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The impact of digitization on corporate controlling and the role of controllers

1. Introductory overview

In 1993, a university in Illinois published one of the first web browsers called "Mosaic". This browser contributed to the world wide web being adopted by a broad user base. As a result, ten million people were already using the internet in 1994 (Handelsblatt 2014, 2).

A lot has changed since then because digital technologies such as the internet are completely integrated into people's everyday lives. According to a recent study, around 67 million people in Germany used the internet in 2022 on a regular basis (Statista 2022, 4). Today, digitization encompasses many modern technologies, such as cloud computing, big data, artificial intelligence, the internet of things, and many others. It is therefore not surprising that these trends are being closely monitored by businesses to generate competitive advantages by using these technologies or at least to keep up with their competitors. The integration of new digital technologies is leading to fundamental changes in the corporate world. The associated effects on individuals and businesses are difficult to assess, diverse and subject to constant change due to an elevated level of innovation (Dorow et al. 2023, 5).

If we focus on the operational function of controlling, drastic changes can be observed in relation to digitization. In this context, technologies play a decisive role as they transform the environment in which controllers operate and in which their processes work. Thus, controllers will require a different skillset in the future

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and their role within a company will change. Consequently, they must accept the adjustment of their tasks, business processes, and competences.

In this paper, the megatrend of digitization and the effects of selected technologies on controlling are examined. An overview of current controlling processes, the role of controllers and selected technology trends of digitization will be given. Finally, various parts of digitization and controlling are linked to present the current effects on the core processes of controlling and the role of controllers.

2. Corporate controlling and trends in digitization – an overview

2.1. Controlling processes

Controlling is one of the key operating functions in a business. Planning, management, and control are some of the core tasks of controlling. Since controlling – like the activities, processes, and tasks of companies – can be complex and diverse, it should be regarded as a process. To illustrate this process, the International Group of Controlling (IGC) developed a hierarchical structure of controlling (see Figure 1) in which they differentiate business processes, core processes, sub-processes, and activities (Schulze 2019, 33). For example, the business processes include controlling, whereas the core processes include underlying disciplines, such as capital expenditure controlling. The sub-processes and activities are subordinate to the core processes. The sub-processes include, amongst others, the implementation of the set-up (= a sub-process of capital expenditure controlling) and an associated activity could be, for example, the definition of the applied investment calculation methods.

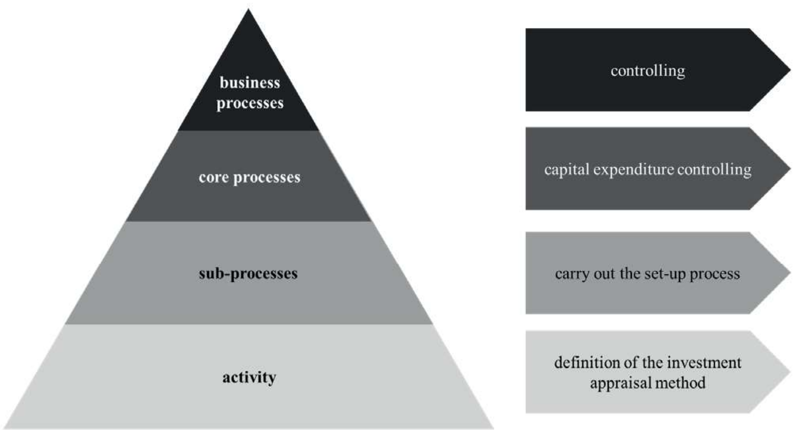

Figure 1. Hierarchical structure of the controlling process (International Group of Controlling 2017, 19)

Based on the IGC Process Model 2.0, controlling consists of ten core processes. At the sub-process level, these are described in detail by the objective, the content, the input, and output as well as by the process interfaces. The ten core processes can be differentiated into five essential and five additional core processes. The essential core processes of controlling that are analysed in this paper are (see Figure 2):

- the interrelated process of planning, budgeting, and forecasting,
- capital expenditure controlling,
- cost, performance, and profit accounting,
- management reporting,
- business partnering.

In addition, the IGC model includes strategic planning, project controlling, risk controlling and data management. These four core processes are usually conducted in cooperation with other organisational units. The last core process "further development" focuses on the organisation, the processes, and instruments as well as the systems and assures quality and is therefore differentiated from the other core processes (International Group of Controlling 2017, 18–20).

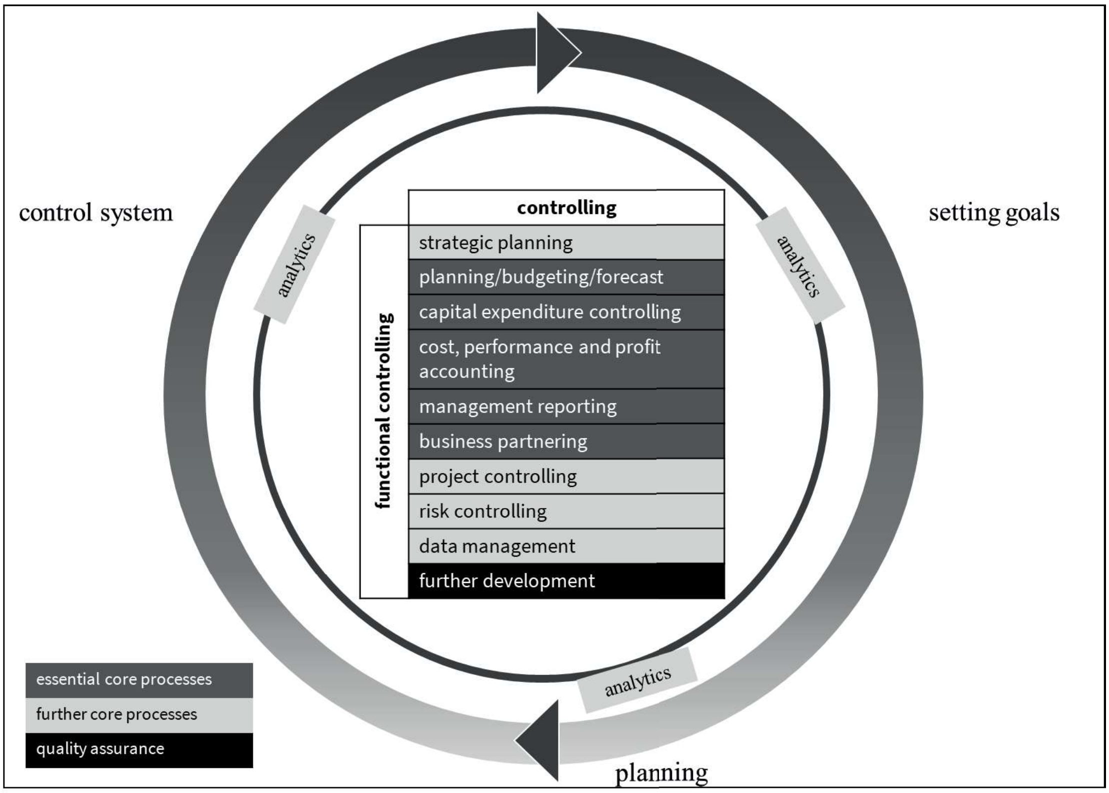

Figure 2. The IGC controlling process 2.0 (International Group of Controlling 2017, 20)

2.2. The traditional role and tasks of controllers

To examine the influence of digitization on the role and tasks of controllers, we must first look at the traditional role of controllers. The role and thus the tasks of controllers have evolved continuously over the years. Mäder, for example, divides the development of controlling into five stages:

- development stage (1500–1930),
- build-up stage (1930–1950),
- internationalisation and foundation stage (1950–1980),
- boom stage (1980–2010),
- consolidation and reflection stage (since 2010).

The last phase is characterized by the critical questioning of the current state of research in controlling (Mäder 2018, 103–107). According to this classification, controlling is currently in the consolidation and reflection phase, which analyses the current requirements due to changes in digital technologies and its effects on the role and tasks of controllers. In this context, the mission statement for controllers of the International Group of Controlling is important (see Figure 3).

