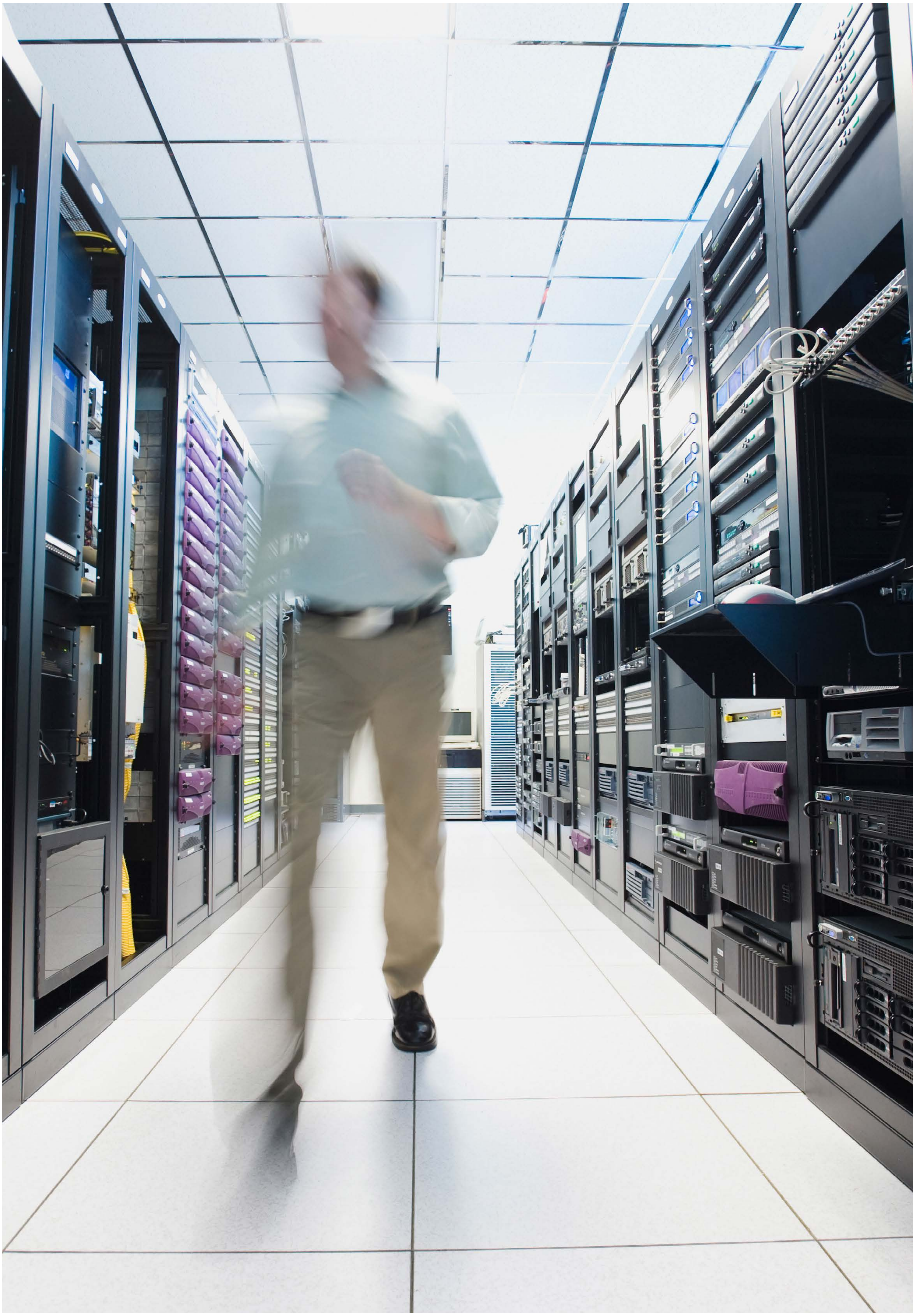
Looking at the data use requirement (TR3), classic and evolutionary ERP systems are not mature in terms of intuition and personalization. They are equipped with elementary visualization, analysis, and automation functionalities in the form of transaction-based user interfaces. By contrast, SAP S/4HANA offers a much more advanced mobile and role-based user experience with the help of modern technologies such as SAP Fiori and SAP UI5 which are available out-of-the-box.

