

# The Corporate IT/IS Function: Competences and Organization for a (Digital) Future

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**Abstract.** The notion of “digitalization” is associated with fundamental changes in the technology and business environment of organizations that challenge the traditional role of corporate IS Functions. However, little research is available on the impact that digitalization has on this function and on how it can transform to best respond to new challenges. Taking this as motivation, we present the results of a Delphi study among IT executives and management consultants on the competences required by the future IS function and its organization. With respect to competences, we could confirm the importance of competences in information resource management, agile development, and information security and risk management. However, we could not confirm the general trend towards outsourcing parts of the IS function. Rather, we found that IT outsourcing is judged differently depending on the size and business model of organizations. Our research also suggests different future paths for the CIO and his involvement in digital innovation.

**Keywords:** Digitalization, IT/IS Function, IT/IS Competences, IT/IS Organization, IT Outsourcing, CIO Role

## 1 Motivation

The notion of digitalization expresses the diffusion of digital technologies, often described as SMAC technologies (Social, Mobile, Analytics, Cloud), in the economy as well as into everyday lives. Unlike the term digitization, which denotes the technical process of converting information into a digital format, digitalization refers to socio-technical changes in business and society. Such change imposes significant challenges on organizations and specifically on the corporate IT/IS function. Accordingly, surveys among business and IT executives indicate a strong need for the corporate IT/IS function to transform. Unfortunately, research on the corporate IT/IS function is scarce [1–3] and little research has been done on transformation needs in the face of digitalization. The few academic publications available on this topic are opinion papers published in practice-oriented journals, which present good arguments but little empirical evidence

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[4–9]. Taking this as motivation, we conducted a Delphi study to evaluate hypotheses on how corporate IT/IS functions might appropriately respond to future challenges, most of which are driven or at least influenced by digitalization.

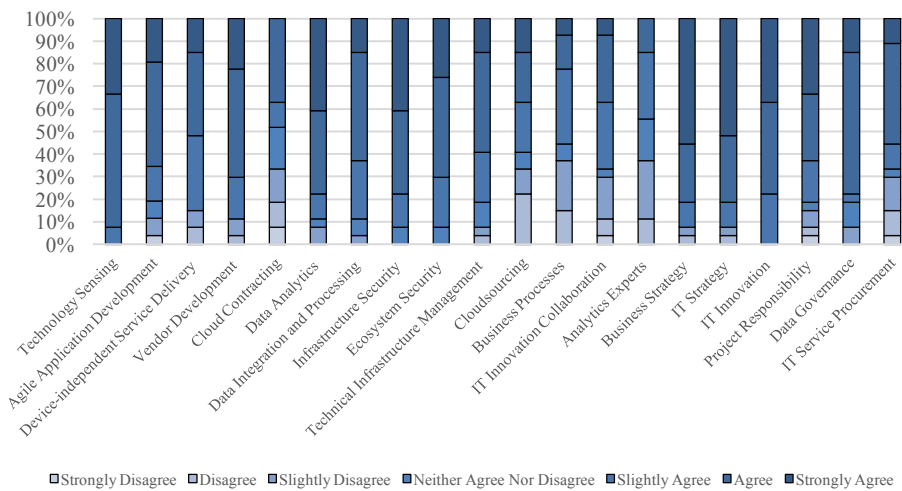
## 2 Research Objectives and Approach

The goal of our research was to identify competences and organizational structures required for corporate IT/IS functions of the future. We have approached this research goal by first identifying emerging trends that could possibly have an impact on the IT/IS function. In the absence of empirical research from academia, we did this against the backdrop of current publications from market research institutions and IT management consultancies focusing on this topic. It is important to note that we did not use the consultancy literature as a surrogate for academic theory, but only as a rich practical source for uncovering potential trends in the transformation of the corporate IT/IS function that are worth further investigation. For example, Capgemini discusses the latest technology trends, McKinsey proposes guidelines for organizations to go digital, and KPMG examines the impacts of sourcing trends on organizations [10–12]. In addition, The Corporate Executive Board [13], Gartner [14], and McKinsey [15] have identified trends that possibly challenge the IT/IS function.