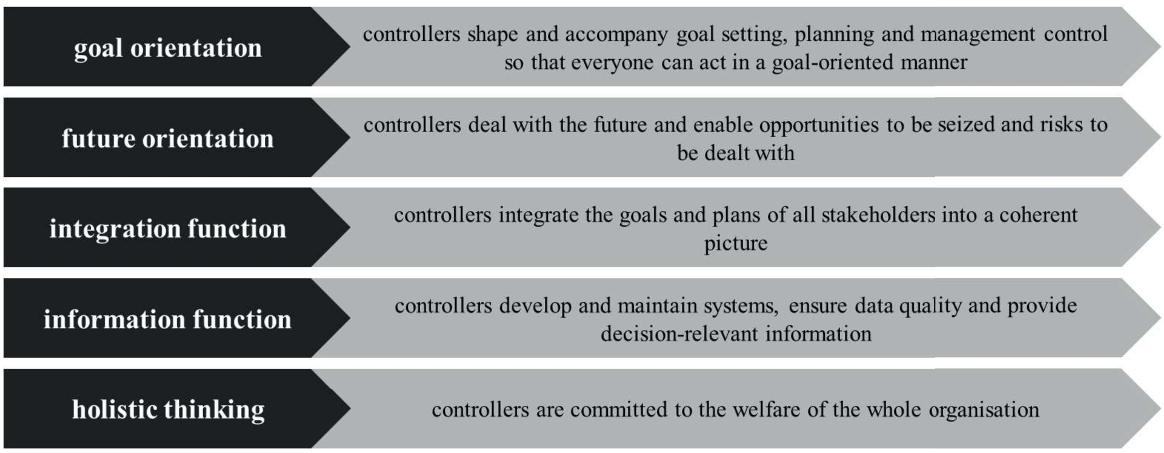

Figure 3. The controller's mission statement
(Internationaler Controller Verein, International Group of Controlling 2013)

Based on this model, it becomes clear that the tasks of controlling are diverse. If one now tries to link this mission statement and the previously identified core processes of controlling, the result is a hierarchical model in which the skills of a higher level are important for all subordinate levels. The controllers are therefore so-called "knowledge workers" and must always fulfil all requirements that are related to this. These skills are then aggregated into cross-process controlling skills that are relevant for most of the core controlling processes. In contrast, the process-specific controlling skills are only critical for individual core processes (International Group of Controlling 2015, 39–42). Firstly, the skills from controlling activities are identified at the sub-process level and then aggregated at the core process level to be able to select the relevant cross-process skills (International Group of Controlling 2015, 43). Based on this, the skills can be divided into (Heyse, Erpenbeck 2011, XIII):

- personal skills,
- activity and implementation skills,
- social-communicative skills,
- technical and media skills.

Figure 4 shows the aggregated controlling skills based on the previously identified main processes. These are the traditional skills controllers needed in the past.

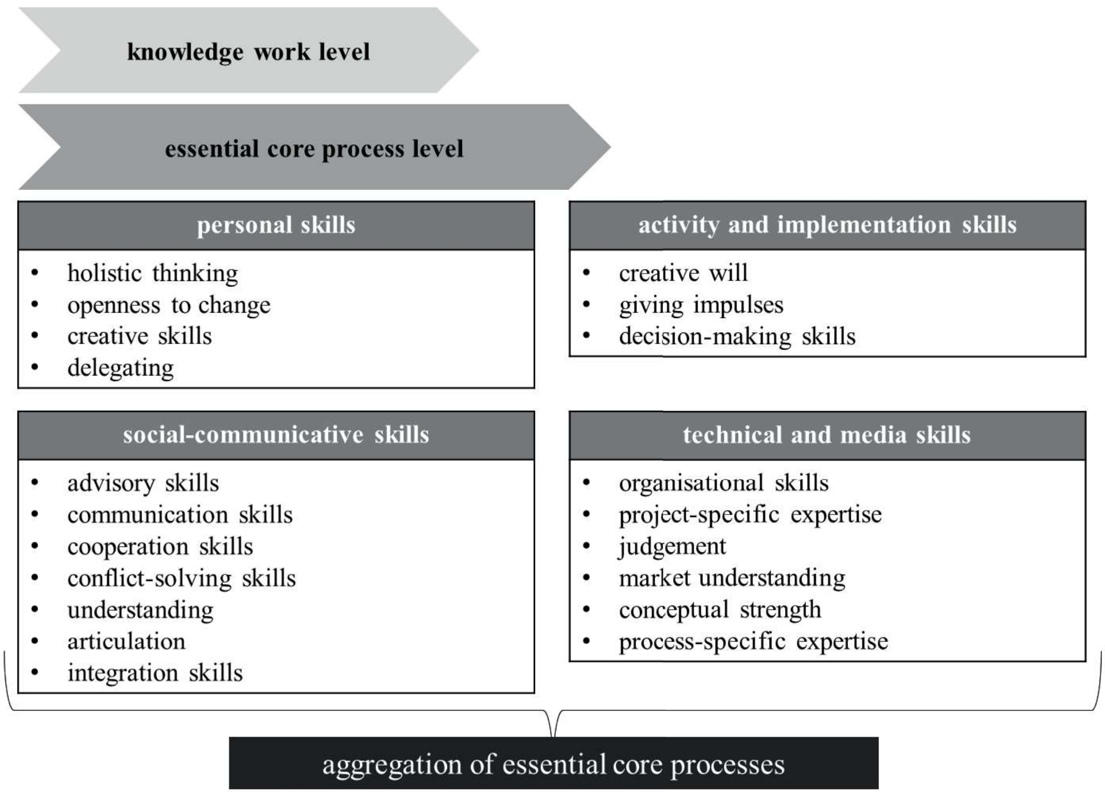

Figure 4. Traditional controlling skills map
(International Group of Controlling 2015, 38–101)

Now that the core processes of controlling and the essential skills of controllers were discussed, selected digitization trends will be presented before digitization and controlling are linked to analyse the influence digital technologies have on controlling and on the role and tasks of controllers.

2.3. Internet of things, big data and co. — key components of digitization

2.3.1. Introductory overview

Digitization includes the digital transformation and representation or implementation of information and communication or the digital modification of instruments, devices, and vehicles as well as the digital revolution (Bendel 2021b). Whereas IT was used in the 20th century primarily to automate, optimise, and modernise private households and workplaces, to create computer networks and to introduce software products (e.g., MS Office and ERP systems), since the beginning of the 21st century the focus has been on disruptive technologies and innovative business models as well as autonomation, flexibilization, and individualisation (Bendel 2021b). The technologies used and continuously developed in this context are diverse. In the context of controlling, mostly the following technologies are important as they generate or process data that is important for the previously identified core processes of controlling (Dorow et al. 2023, 10):

- internet of things,
- big data,
- cloud computing,
- artificial intelligence.

2.3.2. Internet of things

To put it simply, the internet of things is the networking of objects with the internet so that these objects can communicate independently via the internet and thus perform various tasks. The scope of application ranges from general information supply and automatic ordering to warning and emergency functions (Lackes, Siepermann 2018). It is a dynamic network that consists of identifiable physical and virtual objects that include technological properties to communicate, perceive or interact internally or externally (Borgmeier et al. 2021, 13). The internet of things uses a model which, according to Kaufmann and Servatius, consists of eight distinct levels, which are presented below (see Table 1).

Table 1

IoT reference model (Kaufmann, Servatius 2020, 6)

Level	Explanation	Technologies
1. perception	objects and data acquisition	sensors, actuators
2. connectivity	connectivity of devices and communication	network technologies
3. edge	local data storage and processing	edge computing
4. data storage	storage of large amounts of data	computing
5. data abstraction	data processing, stream aggregation, aggregation and pre-processing	big data, artificial intelligence, cloud
6. application	mobile and stationary applications, evaluations and reporting, control applications	app technologies
7. collaboration & processes	human interaction and integration of IoT data into business processes	API technologies
8. business model	building blocks of an IoT business model	IoT plattforms

Regarding controlling, it is important to understand why companies are integrating these complex and dynamic systems and what the main advantages and disadvantages are. Therefore, the general main advantages and disadvantages of the internet of things are summarized in Table 2.

Table 2

Advantages and disadvantages of the internet of things (Mattern, Flörkemeier 2010, 109; Kaufmann, Servatius 2020, 76 and 151; Ziegler 2020, 97; Soldatos 2021, 17 and 140)

Main advantages	Main disadvantages
increasing customer centricity linking data-driven services with production, making it possible to offer digital services in addition to the actual product	**data protection-oriented measures** esp. device security, network and communication security, database security, application protection
increased addressability of objects as each object can be influenced via electrical signals, productivity and work safety increase, while operating costs can be controlled better	**demand development** if demand does not increase at the same rate as efficiency, productivity and the degree of automation, there is a risk of a mismatch between supply and demand, which in turn can lead to a reduction in the required human labour

Table 2 cont.