It can be concluded that revolutionary ERP systems such as SAP S/4HANA best meet the technical requirements in terms of Industry 4.0. Nevertheless, there is still development potential in all defined criteria. In future, data will still be stored centrally in the ERP system's database which will offer additional potential for decentralized data management. The shift of the source code from the application to the database layer increases the speed of data access but does not yet tap the full potential. Moreover, SAP Fiori apps do not so far support all user roles and business functions and thus cannot fully replace classic transactions. This leads to the fact that there might still be a major development and configuration effort when implementing e.g. S/4HANA, based on special custom requirements.

Independently of the ERP system class, the integration of SAP ME, SAP MII, and SAP PCo increases the degree of fulfillment, especially in the area of data storage (TR1) and data exchange (TR2).

Assessment with regard to process-related requirements

In fact, the assessment of ERP systems with regard to process-related requirements correlates to the assessment with regard to technical requirements (see Figure 12).



The main principle of Industry 4.0 is to increase flexibility and adaptability in production and logistics processes (PR1). The ERP systems of all three categories enable vertical integration of IT systems from the different organizational levels in a company. Nevertheless, this may require the development of complex interfaces and major configuration efforts caused by e.g. the different communication standards of information technologies. Vertical integration is facilitated by the use of integration software such as SAP ME, SAP MII, and SAP PCo, which connects the top floor and the shop floor level. This way, production becomes more flexible and dynamic as data can be transmitted demand-driven from the ERP system to the PLC and vice versa. This makes possible a greater variety of variants at low cost.

The horizontal integration of supply chain partners (PR2) is also a traditional functionality of all ERP system categories. They provide different interface standards to exchange data across companies but the automation of these data exchanges still represents an area for improvement.

Revolutionary ERP systems provide an efficiency gain in the area of human-machine interaction (PR3). While classic and evolutionary ERP systems do not provide intuitive data input and output technologies, SAP S/4HANA does with its SAP Fiori and SAP UI5 applications. Role-based and intuitive user interfaces help avoid errors and increase the efficiency of control and execution activities. This will become even more efficient when using these functionalities on mobile devices (PR4). The user may use the modern data human-machine interfaces on-the-fly on a smartphone or tablet. This location-independent human-machine interaction enables new processes which have not yet even been in focus.

Another very important aspect in Industry 4.0 is the timeliness of data and the speed of data access (PR5). While evolutionary ERP systems are based on new database technologies that allow for fast data access, revolutionary ERP systems basically avoid the storage of aggregated intermediate results through the use of a logically simplified data model. This way it is ensured that the user always works with current data.

The timeliness of data is mainly needed for intelligent analysis tools (PR6) which are integrated into the core of ERP systems (S/4HANA Enterprise Management). Classic and evolutionary ERP systems do not offer a variety of functionalities for data analysis whereas revolutionary ERP systems are meant to visualize data in form of dashboards and provide them to the user – also on mobile devices.

It can be said that the improvement potential of ERP systems lies rather in the user interaction with the system than it does in the integration of IT systems within and across companies (PR1 and PR2). Moreover, process efficiency can be increased by both the timeliness of data and the transparency created by different, newly integrated analysis functionalities. As revolutionary ERP systems originally fulfill the majority of these requirements, they have received the highest rating in this assessment.

Use cases: successful examples in the area of ERP

Industry 4.0 is no longer in the future. The first technical innovations in the area of production and logistics are helping to make processes more transparent and more efficient. The following section outlines how existing technologies may be used throughout the whole company and how they can contribute to the flexibility of business processes.

Deloitte-M4.0-Cube: integration of use cases

The Deloitte-M4.0-Cube , which stands for Manufacturing 4.0, helps companies to plot their solution space for Industry 4.0. This way they get an overview of their feasible solutions and can draw a conclusion about how to achieve their individual goals.