In our analysis of the consulting literature, we distinguished between IT and business drivers that had an impact on the IT/IS function. IT drivers such as emerging technologies, [16, 17] and the growing and broadening range of offerings from third party IT service providers [1] have a direct impact on the IT/IS function. Changes in the business environment of the organization such as new skill profiles of employees and changing employee and customer expectations impose new business demands on the IT/IS function, and thus have an indirect effect on it [18]. Our analysis resulted in a set of hypotheses on the future IT/IS function that express adequate or likely responses to the new demands made. For the evaluation of these hypotheses, we chose a Delphi study. Delphi studies facilitate the interaction of experts and the collection of their opinions [19–22]. Moreover, Delphi studies allow for the use of rather small panels with ten members or more and do not require the experts to meet physically [19, 20]. This was a crucial prerequisite since the number of available experts was limited.

For the topic under investigation, we chose experts that had significant experience in the management of IT/IS functions and a good reputation for being able to think ahead. Since getting access to such qualified experts is difficult, we embraced the support of an international management consultancy that gave us access to both, experienced and forward-thinking CIOs and other senior IS executives in industry as well as to experienced IS management consultants. Most participants were from Germany (78%) and other European Countries (15%), and two participants were from the USA. Our sample of 27 participants splits half-and-half into consultants (48%) and IT managers (52%). The managers come from 14 companies in different sectors including manufacturing, retail, chemicals, logistics, consulting, IT and media. The revenues of the companies range from less than 1bn Euro to 10bn and even more in a few cases.

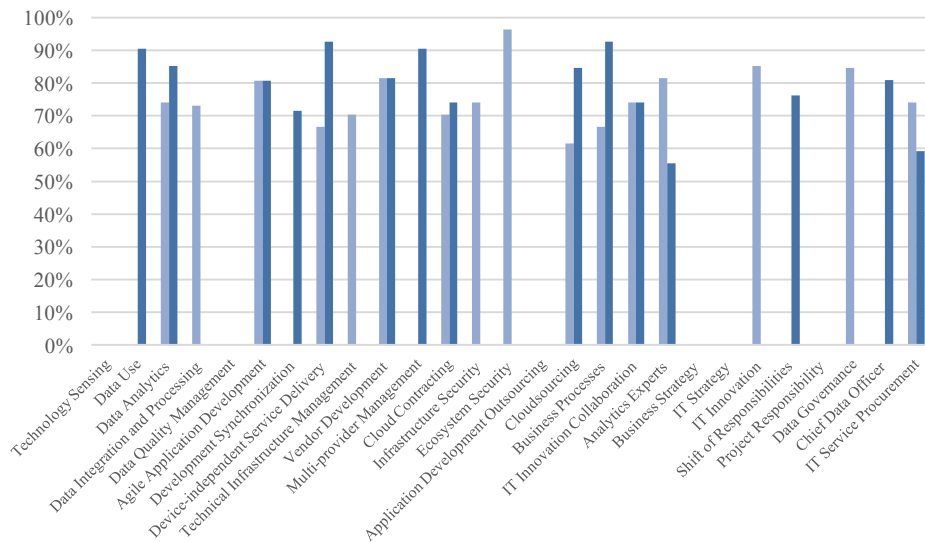
In our Delphi study, we asked the experts to rate their agreement with the hypotheses on a 7-step Likert scale ranging from ‘strongly agree’ to ‘strongly disagree’. We also invited the participants to comment on the hypotheses and to make further recommendations in a free-text field. Though Delphi studies ultimately seek to achieve consensus and stability, we did not consider the set of hypotheses as stable but put it to discussion [23]. Hence, we conducted three rounds that took eight weeks in total. In the first round, we confronted the experts with our hypotheses and collected additional insight from them. The second round aimed at facilitating interaction with the group and developing a group opinion. The third and the last round aimed at clarifying remaining controversial issues and finding consensus where possible.



**Figure 1.** Distribution of Responses (first round)

After each round, we analysed the results and provided group feedback to the participants, which included the distribution of responses (Figure 1), a summary of the comments given, and preliminary interpretations. In addition, we checked for the degree of consensus on the different hypotheses. For this purpose, we displayed the response quartiles and calculated the inter-quartile ranges (IQR) as  $\{3^{rd} - 1^{st} \text{ quartile}\}$ .

