

# A Literature Review: The Development of IT Skill Requirements in the Employment Market

*Seminar paper*

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## Abstract

As part of a seminar in IT Management in Master at the Wedel University of Applied Sciences, this paper examines the changes of the job titles and skill set requirements of IT professionals during the last three decades from 1990 to 2020. Based on a systematic review of the literatures published over the last 30 years, the results from various research methods are synthesized to get a comprehensive composition of required skills from Information Technology (IT) professionals. The requirements are divided into technical, technological, business and organizational, and interpersonal skills. Previous researches have shown that a consistent increase in the number of skill requirements, especially in the soft skill division, are noticeable in today's employment market. The overall purpose of this paper is to crystallize the demanded personnel with the skill requirements and knowledge during the digital age so that educators and managers are provided with relevant information. In the end, some implications for practice purposes are suggested.

*Keywords: IT skills, IT skill set, digital age, IT professionals, MIS skills, IT critical skills*

## Table of Contents

1. Introduction .....	1
2. Background .....	1
3. Literature Review .....	2
3.1. Descriptive Analysis.....	2
3.2. Selection of Relevant Sources .....	3
4. Results: Changes in IT Skill Set Requirements.....	4
4.1. First Decade: 1990-2000 .....	5
4.2. Second Decade: 2001-2010.....	6
4.3. Third Decade: 2011-2020.....	7
5. Discussion .....	8
5.1. Limitation .....	8
5.2. Implication.....	9
6. Conclusion.....	9
References .....	11

## List of Figures

Figure 1: Number of search results by the selected data bases. ....	2
Figure 2: Number of relevant literatures per decade .....	3
Figure 3: Literature matrix .....	4
Figure 4 Item measures of critical IT skills.....	4
Figure 5 Development tendency of the skill categories .....	8

## 1. Introduction

In today's century, companies face major challenges due to increasing technologies and opportunities, which leads to stronger competition. Information systems and data resources have grown in importance in business organizations by improving the efficiency of business processes, for example through automation, standardization, reduction of monitoring and supervisory costs, flexibility and more (Leitheiser 1992; Arregui Pabollet et al. 2019). The training serves as the basis for preparation for the specialist staff, which is why it is also necessary to define and prioritize the skills of current needs in order to be able to train qualified IT personnel (Leitheiser 1992). Since ever, many researcher have tried to develop a standardization for IT skills to provide workers and students with a benchmark of the future employment market (Rada 1999). Being able to define the required skill set for today's market, organizations should acknowledge employees as valuable asset which can be enhanced by education and targeted training (Nelson 1991). IT skills are declared to be an important component of the human assets in today's employment market (Benbasat et al. 1989; Levina and Xin 2007). But what are the other needed skills to reach high business productivity?

As part of my research, I have sourced relevant sources on how the evolution of IT relationships have changed between 1990 and 2020. For this I categorize the development in three decades. The first decade covers the time interval from 1990 to 2000, the second decade includes the years between 2001 and 2010, and the last decade starts from 2011 to 2020. The focus of this research is the detection of relevant knowledge and skills of IT specialists. For this purpose, I divide the qualifications into four different categories to get a better affiliation: technical, technological, business and organizational, and interpersonal skills.

## 2. Background

Since the 1970s, researchers have been asking what IT skills are important for the job market. The central debate between researchers is whether IT staff should have more technical or management skills, or even both. Due to the prevailing computer environment at the time, which focused on the development cycle of software applications and the lack of strategic orientation, technical skills are declared as mandatory skills for IT programmers and system analysts. Management and business skills come second (Clark et al. 1997; Strout 1971). According to several researchers, the demand of specific IT skills requirements changes over time in their relevance. The development of IT skills requirement for the employment market has shown over the years that, depending on who was interviewed and what job position the person has, the weightings of the skill categories differ. As a result of the rapid growth in the possibilities in technology, the expectations in the IT sector also increase, especially in the technological area. Nevertheless, researcher have recognized many years before that interpersonal skills and other soft skills are of great importance (Benbasat et al. 1987; Lee et al. 1995; Leitheiser

1992). For that reason, defining IT skills requirements helps managers in the employment market as well universities and their curriculum to prepare demanded and qualified IT professionals. However, there are evidence of the differences in the priorities of academics and the labor market which affects the productivity and performance when IT graduates start to work (Leitheiser 1992; Wade and Parent 2002).