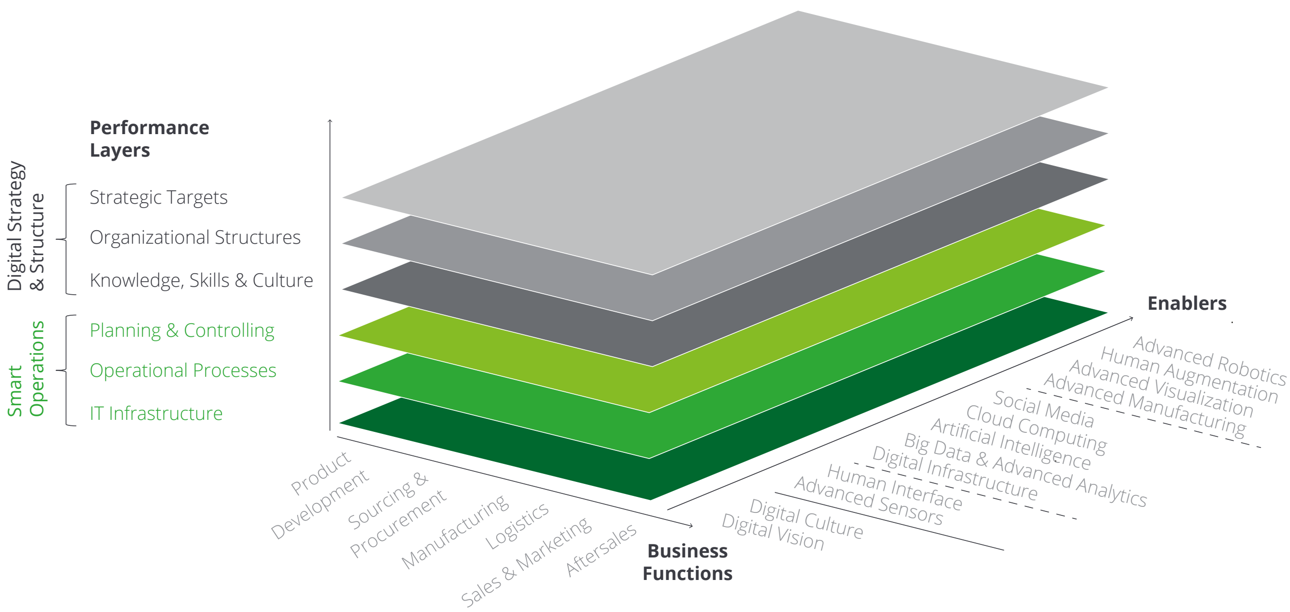
As shown in Figure 13, the Deloitte-M4.0-Cube consists of the following three dimensions:

Business functions:
define the context in which the enabler is applied in the company. They represent the traditional business functions along the supply chain.

Enabler:
describe technical solution opportunities which facilitate the implementation of Industry 4.0. The enablers are a selection of technologies that facilitate the connection of the physical and digital worlds. They can be divided into three types. They are characterized by the transformation of information. They are distinguished between "physical to digital", "digital to digital", and "digital to physical" which are the dimensions of the value loop.
Moreover, the enabler "Digital Vision and Culture" exists. It describes the readiness of a company to invest in digitalization and the visualization of processes and its willingness to implement necessary changes in the organization.

The Deloitte-M4.0-Cube is a conceptual model which is used to plot use cases with regard to performance layers, business functions, and enablers.

Fig. 13 – Deloitte-M4.0-Cube



Performance layers:
describe the levels of perspective from planning, to control and execution. The organization and the IT infrastructure are considered as well. The performance layers are divided into two categories – digital strategy and digital operations. Digital strategy comprises all performance layers that support long-term competitiveness and growth. Performance layers being in the area of smart operations support short- to medium-term operational excellence. The performance layers are shown in Figure 14.

Digital options will be plotted in the Deloitte-M4.0-Cube each with one performance layer, one business function, and one enabler as coordinates. Different digital options build a use case. Companies can benefit from the combination of different use cases which may seem independent from one another. A number of use cases can be summarized to an integrated Industry 4.0 concept for the whole supply chain. This concept serves as a basis for an Industry 4.0 implementation strategy.

Ideally, companies should try to define digital options for all business functions and all performance layers. Only through this the full potential of Industry 4.0 can be tapped which leads to a long-term, strategic competitive advantage for the company.

The performance layers describe the levels of perspective from the planning, control, and execution points of view plus the organizational and IT infrastructure.