We also calculated the stability of the response as  $\{1 - \text{changed responses} / \text{total responses}\}$ . Figure 2 compares the stability from round 1-2 (light bar) to round 2-3 (dark bar). The figure does not display bars for six of the hypotheses. Thereof, three hypotheses showed strong consensus ( $IQR \leq 1$ ) in the first round and sufficient comments for interpreting the result, so that we saw little value in putting them to discussion any further. Hence, we excluded them from the following rounds in favour of investigating other, less clear hypotheses in more detail. In two cases, we added new hypotheses based on the comments received in the last round, so that we could not calculate stability measures. For six of the hypothesis, Figure 2 displays only one single light bar. The reasons are that these hypotheses showed strong stability ( $>80\%$ ) and a high consensus ( $IQR \leq 1$ ) in the first two rounds already.



**Figure 2.** Development of Response Stability (R1-R2 vs. R3-R4)

In five other cases, we reformulated the initial hypotheses or created new ones based on the comments in the first round so that they entered the second and third round in a modified form allowing for only one stability value (dark bars in Figure 2). Overall, Figure 2 displays high (>80% in average) and increasing stability of responses in line with the intention of a Delphi study. Exceptions are one hypothesis on the importance of analytics expertise and another on the role of IT service procurement, where the discussion became controversial (18<sup>th</sup> and last hypotheses in Figure 2).

### 3 Findings

This paper does not allow for presenting all our findings. A comprehensive overview of the study and its findings is given in [24]. For this paper, we have selected findings that we look upon as especially interesting. These refer to hypotheses for which we found remarkable and unreserved support [compare Figure 2]. We also included hypotheses that did not receive the unanimous support we expected from our pre-study of consultancy and market research publications, but that were seen as more nuanced by our participants.

In the following subsections, we first introduce the findings from our analysis of consultancies and market research publications that underlie our hypotheses. We then present the hypotheses (in italics) we put to discussion, before we finally discuss them in the light of the data we collected in our Delphi study. We start with hypotheses on the competences required from the IT/IS function in the future (3.1). We then go on with hypotheses on the future organization of the IT/IS function (3.2).

### 3.1 Critical IT/IS Function Competences

The first set of hypotheses we introduce deals with the competences that organizations need to possess to exploit the potential of information and communication technology and to operate it reliably and efficiently. We use the term IT/IS function to refer to the specialized tasks associated with this aim, which are often organized in dedicated departments for “information technology”, “information processing”, or “information systems”. Hence, the IT/IS function competences discussed in the following can also be looked upon as skill requirements for the employees of such departments.

**Management of Data and Information as a Business Resource.** Digitalization of customer interaction, products and business processes through the Internet of Things and Industry 4.0 increases the amount of data produced and stored in organizations [25–27]. Making these data organizational resources for business exploitation, e.g. for increasing product quality or opening new business opportunities, requires integrating data from different sources and of different formats. The variety of data types and sources brings forward additional technical challenges in data integration as well as challenges regarding data quality [10, 28]. Moreover, business demands are driven by a rising share of knowledge workers, who require information for decision-making and creative work [29, 30]. At the same time, advancements in technologies and concepts like Spark, Hadoop and Data Lakes facilitate the integration and analysis of data technically [28, 31, 32]. Accordingly, we hypothesize that the future IT/IS function needs to have specific competences in collecting, integrating, and analysing big data. It also should be able to provide quality information on business demand and for proactively developing new business opportunities.

*Hypothesis:* *In order to leverage the increasing quantity of data from different sources for business opportunities and decision-making, organizations are in need of strong competences in data integration, data analysis and data quality management.*

Approximately 80% of our respondents agreed or strongly agreed that data analytics is a key skill for the IT/IS function. Agreement was particularly high for organizations that built their business on a close contact to customers. One respondent (consultant) emphasized that data analytics is “*still a differentiator! Companies possessing this competence will lead the curve*”. About 70% agreed or strongly agreed that technical data integration is an important future skill. However, the experts also noted that data integration is not so much a question of tools but “*more a question of the employees’ understanding the processes, dependencies, interfaces and the “metadata” behind the data*” (IT manager). While the vast majority of respondents (85%) agreed or strongly agreed on the importance of data quality management skills, they pointed out that sound data quality is difficult to achieve in a world of “Big Data”. Hence, they conceded that organizations should not reach for highest data quality but should seek for reliability.

Beyond these skills in building data (re-)sources, 95% of the respondents saw a strong need for organizations to become data driven thus calling for skills in understanding organizational structures and decision-making processes in a way that allows for providing them with appropriate data.