Main advantages	Main disadvantages
basic sensor technology different types of sensors can digitally map the real world and machines can communicate directly with each other via databases or sensors, which can lead to time savings, faster reaction speed and increased data storage	**changes lead to additional work for the management of the company** numerous changes in a company require, for example, a reorientation of employees, a secure handling of complex IoT solutions and innovative business models, as well as different and sometimes more intensive control mechanisms
generation of so-called digital twins through logics and networking virtual images of real systems, high individuality and generation of knowledge through the creation of (new) data sources	

2.3.3. Big data

One of the core tasks of controlling is to collect, process and interpret data and to make it available to the decision-makers of a business. This is no longer simple data, but often big data. Big data refers to large, partly unstructured data volumes from different data sources (Iafrate 2014, 26), which are stored, processed, and evaluated by special data science solutions (Bendel 2021a).

There are various definitions for big data in the literature. What most definitions have in common, however, is that they focus on a different number of characteristics ("Vs") and a five-dimensional construct ("5Vs") (see Figure 5).

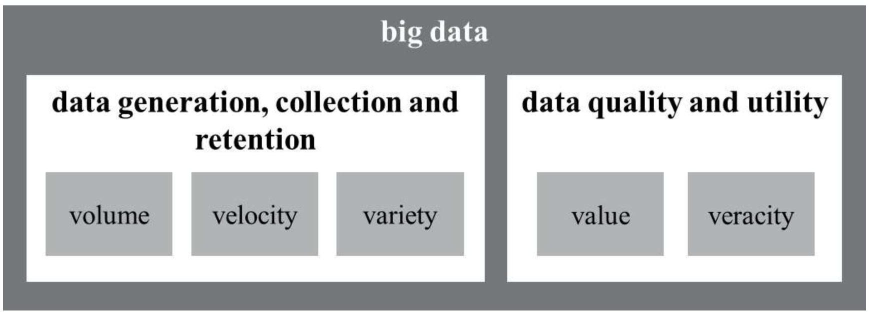

Figure 5. 5V of big data (Luengo et al. 2020, 1–2; Hastenteufel et al. 2021, 6)

Volume describes the huge amount of data. This data is generated at an extremely high speed (velocity) and should be processed in real time if possible. It comes in different forms (variety) and can be either structured, semi-structured or unstructured, which is why data must first be cleansed to ensure its accuracy and credibility (veracity). In addition, data must provide added value (value) for a business. While the first three dimensions (volume/velocity/variety) refer to the acquisition, collection and storage of data, value and veracity focus on the quality and usefulness of data (Luengo et al. 2020, 1; Hastenteufel et al. 2021, 6).

Even though the collection of data is not new, it is the amount of data that is often overwhelming. This results primarily from the fact that

- countless devices and applications, such as sensors or social media, are continuously collecting information,
- storage capacities and technologies have increased enormously in recent years and at the same time the associated costs have dropped,
- the approaches and procedures in the areas of data science, artificial intelligence and machine learning have improved so much in the recent past that the knowledge gained from the data has also increased enormously (Hastenteufel et al. 2021, 7).

In addition, the increasing networking of already existing data opens new possibilities for companies to use data (Bloching et al. 2012, 73; Bendel 2021a; Hastenteufel et al. 2021, 7). However, for businesses to be able to use this data in a targeted manner, suitable procedures and tools are necessary. This is because the benefit of big data is usually not the amount of data or the data itself, but the possibility of recognizing previously unrecognized patterns and gaining insights by using data science and artificial intelligence (Luengo et al. 2020, 3; Hastenteufel et al. 2021, 7).

2.3.4. Cloud computing

Cloud computing comprises various technologies and business models for making IT resources available and charging for their use according to flexible payment models (Fehling, Leymann 2018). Here, IT resources (e.g., servers or applications) are not operated in a company's own data centre but are available on demand via the internet as a service-based business model. This leads to an industrialisation of IT resources and companies can reduce their long-term investments in IT by implementing cloud computing, as cloud solutions are usually much more cost-effective than classic IT solutions (Fehling, Leymann 2018).

Cloud computing is thus a model that allows a business to access a pool of configurable computing resources (e.g., networks, servers, storage systems) on demand, anytime and anywhere, conveniently via a network, whereby these can be made available quickly and with a minimum of effort (Mell, Grance 2011, 2).

The essential characteristics, organisational forms and levels of cloud computing are shown schematically in Figure 6.

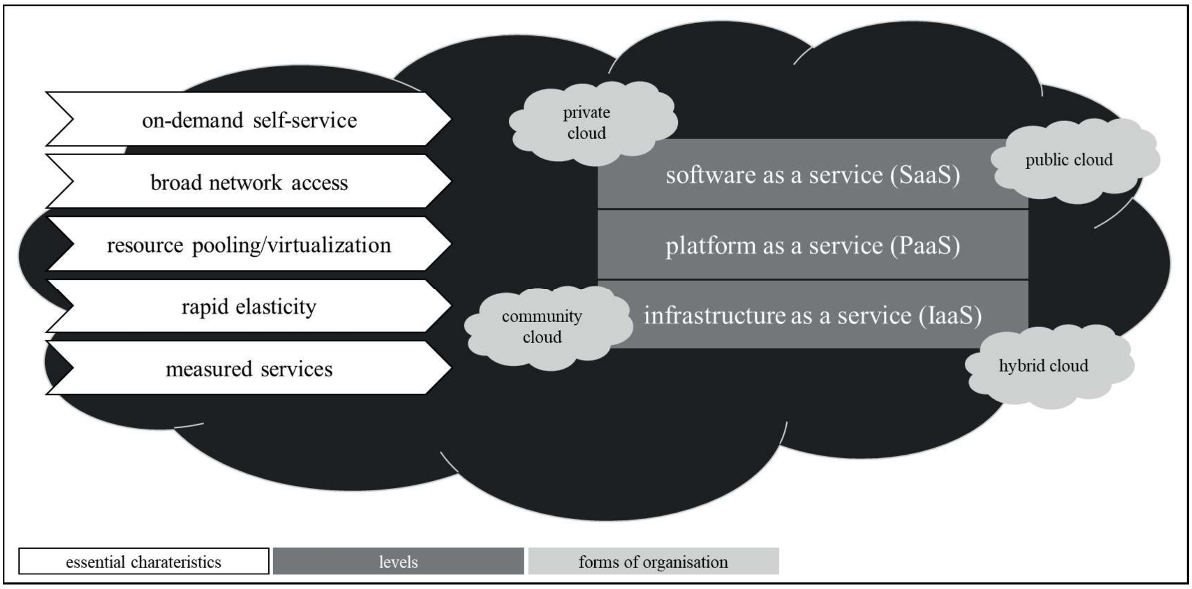

Figure 6. Principles of cloud computing (Hentschel, Leyh 2016, 569)

Cloud computing is characterized, among other things, by on-demand self-service, which means that server capacities can be rented and used by the user without human interaction. The access of a broad mass of devices via the internet is secured by broad network access. Since, depending on the requirements of the users, there is a need to scale these provided resources, resource pooling (concentrated form of virtual and physical resources with which they can serve several consumers) and rapid elasticity (scalability of resources) are important. Measured services serve to increase transparency for service providers and recipients by monitoring and automating the optimization of the use and availability of cloud computing services (Mell, Grance 2011, 2).

According to their organisational form, cloud solutions can be either private, public, community or hybrid. In a public cloud, services can be offered to the public and these services can be booked by several users, whereas access to a private cloud is only granted to a limited group of users (Bundesamt für Sicherheit in der Informationstechnik 2022). Based on this, a community cloud can be understood as an extension of a private cloud, in which not a single company but, for example, a group of connected companies wants to implement a private cloud, whereby not a single company but an entire group gains access to it (Mell, Grance 2011, 3). However, since the requirements for a cloud cannot always be categorised into the three cloud solutions described, hybrid solutions are often state of the art, which optimise the advantages and disadvantages of different cloud types (Zawaideh et al. 2022, 794).

Furthermore, cloud computing has various levels. IaaS represents the lowest layer of the model and comprises the provision of the basic physical IT infrastructure (Hentschel, Leyh 2018, 9), whereby fundamental digital resources are available to the users, but the applications or operating systems can be managed and used independently (Mell, Grance 2011, 3). PaaS extends IaaS by providing additional content (Hentschel, Leyh 2016, 570–571). This can be, for example, complete development and deployment environments, operating systems required for this, any business intelligence services or database management systems (Microsoft 2022). SaaS extends PaaS and thus has the highest level of abstraction (Hentschel, Leyh 2018, 11). The goal is to provide the user with a required software as a cloud-based application, whereby the user is not given any configuration options about the underlying services such as operating systems, server structures, or network components (Mell, Grance 2011, 2).