Fig. 14 – Performance layers

Project experience visualized as use cases

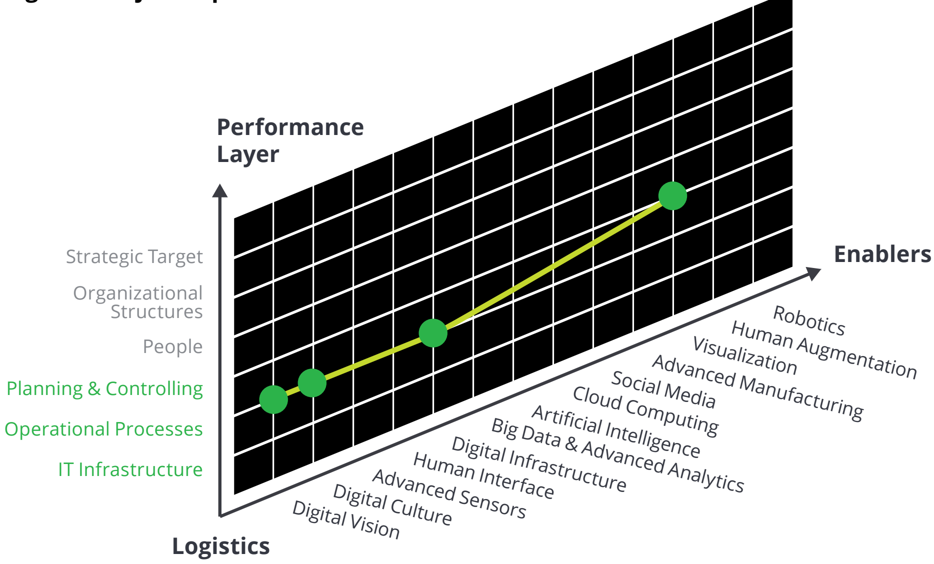
Industry 4.0 is no longer in the future. The first technical innovations in the area of production and logistics are helping to make processes more transparent and more efficient. The following section outlines how existing technologies may be used throughout the whole company and how they can contribute to the flexibility of business processes.

Use Case #1: Mobile inventory management

Description:
It is an application that provides mobile inventory management functionalities to the user. It enables the mobile and easy entry of stock information in the supply area which ensures that all stock data are always reflected correctly in the system. This reduces manual work, decreases costs, and increases the efficiency of materials management.

Benefit:
The application uses the scanner function of mobile devices and enables the real-time entry of stock information. A previously non-existing transparency is thereby created for materials management which leads to an improvement in production and logistics processes.

Fig. 15 – Project experience use case #1



#1

Digital Option #1: Logistics – operational processes – digital vision and culture:
The use of mobile devices in warehouse management facilitates the digitalization of business processes which previously caused a lot of manual effort.

#2

Digital Option #2: Logistics – operational processes – advanced sensors:
Mobile devices enable the production worker to collect physical data (i.e. stock information) with the help of a scanner.

#3

Digital Option #3: Logistics – operational processes – Big Data and Advanced Analytics
Thanks to an advanced data model a more detailed representation of production can be captured in the system.

#4

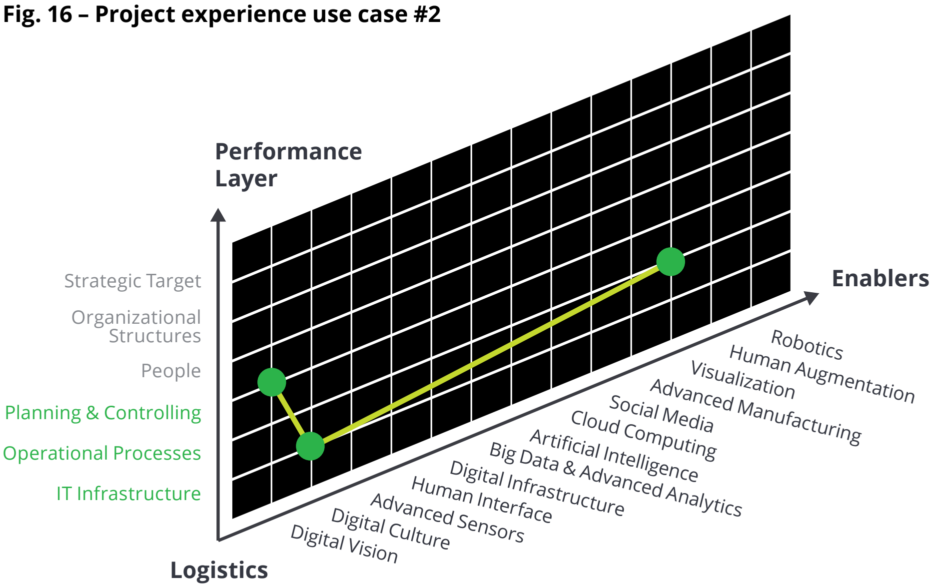
Digital Option #4: Logistics – operational processes – visualization
The user-friendly visualization of information on mobile devices offers the opportunity to analyze data in real-time and to make decisions as well as corrections (stock transfer postings).