**Information Security Management.** Recently, organizations have encountered a rising number of security breaches, which resulted not only in a loss of data but also in reputational damages [33, 34]. Thus, preventing this should be a priority for organizations. However, current trends increase security risks. The digitalization of business activities requires additional interfaces for automated data exchange and IT-based collaboration, both within and across organizations, e.g. in order to operate digital products and services but also connected assets in production [33]. This results in a deliberate opening of an organization's IS infrastructure (technical infrastructure, applications and data). We therefore developed the hypothesis that organizations should not only protect their technical infrastructure (hardware) but should also make security management part of project management and application development. In addition, we proposed that organizations differentiate IS infrastructure clusters with different security requirements depending on the business value they provide and the degree of risk that is acceptable [35]. Such a clustering could also help to balance protection needs with security costs and usability requirements for different entities and purposes.

*Hypothesis: Digitalization and IT-based collaboration increasingly expose elements of an organization's IS infrastructure to the public. Hence, organizations should build and monitor security as an integral part of projects, applications and hardware.*

The vast majority of respondents (90%) agreed or strongly agreed that skills for building and monitoring the security of the IS infrastructure are important. However, they also warned that a too rigid security policy might slow down application development.

*Hypothesis: Distinguishing domains with different security requirements according to business value and acceptable risk is important to balance security requirements with cost and usability requirements.*

More than 3/4 of the respondents agreed or strongly agreed that it is better to define various protection levels for different security clusters as opposed to establishing one single protection level for the whole IT/IS infrastructure. Only very few respondents failed to see the advantages of differentiating protection clusters and levels.

**Agile Application Development.** In addition to security demands, digital business also challenges application development to respond flexibly to changing needs and new opportunities in a volatile business environment [33]. From a technical point of view, small and modular applications supporting communication and collaboration (in practice often called systems of engagement) correspond best with this need. Such applications can also be used to extend and enhance traditional transactional systems (in practice often called systems of record), e.g. through apps or collaboration tools that tap into the underlying data of the transactional systems [36–38]. Agile development methods, such as SCRUM, are specifically suited for small and modularized applications and innovative solutions. Such methods allow for the flexible adaptation to changing project scopes and rapid deployment of functionality with short release cycles [39, 40]. Hence, to account for the flexibility and speed requirements of volatile business environments, we hypothesized that organizations should have skills for agile application development. A closely related method to decrease time to market is DevOps, i.e. a

close collaboration between development and operations teams to rapidly develop, test and deploy applications [41].

*Hypothesis: Volatile business environments demand flexible and quick responses that can be best realized through modularized IT applications. Agile software development and integrated development and operations teams (DevOps) are the future choice approaches to develop such applications.*

About 70% of the Delphi study respondents expressed agreement with this hypothesis, indicating that organizations should have agile application development skills and seek close collaboration between development and operations teams. However, as pointed out before, not all application types should be developed or managed in an agile way. Integrated transactional systems, for example, are better managed in more controllable, traditional ways. One expert (consultant) said “*Agility for systems of engagement: Yes. For systems of record: no.*” Most participants agree that agile and traditional modes will coexist in the future thus supporting the idea of a “two-speed IT”. Hence, 80% of the participants see a major challenge in the future in synchronizing both development modes and ensuring the consistency of underlying data models.

### 3.2 Organization of the IT/IS Function

The second set of hypotheses refers to the question of how to organize the IT/IS function. In a broad sense, the organization also includes the decision on which tasks to keep in-house and which to outsource. We start with the hypotheses on IT outsourcing and go on to discuss hypotheses on the future organization and management of the IT/IS function, as far as it will be retained in-house.

**Cloud Sourcing.** With the growing amount of offerings and the specialization of IT service providers the IT sourcing market provides more options than ever [32]. Cloud service offerings may serve as a case in point. They promise to fulfil high demands on a broad spectrum of technical levels including Infrastructure-as-a-Service (IaaS), Platform-as-a-Service (PaaS), and Software-as-a-Service (SaaS). Examples are Amazon Web Services, the Blue Mix platform, Azure or Big Tables [10]. The increasing availability of standardized IT services leads to a commoditization of the IT service markets and falling prices for IT services. Hence, the practice-oriented literature proposes that organizations will outsource more and more parts of their IT functions making specific use of cloud services:

*Hypothesis: Cloud services (SaaS, PaaS, IaaS) have grown significantly and more specialized IT services have become available. Hence, IT services become commodities and as such should be better sourced from external vendors in order to reap cost benefits and gain access to new technologies.*