2.3.5. Artificial intelligence

Among the numerous definitions available, artificial intelligence encompasses all procedures that are used to imitate or reproduce human thought processes with the help of a computer (Buxmann, Schmidt 2021, 6–7). Currently, the research field of AI is characterized by the attempt to replicate on machines the processes of human experience which determine human decisions and actions (Zhou 2021, 2). This is also referred to as machine learning, i.e., the learning of machines based on empirical values by means of algorithms. The concept of robotic process automation (RPA), which is based on this, goes one step further and carries out the learned activities in an automated and high-volume manner within software, so that a versatile process automation is achieved (Lawton 2021). Today, there are already different forms and possibilities of how AI can be used in companies in general and in controlling in particular.

3. The effects of digitization on the core processes of corporate controlling and the role and tasks of controllers

3.1. Impact on selected controlling processes

3.1.1. Planning, budgeting, and forecast

With the internet of things, data from intelligent objects are made available, which can contribute to an increase in flexibility and planning reliability within the planning process due to their granularity. On the one hand, this leads to real-time evaluation in forecasting. On the other hand, a clear demarcation between operational and analytical data management will no longer be relevant for the future, as both data sources can increasingly be considered simultaneously

(Gleich et al. 2017, 117). The large volumes of data are analysed and incorporated by using data science. If a business pushes this integration and includes externally generated data, this can be used within the planning process to uncover, for example, previously hidden market trends and relationships within existing data sets (Georgopoulos, Georg 2021, 55).

In-memory technologies ensure that the increased computing capacity of big data is processed within the planning process. Accordingly, the data relevant to planning is becoming more flexible via increasing computing capacities of cloud computing and more efficient main memory processing (Schmitz 2019). These newly created, structured, granulated data sets can then be integrated into the planning activities of a controlling department by filtering, e.g., through machine learning algorithms, and thus lead to relevant information within a brief time (Portal 2020, 70–72). In this context, cloud solutions that map the entire planning process of controlling and integrate various subsystems, e.g., sub-technologies, are a favourable and flexible way to optimise this core process (Wagner, Wernitz 2022, 17).

The main advantages resulting from integrative planning can also be identified in a comprehensive perspective, which enables the management to recognise deviations from the original plan within the various planning aspects considered and to react accordingly in a dynamic and risk-adjusted manner (FondsKonzept 2022). Different options for action can be calculated by risk-adjusted planning and a driver-based planning model in a volatile corporate environment. Examples are the so-called frontloading approach or the Monte Carlo simulation. Concepts such as the Monte Carlo simulation have been known for a long time, but they can only be used in the practical corporate environment due to the increasing availability of powerful IT infrastructures, since e.g., the calculation times are becoming increasingly shorter due to cloud computing or in-memory technology (Grund et al. 2020, 17).

Standardisation of the processes and the associated adaptation of technologies to the planning processes also mean that increasing automation and digitization in daily work release large capacities that can be used elsewhere (Schrader et al. 2022, 22). Likewise, medium-sized companies could increasingly access these technologies due to the increasing scalability of cloud technology. If, in the case of full integration, sovereignty over the planning logic is then transferred to the system, the company can positively influence both the planning output, the planning quality and the increasing dovetailing of the results of the strategic and operational planning elements (Horváth et al. 2019, 480; Langmann 2019, 23–25). For example, at this point it would be conceivable to have automatic evaluations of strategies according to a certain environment or business information from practice and, in conjunction with this, a digital recording, evaluation, and recommendation of controlling. In the case of automated forwarding, this would lead to operational and strategic planning forming a control loop and the boundaries continuing to merge, so that information from both levels can lead to plan adjustments at the other level (Abée et al. 2020, 19–30).

However, planning is not considered by itself, as budgeting is created based on the determined information. Therefore, the operational individual plans must be integrated into a coordinated overall plan, which subsequently influences or is influenced by the strategic orientation of a company. The entire coordination and consolidation process, including the subsequent budgeting, thus benefits from a flexibilization of data and an increase in the exchange of information (Güler 2021, 116).

Advanced analytical methods are also relevant for planning, budgeting, and forecasting, as they use historical data to predict future events by using algorithms (Mayr 2022, 116). While one thinks primarily of forecasting here, the technological instruments also have positive effects on budgeting. For example, predictive analytics in budgeting can primarily contribute to deriving realistic, comprehensible objectives from the planning data and thus lead to a more positive and motivated attitude among employees (Koch et al. 2020, 56–59). Digitization thus necessarily increases the flexibility in this area of controlling, whereby rigid observation periods, e.g., of one year, could lose importance and an adjustment during the year is simplified (Hastenteufel et al. 2022, 4). If this core idea is expanded with visual support, such as an embedded real-time dashboard, the decision-makers of a business can consult an actual comparison at any time and from any location via the flexible ad-hoc budgeting of controlling (Horváth et al. 2019, 491).

When it comes to forecasting, evaluations of past periods are becoming increasingly less important, especially in highly volatile corporate environments, which means that proactive forecasting is becoming more important (Kieninger et al. 2017, 5). This highlights structure-discovering analytics, such as predictive or prescriptive analytics (QUNIS 2022). By using artificial intelligence, it is possible, for example, to apply complex mathematical analysis methods to increase the validity of forecasts (Horváth et al. 2019, 480). In this respect, cloud-based solutions not only ensure data processing and the creation of forecasts, but also make data available, provide cross-location benchmarks or, for example, allow information from accounting to flow into the calculations in a high-performance manner, which is not possible or only possible to a limited extent with conventional ERP systems (Heinzelmann 2022, 175). If the examples mentioned are carried out interactively, fully automated real-time simulations, driver-based forecast models and adaptable scenario models can be implemented. These are characterized by a creation that can be carried out more frequently, faster, more comprehensively and based on previously unconsidered data sources (also non-monetary data). By reducing interfaces, these integrative systems act automatically based on the underlying algorithms and initiate independent countermeasures (Grönke et al. 2017, 37–38). Thus, forecasts can also be created ad-hoc.

Looking at the influencing factors listed, it can be stated that they are dedicated to the overarching goal of achieving a more agile form of organisation. Table 3 structures and summarises these points.

Table 3

Current effects of digitization on planning, budgeting, and forecasting (Dorow et al. 2023, 17)

Effects on planning, budgeting and forecast through	
the internet of things	
– increase in direct data generation through the value-added process – increase in planning reliability through an increase in the population	– real-time data generation and the possibility of feedback to the systems – reactions to changes in the shortest time possible
big data	
– integrating large amounts of data, including external data, within the entire core process – increasing the heterogeneous exchange of information within planning, budgeting and forecast	– increasing efficiency, especially in the coordination and consolidation process of data – advanced analytics support budgeting and forecast by referring to the future
cloud computing	
– flexible planning intervals/adaptation to planning workloads – possibility to integrate sub-technologies within the core process – flexible implementation of complex forecast simulations (also for SMEs) – integration of further technologies to increase transparency	– minimizing the technology interfaces of planning, budgeting and forecast for the end users – agile cross-company planning is enabled
artificial intelligence	
– discovery of hidden market trends and relationships for integration in planning – evaluating complex planning models in a short period of time – discovering hidden market trends and relationships for integration in planning – evaluating complex planning models in a short period of time – implementing new planning models, such as the frontloading approach	– releasing previously tied-up capacities through the automation of standardized processes – increasing planning output and planning quality – increasing linkage of strategic and operational data – automated initiation of countermeasures in the event of deviations from the plan – enabling a control loop of integrative planning

3.1.2. Capital expenditure controlling

The core process of capital expenditure controlling consists of various input-based sub-processes that result in investment plans, investment reports or recalculations (International Group of Controlling 2017, 40).

In general, capital expenditure controlling consists of the assessment, selection, and control of significant investments (Rieg 2022, 899). It starts with the investment idea since capital expenditure controlling is influenced by implemented digital technologies. The investment requirement arises mathematically from the planning results already described, which can be circumscribed by a mathematical-analytical activity (Behringer 2021, 98). In the case of agile planning, there is already an intensified exchange of information here, which must be considered within the investment calculation. Especially cloud-based software such as SAP S/4 HANA can already facilitate communication and data access for investment controllers (SAP 2022). The improvement of communication leads to the emergence of discussions within various parts of a business, the discovery of bottlenecks by using IoT technologies and the identification of new investment needs, which can lead to a long-term improvement of the process start of capital expenditure controlling (Behringer 2021, 78).