Use Case #2: GPS-based vehicle management

Description:
GPS can be used for the management of trailers in the yard. Transmitted data is visualized in real-time on a PC (e.g. based on GoogleMaps). Another opportunity is to transfer the collected data to an upstream ERP system using e.g. interfaces such as IDocs. The data is then available for production planning and execution.

Benefit:
More efficient planning and control of intra-company inbound and outbound logistics through the localization of trailers in the production ground increases the transparency of the trailer park. As a consequence, production supply planning and execution become more efficient.

Fig. 16 – Project experience use case #2



#1

Digital Option #1: Logistics – operational processes – digital vision and culture:
The digitalization of business processes (logistics planning and execution) shows a living digital culture in the company.

#2

Digital Option #2: Logistics – operational processes – advanced sensors:
Collecting position data of trailers using GPS enlarges the intra-company IT infrastructure.

#3

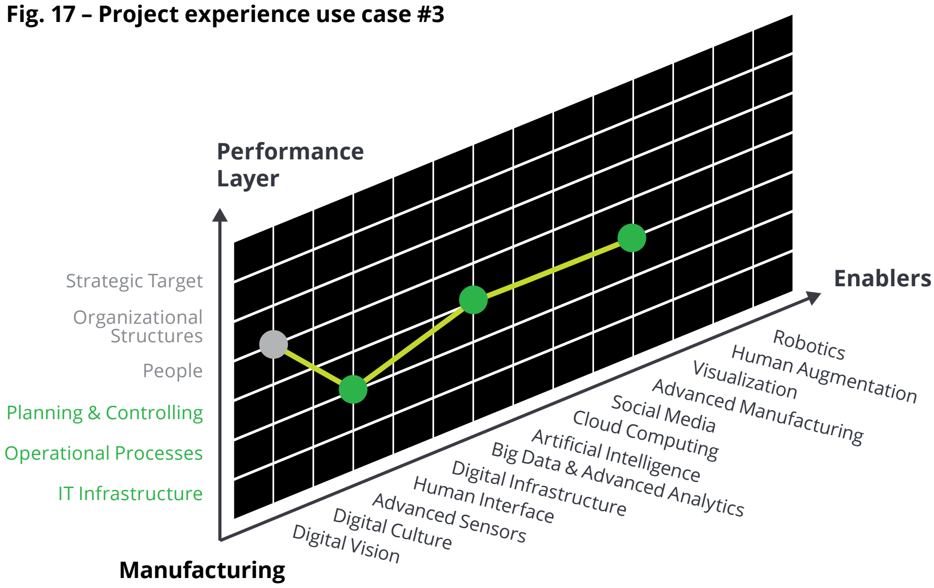
Digital Option #3: Logistics – operational processes – visualization
The processing and subsequent visualization of GPS-position data enables a new form of planning and executing logistics processes.

Use Case #3: Shop floor integration with MES

Description:
The bidirectional data exchange from the ERP system to the machine control level (PLC) through an additional interconnection of an MES fosters customer individualization and flexibility in production. This way customer orders may change at short notice and the changes will still be taken into account during production.

Benefit:
Time and cost savings through greater flexibility in production due to data exchange between the planning, control, and execution levels and hence the possibility of parametrizing machines based on customer requirements. Production efficiency is increased as workers benefit from e.g. digital work instructions.