Compared to the popularity of the trend towards intensive IT outsourcing and cloud sourcing, our Delphi study provides only little consensus on this hypothesis. While the median at ‘slightly agree’ indicates that more IT services are expected to be outsourced

in the future, the interquartile range of 3 does not allow for deriving general recommendations. Rather the comments indicate that outsourcing is a case-by-case decision, which depends on more factors than commoditization alone. The experts named cost, resource shortage and financial liquidity management as drivers for outsourcing. In addition, they listed the business model, a regional responsibility for jobs, the organization's size and security as factors that play a key role when making an outsourcing decision. One expert, for example, stated that "*if the size of the company is big enough my advice - manage your own cloud or at least do it in the country where you feel most comfortable*" (IT manager). Another one said that it "*depends on business model. So, may be right for most businesses but definitely not for all*" (consultant).

**Outsourcing of Application Development.** Our hypothesis concerning agile application development sparked a discussion on outsourcing application development. Some respondents commented on the difficulties for internal IT/IS organizations to meet varying application demands suggesting a high degree of outsourcing. To collect opinions on this issue and to examine it systematically, we introduced an additional hypothesis in the third round of the Delphi study:

*Hypothesis: Internal IT/IS organizations have difficulties meeting the volatile business demand for application development and adaptation. At the same time, specialized IT service providers offer application development skills and expertise on demand. Hence, application development will be increasingly outsourced in the future.*

Our study results do not support a general recommendation to outsource application development. The median value is 'neither agree nor disagree'. While 30% agreed to the proposition, another 20% disagreed (IQR = 3). However, the comments we received indicated that the type of application and the development method applied influence the degree of outsourcing. One respondent said that "*for standard [...] applications (systems of record) [outsourcing] could be an option, but not for the agile innovation systems*" (IT manager). Another respondent (consultant) added that core applications and those that help to differentiate the organization's value proposition must not be outsourced, but need to be developed in-house to keep critical organizational knowledge.

**Multi-provider management.** The IT service market is growing, but is also becoming increasingly fragmented with many small providers specializing in specific segments [11, 12]. Niche players offer innovative services where large providers still lack experience [11, 42]. In response, companies have adopted multi-vendor sourcing and best-of-breed strategies to take full advantage of the IT outsourcing market [12, 43]. A key challenge of multi-vendor sourcing, however, lies in the orchestration of different providers and their services for seamless IT support to business [12].

*Hypothesis: The IT services market grows and matures offering new opportunities for outsourcing different IT/IS functions selectively to specialized providers. Consequently, the provider portfolio will broaden, making multi-vendor management a key future challenge.*

Our respondents agreed that distributing work across different external partners is a crucial future challenge. Hence, the majority (>90%) also agreed to some extent that



managing multi-provider interdependencies will become an important future challenge. The median response is 'agree' with an IQR value of "2". One respondent (Director of a consulting firm) said: "The multi-vendor approach provides an organization with a variable cost model and with a lever to optimize cost by moving work between vendors based on performance on a regular basis. This requires vendor management skills beyond a simple procurement background". Some respondents even perceive multi-provider management as key to optimizing IT cost and performance in the future.

*Hypothesis: Sourcing IT services from multiple external sources calls for dedicated skills in managing provider interdependencies. These include, above all, (a) managing interdependencies between the providers and orchestrating their contributions to meet the organization's needs and (b) standardizing interfaces and harmonizing provider management processes.*

Respondents also agreed on the need for specific organizational responses including the importance of managing provider interdependencies (IQR = 2, stability >80%), and even more on the need for standardizing the interfaces to and the processes for coordinating external providers (IQR = 1, stability = 90%). In addition, many respondents saw the need to set up specialized internal functions and teams for managing vendors and suppliers.

**CIO Involvement in Strategy Development.** Digitalization inextricably links business success to IT as is the case with the Internet of Things or with the vision of an Industry 4.0. In the case of digitalization, IT does not only support (existing) business processes but becomes a driver and a means for generating value and opening new business opportunities, e.g. for creating digital products and services. Hence, digitalization makes new demands on business and IT executives when defining digital business strategies. Business executives need an increased understanding of information and communication technology and its potential for creating new business opportunities [32]. The CIO and other IT executives need to be able to think about and represent IT not only in technical but also in business terms.