### 3. Literature Review

In this section, the process of the systematic literature review will be explained. The process contained four initial steps: (1) Define relevant keywords and search strings, (2) choose the appropriate databases, (3) narrowing down the search, and (4) working through the found sources in detail.

The key words "IT skills", "IT skills", "MIS skills" and "IT critical skills" are selected as the starting point for the detect relevant sources in order to receive a first overview of the topic. It was clear that educational aspect such as the academic career of an IT specialist plays an important role. As a result, the keyword "IT skills curriculum" and "IT professional skills" are considered in this research. However, the results turn out to be not helpful for the field of development of IT skill set in digital age. For research, I decide to choose Ebsco, Google Scholar, and IEEE Xplore. Ebsco and Google Scholar deliver comprehensive results, whereas IEEE Xplore provides high quality journals in the field of Information and Technology. The founded literatures were analyzed in a quantitative as well as in a qualitative perspective.

#### 3.1. Descriptive Analysis

In the past decades, continued researches toward IT jobs and the skill requirements have been carried out, also toward the future development for the employment market. The used methodologies includes peer-to-peer methods like traditional surveys, interviews, focus groups, Delphi studies, and content analysis of classified job advertising (Gallivan et al. 2004). I will focus on the key studies and their key findings while compare them in their similarities and contradictions.

The following table demonstrate the used search terms and the number of journals categorized by the databases. Overall, the number mainly relates to literature whose titles and abstracts are clearly assigned to the topic.

Database Search term	Google Scholar		Ebscohost		IEEE Xplore	
	total	suitable	total	suitable	total	suitable
"IT skills"	33	14	46	15	23	5
"IT skill set"	315	1	0	0	0	0
"IT critical skills"	150	3	57	5	28	4
"IT skill requirement"	30	3	1	0	0	0
"IT skills curriculum"	52	6	6	1	0	0
"IT professional skills"	116	2	74	1	3	0
MIS Skills	664	7	5	0	0	0
<b>Total (67)</b>	1.360	36	189	22	54	9

Figure 1: Number of search results by the selected data bases.

With a total of 67 data sources through the three different databases, there are also some duplicates. By eliminating all the duplicates, I achieve a total number of 41 literature. Still, some of them may still not be relevant or reviewed by experts. Most literatures are found with Google Scholar.

### 3.2. Selection of Relevant Sources

After examining the publications in more detail, I extract the relevant publications for this work. Two selection criteria are defined for the selection. First, the publication must have a high rank (at least B) in the VHB-JOURQUAL3 to ensure that only approved literatures are taken into consideration. Second, the main research of the journal corresponds to the topic of this literature review. Additional literatures cited from the selected sources have been added if they meet the criteria. As a result, 17 journals are identified as systematically important.