Fig. 17 – Project experience use case #3



#1

Digital Option #1: Manufacturing – knowledge, skills and culture – digital vision and culture
The production worker is supported by digital work instructions which are stored at MES level and can be accessed on demand.

#2

Digital Option #2: Manufacturing – operational processes – advanced sensors
Machine data such as quality information are collected by sensors during production and sent to MES. This way the production can be adjusted if quality issues occur.

#3

Digital Option #3: Manufacturing – planning and controlling – big data and advanced analytics
The MES also serves as a platform for Big Data analyses. With the help of advanced analytic tools such as SAP MII there is the opportunity to e.g. analyze the root causes of errors and non-conformity that led to customer returns.

#4

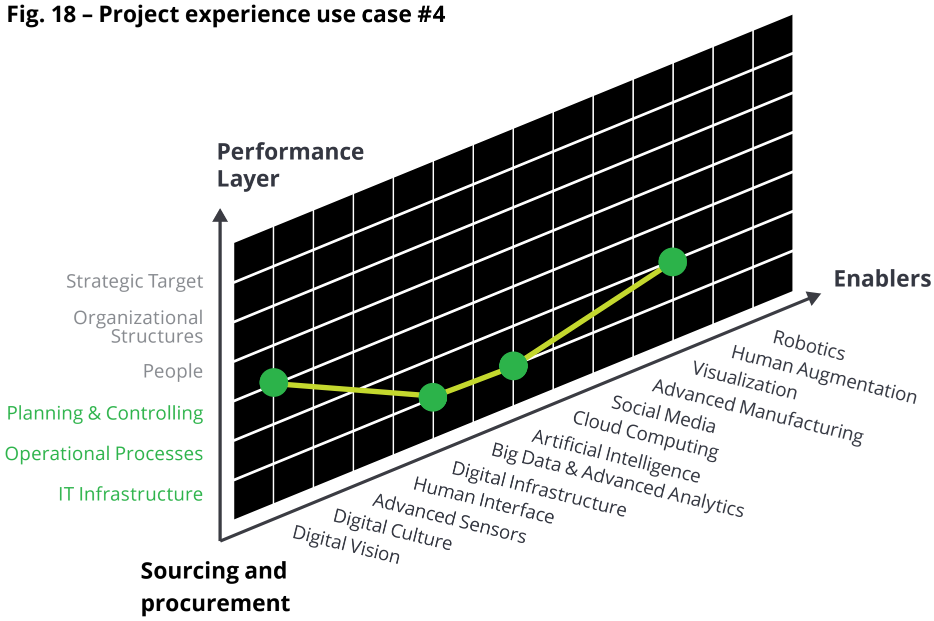
Digital Option #4: Manufacturing – planning and controlling – advanced manufacturing
The direct transfer of customer orders from the ERP system via MES to PLC permits the production of a lot size of one. With the help of technologies such as SAP PCo which serves as middleware between the MES and the PLC, an individualization of products is enabled and changes in customer requirements can be taken into account during production even at short notice.

Use Case #4: Online platform for the procurement of indirect materials

Description:
SAP Ariba® is an online platform that increases the efficiency of the procurement of indirect materials. Transactions will be (semi-)automated which leads to more time available for strategic procurement. The platform is not only usable for operational procurement but also for strategic procurement, thanks to its analysis and dashboard functionalities.

Benefit:
By automating frequently repeated procurement transactions, the efficiency of procuring indirect materials can be increased.

Fig. 18 – Project experience use case #4



#1

Digital Option #1:
Sourcing and procurement – planning and controlling – digital vison and culture
SAP Ariba enables the digitalization and automation of strategic, tactical, and operational procurement processes.

#2

Digital Option #2:
Sourcing and procurement – planning and controlling – Big Data and Advance Analytics
The data model used by SAP Ariba and its built-in analytics functionalities support the transformation of large amounts of data into intelligent data analyses which serve as beneficial decision support for procurement transactions.

#3

Digital Option #3:
Sourcing and procurement – operational processes – cloud computing
SAP Ariba functionalities are available in the Cloud which makes them usable at any time. The technical connection to a Cloud facilitates a more effective integration of supply chain partners.

#4

Digital Option #4:
Sourcing and procurement – operational processes – visualization
Thanks to a modern user interface procurement information is visualized role-based for the user.