After an initial exchange of information took place, investment controllers accompany the investment project by determining the investment amount, the profitability, and the underlying risks of a project (International Group of Controlling 2017, 40). This is the investment planning sub-process. Regardless of whether static or dynamic investment appraisal methods are used, the values must be analysed as precisely as possible and included in calculations to be able to carry out a targeted investment assessment. If the net present value method is used to calculate the discounted cash flows based on a fixed purchasing behaviour of customers over five years, a sharp rise in inflation, for example, can lead to this calculation no longer being applicable. Market data, pricing data, production data, research and development data, design data, tool data or process information and other data can be used as influencing factors in investment calculation (Mühlböck, Kronawettleitner 2022, 448). This example shows that capital expenditure controlling is strongly future-oriented and risky. It should be mentioned that not only a business itself bears this risk, but also the stakeholders (Wagner 2022, 239). Therefore, it is an essential task of capital expenditure controlling to deal with uncertain forecast data, for which small and agile control loops should be developed to be able to initiate any investment changes regarding the agile environment (Lamla 2017, 135). These control loops should in turn be used with big data. In practice, predictive analytics can help to forecast probable future values from historical data, which can then be included in the investment calculation (Schrader et al. 2022, 8). Integrated sensitivity analyses inform about the corresponding risk (Langmann 2019, 11), which can reduce the uncertainty factor and increase the quality of the instructional content. If the diversity of data is combined with the learning mechanisms of artificial intelligence and the computational speed of cloud computing, coherent investment models can be developed that are already being used in practice, e.g., in asset management. They can automatically collect data from recent decades on financial investments, process them for investors or check and correct the decisions of investors themselves (EY 2023). The individual, clearly definable solutions in capital expenditure controlling are becoming comprehensive overall services due to multi-layered data (Horváth et al. 2019, 486).

If an investment has been planned using modern technologies, it is possible to combine this planning with other investment plans within a programme or to weigh up individual investments (International Group of Controlling 2017, 40). In practice, the number of courses of action poses a particular problem in this regard because, on the one hand, many alternatives lead to confusing content and, on the other hand, timing plays a key role. Investment options may arise, while others may expire and thus no longer be available (Schneider 2022, 38). Overall, controllers need to use digitization approaches to cope with ever-shrinking investment cycles (Abée et al. 2020, 20). If one wants to evaluate partial solutions, one can refer to the overall services above. However, to gain a comprehensive overview, the individual measures can also be evaluated coherently by using artificial intelligence and thus form a new integrative level of consideration. AI can then in turn complement this new layer of data so that new, up-to-date information is integrated into investment programmes (Foy 2021). It is also conceivable to integrate the growth business perspective, in which effects are operationalised that occur after the investment has been made (Kappes, Schentler 2017, 167). Standardized investment portfolios can be used to visualise the benefits of various programmes and present aggregated information on a dashboard via cloud computing (Vanini 2022, 284). The role of controllers is to monitor this process and incorporate their own experience into the selection of an optimized investment programme. An embedded reinforcement learning structure improves the future decisions of AI, which can successively increase the quality of statements about learning intervals (Foy 2021).

If the need for investment is confirmed through communication, if it is planned and an investment programme is decided, capital expenditure controlling must, among other things, observe investment decisions, create recommendations for action and recalculate investments.

The increased performance orientation described above must always be considered from a cost-benefit perspective, since businesses are subject to great uncertainties regarding the success potential of investments. Although it is possible to scale evaluations, including cost-related ones, via cloud computing, excessive costs are associated with implementations or process changes in capital expenditure controlling (Güler 2021, 109). Partial integrations, such as the information networking of forecasts and capital expenditure controlling to take early countermeasures, will therefore predominate in practice (Müller 2021, 46). In contrast, far-reaching digital environment assessments must be subjected to an intensive individual cost-benefit analysis and are therefore likely to be found less frequently in SMEs than in large companies (Abée et al. 2020, 28). Finally, Table 4 summarises the influence of digitization technologies on capital expenditure controlling.

Table 4

Current effects of digitization on capital expenditure controlling (Dorow et al. 2023, 19)

Effects on capital expenditure controlling through	
the internet of things	
– bottlenecks and investment needs are uncovered – agile adjustment due to new data within fast control loops in capital expenditure controlling	– provides versatile industry data that helps in investment appraisal – provides the internal basis to carry out capital expenditure controlling on a real-time data basis
big data	
– provides influencing factors (multi-layered data) for inclusion in investment calculations – increases the quality of the content of the report	– reduces the risk of the organization and the stakeholders by enhancing metrics
cloud computing	
– increased information transparency in finding an investment idea – faster evaluation of related investment models – easier access to data by capital expenditure controllers	– more flexible information for relevant stakeholders of investments, e.g. by means of dashboards
artificial intelligence	
– learning mechanisms help to achieve accurate investment recommendations – versatile data use and complex algorithms are applicable in capital expenditure controlling	– sensitivity analyses become applicable and independently extended – new level of consideration: entire investment program decisions become comparable

3.1.3. Cost, performance, and profit accounting

Society is changing continuously due to digitization, which means that product life cycles are becoming shorter, and customers are demanding flexible products and services that are adapted as precisely as possible to their individual needs (Mayr 2022, 107–109). Businesses need to address these changing needs to maintain their position in the market. To guarantee a profitable operating process, controllers must evaluate this change within cost, performance, and profit accounting and collect relevant information.

Due to the permanently changing conditions in production, the number of employees in indirect areas such as marketing or IT is increasing (Mayr 2022, 104). Automation, high-tech and increasing digitization of business systems and processes lead to product-independent resources being increasingly tied up and costs rising as a result. At the same time, more intense competitive pressure can be observed due to digitization and the globalization of markets, resulting in increased cost pressure on companies (Günther 2018, 545). A central challenge for companies today is therefore to counter increasing cost pressure and changes in cost structure.

In this regard, in cost management a variety of instruments have been developed which can be applied in a solution-oriented manner depending on the area of application. These include, for example, flexible standard costing which serves resource-oriented cost planning as well as activity-based costing, with which transparency is created within increasingly complex business processes. In addition, product life cycle costing, in which the cost perspective is considered and managed over a product´s life cycle, is also used (Mayr 2022, 106).

All these instruments are based on data and are applied depending on the problem. Data quality can be identified as a particularly critical point. Therefore, the necessity to identify cost drivers along the value chain and to include them realistically in calculations is high. Cross-company information systems, such as a cloud-based integrative business intelligence system, are effective ways to meet these quality-assuring requirements (Georgopoulos, Georg 2021, 11). However, Monte Carlo simulation, for example, also benefits from increased data quality in cost and performance accounting. Data can be incorporated into business scenarios determined in real time and, through big data combined with external data, lead to better results (Grund et al. 2020, 17). These models can then be optimized by enhancing data with actual prices and observation of competitive prices, for example with machine learning, to create the highest possible transparency within this core process (Georgopoulos, Georg 2021, 48).

Looking at the approaches of digitization within cost accounting, we can see a higher agility, an innovation orientation, and a smarter use of data. An attempt is made to create a certain proactivity to successfully lead a business through constantly changing environmental conditions and to use diverse opportunities in this process (Becker et al. 2022, 1013). Initiative-taking cost management is characterized by enforcing a consistent market orientation while considering the entire product life cycle. As rising fixed costs and overheads can be challenging for businesses, IaaS, PaaS, SaaS services can be implemented to modify or reduce fixed costs (Mell, Grance 2011, 2). Reactive cost reductions due to deficient performance indicators are thus a problem of the past and are replaced by an intra-year and ongoing cost analysis. This aims to secure sustainable competitive advantages and long-term corporate success. In contrast to hierarchical top-down planning, employees are actively involved in cost planning. Initiative-taking planning is thus characterized by communication and interdisciplinarity. Information systems that use the entire data of the digitally influenced cost, performance, and profit accounting create a centralised data model (Güler 2021, 130; Mayr 2022, 107–122).

It should be mentioned that the drivers of digitization can lead to structural changes along the entire core process of cost, performance, and profit accounting. This is especially true for material management, personnel policy, investment structures, process levels and product characteristics. The main effects of digitization on cost, performance and profit accounting are summarised in Table 5.

Table 5

Current effects of digitization on cost, performance, and profit accounting (Dorow et al. 2023, 21)

<table>
<tr><td colspan="2">Effects on cost, performance and profit accounting through</td></tr>
<tr><td colspan="2">the internet of things</td></tr>
<tr><td>– increasing asset intensities and reduction of process costs
– changing cost structure (rising costs)</td><td>– allows the inclusion of detailed data, e.g. machine data
– allows individuality and feedback through controllable elements</td></tr>
<tr><td colspan="2">big data</td></tr>
<tr><td>– increasing cost pressure on companies through comparability
– enables the inclusion of versatile data in cost, performance and profit accounting</td><td>– benchmark analyses in line with the market are enabled
– a holistic approach is achieved</td></tr>
<tr><td colspan="2">cloud computing</td></tr>
<tr><td>– changing the cost structure (more flexible, dynamically adaptable)
– central database of cost, performance and profit accounting can be accessed by many organizations and controlling departments
– real-time data relationship for production adjustment</td><td>– enables individuality to be derived from holism
– stand-alone solutions are consolidated into a unified system
– employees and different valuation approaches can be better integrated into cost, performance and profit accounting</td></tr>
</table>

Table 5 cont.