While the increased knowledge facilitates strategic discussions about IT on the board level, we expected business managers to depend on the profound technological expertise of a CIO in strategy development. Hence, we concluded that IT managers including the CIO and business managers should define digital business strategies jointly to tap into the business potential of IT. The hypothesis is backed by a McKinsey observation that CIO participation in business strategy making results in improved business benefits [44]. However, today less than 1/3 of all CIOs are included in board level strategy discussion [45]. The development of IT strategies in support of business strategies, in turn, demands participation of business managers:

*Hypothesis: With digitalization, IT becomes a condition 'sine qua non' for doing business. Accordingly, senior business managers and IT executives including the CIO should develop business strategies and IT strategies jointly. This calls for IT-literate business executives and for IT executives who are able to think in business terms.*

Most of our respondents agreed (26%) or agreed even strongly (56%) that business and IT executives should devise business strategy in collaboration. Similarly, 52%

strongly agreed and 30% agreed IT/IS strategy development should also be a joint endeavour by IT and business executives. For many of the respondents, joint strategy development is “*definitively a MUST*” (IT manager). Respondents also confirmed the centrality of IT for business success. “*It may vary for different business models, but for most IT becomes crucial for the success*” (consultant).

Some respondents commented that the development of digital business strategies does not necessarily require CIO involvement. Rather, they hold that the role of an IT advocate in strategy development can also be taken over by new management roles like that of a Chief Digital Officer (CDO). One respondent (IT manager) holds the view: “*The CIO in its current form [sic] will be replaced by new roles such as Chief Technology Officer, Chief Data Officer*” or “*Chief Digital Product Officer*”. The same respondent also emphasized that applicants for these new roles should have a strong business rather than a technology background, since these roles demand “*strong process and product knowledge*”. Other respondents added that traditional executive roles in marketing or organization might also take over more responsibility for IT in the future.

**Emerging Management Roles for Digital Innovation.** Feedback on the previous hypotheses indicated that our study participants did not see a uniform role of the CIO in strategy development. According to the comments, most participants doubt that today’s CIOs have the ability and authority to realize business change based on IT. In addition, the perception of the future CIO role seemed to depend on additional assumptions made about the design of complementary executive roles. Following this discussion, we developed the following additional hypothesis:

*Hypothesis: Many of today’s CIOs have limited reputations for opening new business opportunities and for generating business value from IT. Consequently, new business roles (e.g. Chief Data Officer, Chief Process Officer, Chief Digital Officer) will emerge to promote digital innovation of products and processes.*

Responses to this hypothesis fall into two different clusters. Four out of five respondents subscribed to the view that the responsibilities for generating business value from IT should not lie in the hands of traditional IT executives alone, but rather be assigned to new management roles with responsibility for IT-based change and innovation. These new roles are not necessarily located within the IT/IS function but are more likely to be set up in the business organization. Many respondents looked upon the future CIO role as that of a “Chief IT Officer (CTO)”. However, there was less consensus on the emerging set of new IT-related management roles on the business side beyond the role of a “Chief Digital Officer (CDO)”, which was advocated by more than 70% of the respondents. Additional roles included in the discussion are, for example, a “Chief Data Officer”, a “Chief Process Officer”, or a “Chief Marketing Officer”.

Only 21% of the respondents disagreed with the idea of the future CIO being a mere technology officer. They expected an extension of the current CIO’s role with additional responsibilities for generating IT value and achieving business impacts. CIOs would then also be concerned with building information resources, facilitating information use in business, developing business applications, and redesigning business processes. “*The role of the CIO is about information, not technology. He/she should be the one responsible for overseeing the use of data and information for the benefits of the*

organization” (consultant). This would require a new CIO profile. One respondent (IT manager) explained: “*The CIO has to be selected wisely – currently this is rarely the case: Many of today’s CIOs are either lateral entrants such as chemists or economists without specific IT knowledge, former heads of data centres, project managers or software developers. Moreover, the CIO must have an appropriate standing in the organization in order to act on par with the CEO*”. However, half of the respondents were sceptical about extending the CIO role, arguing that today’s CIOs do not have the reputation for realizing business impacts.

## 4 Summary and Limitations

Our study provides initial empirical insight into the trends that drive the transformation of the corporate IT/IS function. It adds to the current state of research [1-9] by giving insight into the opinions of IT management professionals on competences and the possible organization of the IT/IS function in the (digital) future. With this, it helps to fuel the academic debate on an important, though much neglected topic in empirical research. Our Delphi study, however, is exploratory. Its limited size and the sample of experts, which is not representative, does not allow for statistical generalization.

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