Conclusion

Result and possible improvements

As shown in the assessment matrices, classic ERP systems only partially meet technical and process-related requirements. Evolutionary systems still have some advantages over classic ones but only revolutionary systems fulfill most requirements to a great extent. They are an initial but very essential step towards Industry 4.0 – nevertheless they can still be improved.

For the realization of Industry 4.0 at least partially decentralized data management is needed to increase overall flexibility and to produce individualized products with a lot size of one in a cost-efficient way. Therefore, companies wanting to implement Industry 4.0 need to consider their data management, which data should be stored centrally or decentrally and how modern user interfaces might increase process efficiency. But due to the limited number of SAP Fiori apps not all necessary business roles and functions are supported in a company. Moreover, improvements are required in the area of analytics for ERP systems in order the better to utilize the data collected and generated. With the help of technology providers and users this may be changed in the near future. To overcome these challenges, a use-case-based approach by the technology user is required to help technology providers improve their functionalities.

So when a company decides in favor of Industry 4.0 there has to be a suitable approach to mastering the implementation. Therefore, it is necessary to change the processes along the entire supply chain, to select supporting technologies, and to qualify workers in order to achieve the goal of increasing flexibility and higher quality in production.

Revolutionary ERP systems such as S/4HANA are an initial but very essential step towards Industry 4.0

Different ways to approach Industry 4.0 with Deloitte as a competent partner

As revolutionary ERP systems offer the greatest support for a flexible planning, control, and execution in production, companies need to think about how to successfully upgrade to SAP S/4HANA. And many roads lead to Rome.

The possible ways to SAP S/4HANA include a greenfield implementation with an initial data load, a system conversion, and a landscape transformation. For companies that already work with SAP ERP ECC 6.0 the transition to SAP S/4HANA can be done with the help of a system conversion. As long as the system is a Unicode system, the change from SAP ERP ECC 6.0 to SAP S/4HANA should work smoothly. If this is not the case, the system has to be converted into Unicode beforehand. The system conversion is done in one step by doing both a software upgrade and a change of the database.

The system conversion can be either done from the SAP ERP ECC or Business Suite on any database to SAP S/4HANA directly or by splitting it into the migration to the HANA database and afterwards the system conversion to SAP S/4HANA or with another intermediate step to S/4HANA Finance. When deciding in favor of the intermediate step to SAP S/4HANA Finance the logistics processes will not be simplified right away but can be added later on when converting to SAP S/4HANA Enterprise Management. Figure 15 shows the road to SAP S/4HANA.