Effects on cost, performance and profit accounting through	
artificial intelligence	
– new models of cost, performance and profit accounting, which, for example, consider the entire product life cycle – automated execution of computationally intensive processes – comprehensive scenario models for adapting offers	– evaluating of complex planning models in a short period of time – feedback and adjustment based on international data in real time – proactivity within cost, performance and profit accounting is developed

3.1.4. Management reporting

Standard reports, ad-hoc evaluations, or the creation of a dashboard are all based on data that is processed and prepared in management reporting. In the following, we will analyse the effects of digitization trends on the core process of management reporting, which includes data collection and preparation, report creation, plausibility checks, analysis, and commenting on and discussing the reports (Langmann 2019, 14).

If we consider data collection and processing, there are for example changes related to the internet of things. Current data from sensors within connected machines ensure that data is generated and available in real time, thus enabling real-time control of production processes (Georgopoulos, Georg 2021, 53). It should be mentioned, however, that the systems of agile organisations are communicating with their environment, which usually creates heterogeneous networks. The data provision of these networks must first be harmonized and based on sufficient data quality to enable a uniform and standardized analysis that is accepted within a business (Ploier, Mayr 2022, 156). Only in this way will data collected and provided by the controlling department remain the sole source of truth and thus the basis for all further reporting (Horváth et al. 2019, 488). AI-based bots enable these reporting process steps of data extraction, harmonisation, and plausibility checks from various sources to be carried out automatically (Langmann 2019, 17). It is also possible to identify relevant value drivers within data structure (Güler 2021, 125). Machine learning algorithms thus accelerate the approaches in management reporting and lead to quality improvements from the very first process step, providing more detailed and flexible access to information in terms of content (Müller 2021, 32–34). This also impacts the capacities in controlling, so that controllers must make fewer manual adjustments, data inconsistencies are avoided, and free capacities can be used for other tasks (Schrader et al. 2022, 10). To disclose cause-and-effect relationships and create sufficient transparency, it is important to pay attention to the integration of interfaces when selecting the software used so that isolated solutions are avoided (Eymers et al. 2018, 124).

Big data technologies have a major impact on management reporting, as they can be used in a number of sub-processes. For example, the cause-effect relationships can be evaluated by using a statistically quantitative database (e.g., via sentiment analysis) (Langmann 2019, 15). Data science can significantly increase the plausibility of a report's content in terms of topicality and informative value by integrating external data, e.g., from social media or from the news, into management reporting. This also leads to a broader view of value drivers within value driver analysis, so that a detailed view on data is provided. This is also referred to as a drill-down (Georgopoulos, Georg 2021, 53–54).

However, data science not only allows for historical analysis. Rather, by advanced analytics, highly granular data can be analysed in real time, while external data can be related to facts within a business to complement management reports. Thus, a shift from past-related descriptive reporting to future-oriented data interpretation and enriched prediction of the impact on an organisation can be observed (Mödritscher, Wall 2022, 46). The indicated mergers of operational and strategic data levels can therefore be found in this core process. For example, the technologies described support so-called real-time reporting, in which standardized reports and dashboards are created automatically and in a customized manner for the management. Moreover, the agility of a business is guaranteed, and a competitive advantage can be generated (Langmann 2019, 17). Conceivable here are, for example, fully automated document postings, report compilations and automated corporate communication with tax auditors or tax consulting firms (Ploier, Mayr 2022, 153). Since management reporting includes individual elements of related core processes and encompasses already established reporting, there is also the possibility that new reporting formats will emerge (Huber 2017, 68).

Therefore, the role and tasks of controllers in this context must be reconsidered. In literature, reference is made to so-called self-service reporting, in which a management uses controlling systems, e.g., via apps, without contacting the controlling department (Georgopoulos, Georg 2021, 53–54). Reports based on voice control, reports on mobile devices or, for example, production information based on the current conditions in a factory open up new possibilities for management reporting and benefit from an increasing performance of consolidated IT systems (Langmann 2019, 16). However, it is questionable whether self-service reporting, by bridging the controlling function as a supplier of figures within the management reporting process, makes the entire tasks of controllers obsolete. Without the specialised knowledge of controllers and sufficient training and experience, there is always a risk of misinterpreting data (Wolf, Heidlmayer 2022, 18). It should therefore be noted that capacities that are released due to digitization should not disappear but should be used to focus on other controlling activities.

Overall, we can state that management reporting in general and financial, market or functional reporting specifically are affected by the selected digitization trends. While financial reporting tends to benefit more from increasing automation and the connectivity of the IoT, market and functional reporting will change in measures and overall concepts. Digitization is changing the past-related reporting requested by management into a future-oriented integrative instrument that adapts the innovations of the core processes of controlling. In contrast to traditional push reporting, in which controlling sends out the reports, we can observe that managers navigate independently through the reports and can thus analyse this consolidated information in a value-driver-oriented manner by means of drill-down procedures (Gräf et al. 2017, 61). In this more efficient world of pull reporting, the tasks of controllers will change. Table 6 summarises the effects of digitization on management reporting.

Table 6

Current effects of digitization on management reporting (Dorow et al. 2023, 24)

Effects on management reporting through	
the internet of things	
– real-time reporting is made possible through CPS – heterogeneous networks become evaluable for reporting purposes	– detailed data of value-added process can be linked in reports – increase in transparency through an expansion of the amount of data within reports
big data	
– allow for sentiment analysis as a quantitative data basis – extensive drill-downs are possible	– reports are improved by highly granular data in real time – future orientation and traceability within reports is increased
cloud computing	
– cause-effect relationships are disclosed by avoiding isolated solutions – increases transparency within reports through individual presentation	– self-service reports can be accessed by managers – reports are created based on consolidated IT systems
artificial intelligence	
– single point of truth is ensured by AI systems – data extraction, harmonization and plausibility checks can be automated within the process – releases capacities for controllers	– relevant value drivers can be identified and a more detailed and flexible access to content is provided – automated reporting can be adapted in an agile manner

3.1.5. Business partnering

In contrast to the essential core processes explained above, the elements of business partnering are not limited. Rather, the sub-processes are designed individually and according to individual needs (International Group of Controlling 2017, 50). The core process of business partnering, and the sub-processes cannot be clearly defined, so that an extensive mapping of different company-specific competences is necessary (Meier 2022). In the following analysis, two selected sub-processes of business partnering are selected as examples, which are particularly relevant. On the one hand, decision-making is considered since management must always make decisions and the decision-support function of controlling can influence the organisation of a company significantly. On the other hand, the promotion and transfer of special knowledge in a business are dealt with, as this aspect serves to secure the future. Both forms of business partnering in focus are therefore highly relevant to the effects of digitization trends on core processes described so far and have a considerable influence on a company´s success. To include big data in decision-making, for example, analytical procedures such as aspirational, experienced, or transformed processes can be used. In this context, aspirational includes the confirmation of decisions already made and the explanation of wrong decisions. In contrast, experienced methods evaluate different decision alternatives by using data science. In transformed decision-making, cause-and-effect relationships are revealed based on decision alternatives and dependencies of different data (e.g., market data). Moreover, decision alternatives are modified to find the best solution (Mödritscher, Wall 2022, 45). If controlling deals with these technologies and uses new instruments in adjacent core processes, a more extensive knowledge leads to the fact that a stronger decision-making participation can be observed, in which, however, the managers should always be included in decision-making and evaluation (Schneider 2022, 86–87). Extensive automation technologies, highly volatile business environments and increasing competitive pressure serve as drivers in this regard, so that controlling is increasingly involved as a sparring partner of the management within the decision-making processes (Wolf, Heidlmayer 2022, 6–15). AI systems can be used, for example, to check decisions based on big data by means of so-called A/B tests, to uncover correlations using data mining and thus to create hypotheses for decisions, or to generate new models via machine learning and complex algorithms in order to be able to interpret alternatives more easily, which ultimately leads to a qualitatively better decision (Wolf, Heidlmayer 2022, 20–27). Optimized starting points of a data landscape as well as data preparation thus lead to the active decision-making process becoming more efficient, while ensuring a high effectiveness of the measures (Kieninger et al. 2017, 6–7). Data science enables the management to make decisions faster, proactively and on a specified information basis. Ensuring data quality is also relevant, as the large quantity and variety of data may lead to incorrect decisions (Müller 2021, 14–84). Information based on big data can also be used in the guidance process. For example, the actions of individuals are based on information they easily remember. New forms of visualization, such as treemaps or Sankey diagrams, contribute to simplifying this guidance process and can be displayed or communicated to the management via a cloud computing-based system (Mödritscher, Wall 2022, 53). However, it is also conceivable to integrate the data obtained into traditional instruments, such as a balanced scorecard, and thus enable managers to routinely deal with new information. In any case, information systems based on cloud computing ensure that decision-making has a clear basis and that various levels of reporting can be flexibly addressed to make the best decision possible (Linsner 2017, 73–74). An openness of the management to new forms of technology is essential in this context.