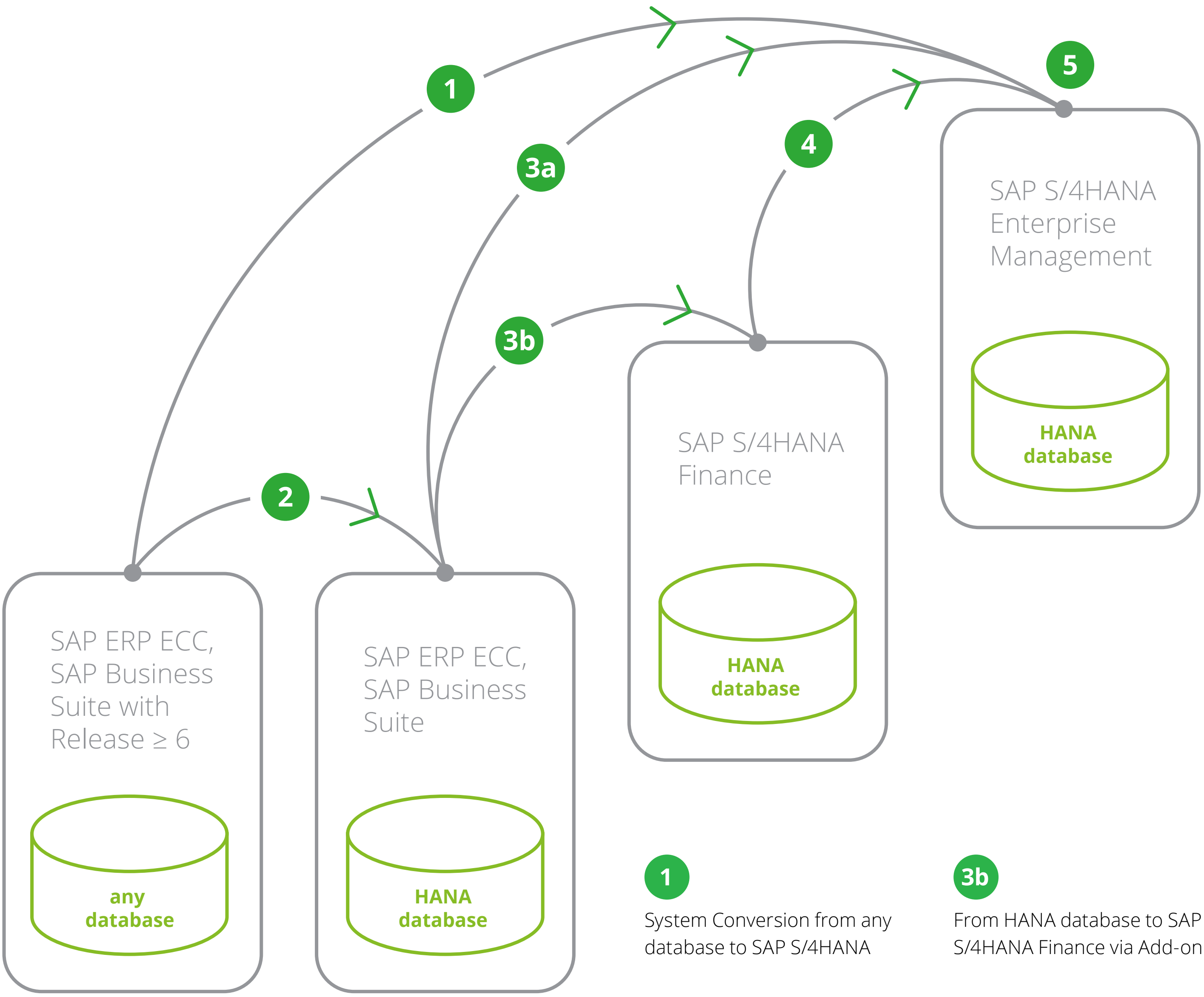
SAP SE recommends a system conversion for existing SAP ERP clients as it is easier, less cost-intensive and less disruptive than a greenfield implementation of SAP S/4HANA. It still offers a majority of advantages which are characteristic for the SAP S/4HANA technology. A greenfield implementation is recommended for those clients who want to build up a completely new system.

This is why the transition process has to be well thought out. Hence, companies opting for a transition should plan it wisely. Therefore, Deloitte represents a reliable partner. We have gained vast professional experience in SAP system implementations and transformations worldwide and across industries. Together with the client, Deloitte analyzes and assesses the client's IT landscape, identifies gaps and improvement potential, and provides advice on suitable information technologies for the client's business. After the selection of technologies, Deloitte may also assist in the implementation, configuration, and operation of them.

Our cross-functional portfolio of consulting services allows us to also look at surrounding business areas which will be affected by the change in IT. As Industry 4.0 can be implemented incrementally, it is advisable to define use cases for the different business functions and realize them one after the other. But the potential of the technical enablers is not used to a full extent until use cases are applied along the entire supply chain. To achieve this, Deloitte may help with the identification and implementation of applicable use cases.

But in addition to looking at process-related improvements, employees have to be enabled to use the new technologies effectively. This requires the training and qualification of workers to carry out their operational tasks but also includes the need for motivation in order to eliminate the negative aspects of resistance to change. Only if the workers support the change in the company can efficiency and flexibility gains be achieved. Therefore, Deloitte offers change management and human resource consulting services to the client to best prepare employees in the company for the upcoming innovations.

Fig. 19 – Transition to SAP S/4HANA



1
System Conversion from any database to SAP S/4HANA

2
System Conversion from any database to HANA Database (Data Migration)

3a
System Conversion from HANA database to SAP S/4HANA Enterprise Management

3b
From HANA database to SAP S/4HANA Finance via Add-on

4
System Conversion from S/4HANA Finance to SAP S/4HANA Enterprise Management

5
Greenfield SAP S/4HANA

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