To be able to make the best possible decisions, companies highly rely on expert knowledge and on modern technologies. This makes knowledge transfer within an organisation indispensable. Controlling can take an expert position in this process since the existing system landscapes can be transferred to the knowledge process. For example, there are platform solutions based on cloud computing that distribute specific knowledge within a company (Horváth et al. 2019, 474). Moreover, they can be used to

- facilitate collaboration with experts via interfaces,
- enforce data governance,
- ultimately integrate AI.

This includes the possibility of including cyber-physical systems (CPS) and thus accessing the data of the IoT within a knowledge database as well as retrieving the data of the knowledge database via CPS (Tridion 2022). There, the entries maintained can then be checked and corrected automatically, e.g., by using innovative, AI-based methods, to ensure they are up to date. In addition to the sustainable development of internal company knowledge, there is also the possibility of implementing external knowledge networks or renting knowledge services to expand a business' expertise (Elste, Binckebanck 2017, 923). Furthermore, the idea of a centre of knowledge is becoming more popular due to better networking. The tasks of reporting, the processes or even the technical specific knowledge are pooled in one department, so that the advantages of standardisation such as bundling effects, efficiency increases or completely new organisational units are the result (Eymers et al. 2018, 123). If new centres of expertise are created in businesses, they can in turn provide consulting services for other divisions, with controlling acting as a data-specialised consultant for example (Langmann 2019, 41). Finally, digital competences built up by controlling can be further concentrated by digitization trends in a business and thus lead to increased knowledge

(Abée et al. 2020, 45). Like other main processes, the best level of integration of digitization within knowledge transfer must always be determined individually.

Table 7 summarises the influences of digitization on the decision-making process and the promotion of business expertise through controlling.

Table 7

Current effects of digitization on business partnering (Dorow et al. 2023, 26)

Effects on management reporting through	
decision-making process	promoting expertise
the internet of things	
– allows for a larger data base for decisions to be evaluated – real-time reporting based on the IoT leads to ad-hoc decisions – increases data quality of decisions	– knowledge is made accessible and explained with the help of CPS data – data updates of the CPS are automated by means of a knowledge database
big data	
– decisions become more transparent and easier to analyze – new methods (aspirational, experienced or transformed) are included in the decision-making process – proactivity is enforced within decisions	– knowledge base is significantly expanded and verifiable – misinterpretations are avoided due to an increased data basis
cloud computing	
– can lead to a higher level of decision-making participation by the controlling department – present simple graphics to simplify decision-making – connect different reporting levels of an organization to simplify decision-making	– company-wide solutions such as portal solutions serve as a central source of information – enable the use of data governance or other IT connections – access to third-party knowledge services is enabled – new organizational units (e.g. data labs) and roles can be created – collaboration with experts is facilitated
artificial intelligence	
– decision alternatives can be calculated, and intelligent decision models are created – complexity promotes the need for controlling as a sparring partner – decision alternatives can be interpreted more easily – feedback of the effects of decisions on the decision alternative itself is possible	– new forms within the knowledge databases, such as an automated correction database, are enabled

3.2. Impact on the role and tasks of controllers

The results of the effects of digitization trends on the essential core processes of controlling show a clear expansion and shift in controlling activities. Thus, IT systems will increasingly take over and fulfil tasks that are traditionally primarily assigned to data collection, processing, and distribution in the respective areas of controlling. Furthermore, the degree to how controlling functions and which controlling competencies will become more relevant, is influenced by the degree of integration and the use of these IT systems. In addition to a shift in roles, the literature also discusses whether future scenarios exist in which controllers become redundant within a business that uses digital technologies (Losblicher, Ablinger 2018, 66). It is assumed here that there will not be a substitution of controllers, but rather an expansion of their role and a modification of their tasks. This is justified, among other things, by a higher digital demand, a stronger competitive situation, greater complexity in general, expanded areas of responsibility for controllers, and the need to balance the limits of automation and AI (Losblicher, Ablinger 2018, 55). This assumption is the basis for considering established role models, as otherwise controlling could be classified as obsolete. However, to develop a starting point that also relates to the influence of digitization trends on controlling, the following roles of controllers will be considered:

- service provider,
- business partner,
- functional leader,
- pathfinder.

If controllers are described as service providers, their focus is on creating reports and providing data (Langmann 2019, 42). This role is the basis for all other controlling roles and is linked to the role model of the traditional controller. Thus, the core tasks of the service provider are (Langmann 2019, 43; Seefried 2017, 60):

- standardized cost accounting,
- consolidation in the annual financial statement,
- planning,
- reporting,
- commenting,
- further calculations,
- the execution of other standardized processes.

This role is linked to the implementation of the digitization technologies described, so that the goal is to further consolidate the data provided by IT systems and to pass on relevant information to the management. However, if the scope of services of digitization trends within an organization is broadened, this outdated form of controlling becomes obsolete, so that in a flexible and agile corporate environment only little or even no added value can be generated by service providers (Hastenteufel et al. 2022, 7).

In addition to traditionally oriented service providers, the role of business partners is already established in many businesses. In this role, controllers function as idea providers and drivers for the management and increasingly take on a role between traditional controlling and management. Proactivity, ensuring organisational control and the architecture of the control system are their main tasks (Seefried 2017, 60). Controllers act on an equal footing with managers, so that independence and self-initiative are highly relevant regarding the implementation and coordination of strategic and operational measures (Hastenteufel et al. 2022, 6). Through the continuous use of new digital technologies and the automation pursued with them, controllers are enabled to use released capacities for management consulting related tasks. The aim is to optimise the decision-making process and thus establish long-term financial success for a company (Langmann 2019, 42). Through authenticity and storytelling, business partners ensure that information is interpreted and used correctly by the management (Haufe 2020). Controllers are thus to be integrated as sparring partners for management (Schöning, Mendel 2021, 47).

If controllers act as functional leaders, their main tasks are to manage and establish business-wide guidelines and standards for handling data. For this purpose, controllers develop, publish and document these and monitor their implementation (Langmann 2019, 43). Digitization is driving the importance of this role, as the number of IT systems is increasing and with it the amount of data. However, there are also problems associated with advancing digitization that functional leaders are supposed to avoid. On the one hand, they are used to avoid the situation of information chaos in which inconsistent or contradictory data arise. On the other hand, incompatibilities between information systems, information overload and data uncertainty, especially of personal and competition-relevant data, are to be counteracted (Heimel, Müller 2019, 413–414). The increasing availability of data, the diversity of data landscapes and the higher sensitivity regarding data protection are thus the main drivers of this role. However, the increased volume of structured and unstructured data within big data in combination with cloud computing pose challenges for controllers (Langmann 2019, 44).

In contrast, pathfinders focus on future trends in digitization and various analytical topics and try to examine which selected methods can be meaningfully implemented within a business so that controlling systems and methods always remain up to date (Schäffer 2017, 29). They can also be identified as drivers of change processes within controlling, which links them to data scientists in terms of their proximity to analytical topics (Langmann 2019, 43). Data scientists, in turn, work operationally with data evaluations and structures. For example, they know various database models, how to access them, transform data, programme queries, visualise them and link them to a task (Aunkofer 2022). It is conceivable that controllers, as pathfinders, transfer innovations of digitization to business models and hand them over to data scientists for an operational evaluation to implement the respective questions. To do this, controllers need extensive technological skills, the will to continuously expand their knowledge, to act with foresight and statistical knowledge (Hastenteufel et al. 2022, 9). This example illustrates the effects of digitization on controlling, whereby the pathfinder has the highest degree of digitization and presents itself as a connection between business controlling and data-driven technology (Langmann, 2019, 45).

If we look at the distinct roles of controllers, we see that they make sense depending on the degree of digitization in a business. However, the roles described should not be seen as static or fixed. For example, pathfinders can also take on tasks of functional leaders if this is necessary in the respective situation. It always depends on a company and its individual circumstances. It seems logical to continue to observe developments in practice and thus to uncover possible sub-roles or further development stages of their role. However, a multitude of other roles already exist today, but they do not always overlap. For example, there are scorekeepers, data scientists, data engineers and decision scientists, to name but a few (Schäffer, Brückner 2019, 21). Whether a controller takes on all these roles, specialises, or how exactly the roles exist in a business can only be answered individually.

If we now combine the role descriptions presented here with the previously considered traditional role of controllers, various skills can be highlighted. If we build on the role of the service provider, the required competencies of the business partner, the functional leader and the pathfinder can be derived from this. Since the development of the various roles in controlling is ongoing, the following ideas are based on a Delphi study conducted by WHU in 2019, in which 448 participants with controlling expertise from various hierarchical levels took part and which can therefore be regarded as a starting point (Schäffer, Brückner 2019, 20). The aim is to transfer these research results to the skills map presented in figure 4 and to link them. For this purpose, the Delphi study looks at the required skills of selected roles in controlling. These are then assigned to the originally developed skills map, which refers to the core processes of controlling (Schäffer, Brückner 2019, 27). More frequently occurring required skills of the study are then aggregated under the originally selected characteristics of the map, while skills that could not be assigned were added in italics. A colour coding indicates the intensity of the required competence level. Finally, Figure 7 shows which of the traditional skills are becoming more important and which new skills will be relevant in the controlling of the future.

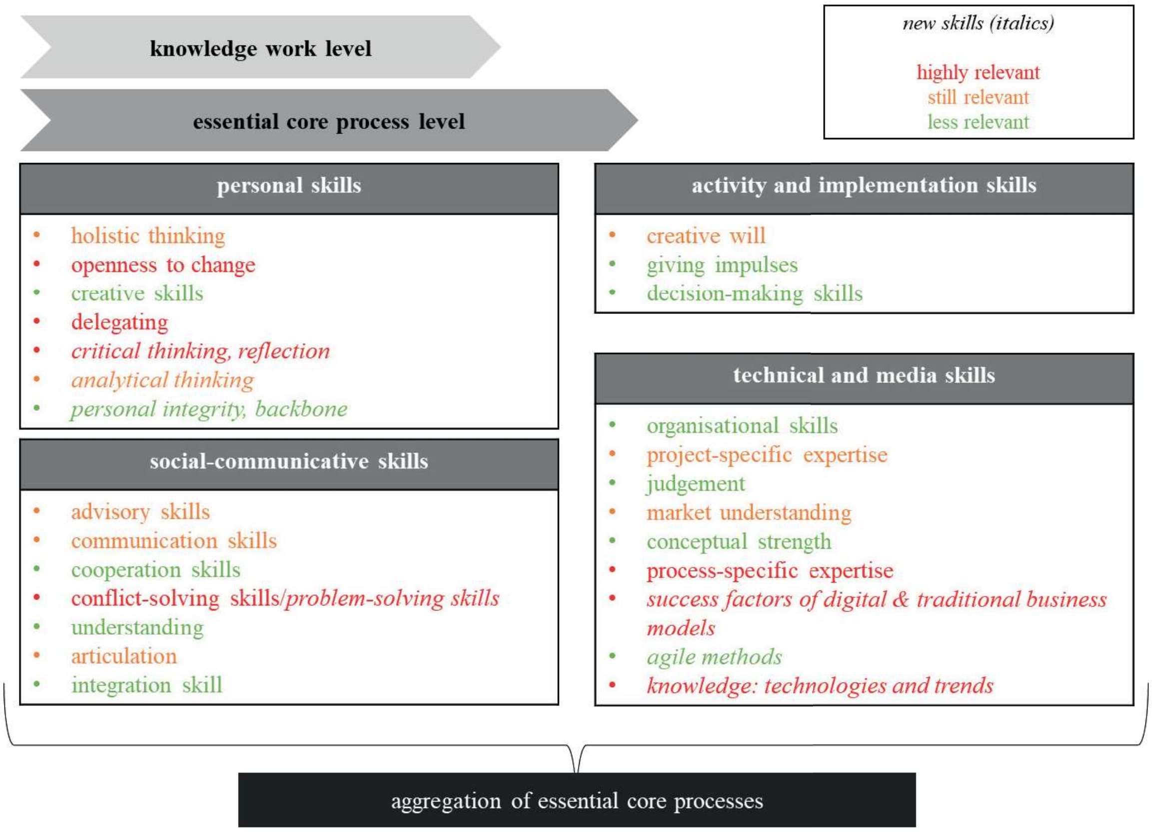

Figure 7. Modified controlling skills map
(International Group of Controlling 2015, 38–101, Schäffer, Brückner 2019, 27; Dorow et al. 2023, 30)

4. Concluding remarks

This paper investigated the extent to which the megatrend of digitization impacts the processes of controlling and how this is reflected in the role and tasks of controllers. In doing so, the competences required for controllers to master the processes were analysed. Based on this, a skills map was developed that refers to the traditionally required competences in controlling from 2015.

To value the technical orientation of this paper, selected key trends in digitization – the internet of things, big data, cloud computing and artificial intelligence – were examined. It was shown that these technologies differ from each other, are in various stages of development and therefore offer individual use cases for controlling departments or have different effects on them.

Subsequently, these technologies and controlling topics were linked and in this context the effects of digitization trends on controlling tasks were analysed. The focus was on the core processes of planning, budgeting, and forecasting, capital expenditure controlling, cost, performance and profit accounting, management reporting and business partnering. It became clear that the individual controlling core processes are all affected by these technologies in diverse ways. In addition to general changes in the processes, risks, but also opportunities, can be identified through the targeted use of these technologies, depending on the design of the respective process. Numerous effects of selected technological trends on these controlling-specific core processes were described and analysed accordingly.

Based on this, the traditional skills map of controlling could be modified, new skills for emerging roles in controlling could be evaluated and related to the already elaborated information. It could be pointed out that some skills are increasingly important, while others become less relevant. In addition, new skills were also identified which modern controllers should focus on.

What do the technologically influenced future of controlling and the future role of controllers look like? This paper has shown that the environment of controllers is subject to constant change. Digitization affects the environment, people, and businesses. Therefore, new types of technologies also influence the described controlling processes in different intensities, characteristics, and diversity. This means that controlling experiences a change in tasks and responsibilities. Terms such as increased agility, proactivity and increasing automation have come up repeatedly in this paper and will continue to force controllers to develop new skills in the future.

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Summary

Digitization is a megatrend that strongly influences organisations and is reflected in all business processes and operational functions. It is therefore not surprising that controlling is also affected by digitization. This paper first defines and explains the key sub-processes of controlling and describes the traditional role and tasks of controllers that are derived from this. Next, selected technologies such as the internet of things, big data, cloud computing and artificial intelligence are described in detail and their influence on controlling and the role of the controller is analysed. It is shown that digitization is already having a significant impact on controlling and still holds considerable potential for the future. This will also lead inevitably to a continuous refinement of the role and tasks of controllers, whereby they will have to further expand their knowledge and skills in the future.

JEL codes: G39, M19, M49

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The impact of markups and wages on changes in the level of inflation in Poland**

1. Introduction

In order to limit the negative impact of price increases on real economic processes, many central banks treat the fight against inflation as a key priority of their economic policy. Anti-inflation policy evolves from a Keynesian (demand) approach using fiscal policy tools, through a monetarist (supply) approach focused on regulating the amount of money, to comprehensive monetary policy instruments, including mainly interest rates, open market operations, reserve requirements or non-standard instruments of portfolio reduction bonds and others.

Isolating the most effective ways and tools to fight inflation is not easy, taking into account the unprecedented overlapping of numerous events such as the aforementioned COVID-19 pandemic and the energy crisis related to Russia's aggression in Ukraine. These events caused numerous disturbances in the monetary and fiscal spheres, business activity (in the areas of supply chains or investment policy in the domestic sector and foreign trade), as well as in the functioning of households (in the area of employment or income). They were the source of numerous shocks of an exogenous and endogenous nature, on which financial policy in the short and medium term often has a limited impact, resulting in the consolidation of inflation expectations in the economy.

This situation forces us to verify the existing theoretical and empirical studies on the determinants of the CPI and the channels of influence. Identifying whether we are dealing with demand or supply inflation, short- and long-term paths of inflation/disinflation in accordance with the model Philips curve. This situation

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