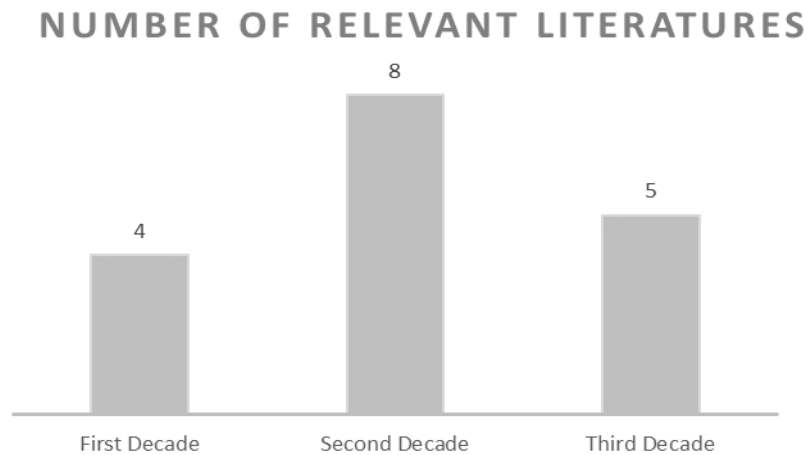


Figure 2: Number of relevant literatures per decade

In the following table compares the literatures based on the method used, the context in terms of IT skills, and the selected skill categories. Most studies are conducted either through a survey or content analysis like job advertisement analysis. Only four of the studies achieved their results through a Delphi study. Apart from that, the studies are categorized into four contexts. Most of the studies reflect the current situation at the time. Todd et al. (1995) provided the development over a period of time, while Leitheiser (1992), Trauth et al. (1993), and Lee et al. (1995) were the only researchers considered the IT professionals' perception of the future demand. On the other hand, there have been also some researcher over the last 30 years investigated the ideal curriculum for IT academic. Many researchers also provided skill categories and the related skills in their studies. The majority considered beside technical and technological skills additionally business and interpersonal skills. Only few have neglected these categories. Benamati et al. (2001), Kappelman et al. (2016), Tambe et al (2012), and Wu et al. (2003) did not group their investigated skills but rather left them as a list. Unfortunately, there is a lack of reliable information sources regarding the third decade, even if this topic has not decreased its importance. As a result, I will undergird the results for the third decade with literatures that may not fully meet my selection criteria.

Author	Used Method			Context regarding IT skills				Skill categories			
	Survey	Delphi study	online analysis	current	development	forecast	curriculum	technical	business	inter-personal	technological
Aasheim et al. (2009)*	x			x			x	x	x		
Ahmed et al. (2012)			x	x						x	
Arnett et al. (2005)			x	x				x			
Bhatt et al. (2005)	x			x				no categories			
Byrd and Turner (2001)	x			x				x	x	x	x
Gallagher et al. (2010)	x			x				x		x	
Kappelman et al. (2016)		x		x				no categories			
Keil et al. (2013)		x		x					x	x	
Lee et al. (1993)		x		x		x	x	x			x
Lee et al. (1995)		x		x		x			x	x	x
Lee et al. (2002)	x			x			x	x		x	x
Leitheiser (1992)	x			x		x		x	x	x	x
Nelson (1991)	x			x				x	x	x	x
Tambe et al. (2012)*			x	x				no categories			
Todd et al. (1995)			x		x			x	x	x	x
Arregui Pabollet et al. (2019)*			x	x				x		x	x
Wade et al. (2002)			x	x				x	x		
Wu et al. (2003)*	x			x				no categories			

\*literatures which do not fully meet the selection requirements

Figure 3: Literature matrix

## 4. Results: Changes in IT Skill Set Requirements

In this section, the skill requirements relate mainly to IT professionals without differentiating the sub areas (programmer, system analyst, etc.) and job position (entry-level, advance, manager). Throughout the literatures between 1990 and 2020 researcher grouped the different types of skill requirements for IT personnel into several categories to investigate the changes over the years. Based on the literature review, I decide to group the skill sets into four dimensions which are learnt by Byrd and Turner (2001), and Lee et al. (1995): technical skills, technological skills, business and organizational skills, and interpersonal skills.

1. Technical knowledge and skills	Technological knowledge and skills
<ul style="list-style-type: none"> <li>▪ Multiple programming languages</li> <li>▪ Multiple structured programming</li> <li>▪ Multiple mainframe computer operating system</li> <li>▪ Expert systems or AI</li> <li>▪ Decision support systems</li> <li>▪ Developing web-based applications</li> <li>▪ Skilled in data warehousing, mining, or marts</li> <li>▪ System integration</li> </ul>	<ul style="list-style-type: none"> <li>▪ Learn new technologies</li> <li>▪ Focus on technology as means not as end</li> <li>▪ Understand technological trends</li> <li>▪ Invest in IT for the long term</li> </ul>
Business and organizational knowledge and skills	Interpersonal skills
<ul style="list-style-type: none"> <li>▪ Understand organization's policies and plans</li> <li>▪ Learn about business functions</li> <li>▪ Interpret business problems and develop appropriate technical solutions</li> <li>▪ Understand business environment</li> <li>▪ Know about environmental constraints which are relevant for the organization</li> </ul>	<ul style="list-style-type: none"> <li>▪ Capable to teach others</li> <li>▪ Ability to plan, organize, and lead projects</li> <li>▪ Plan and execute work in a collective environment</li> <li>▪ Team working</li> <li>▪ Work closely with clients and customers</li> <li>▪ Addressing business problems</li> </ul>

Figure 4 Item measures of critical IT skills

#### 4.1. First Decade: 1990-2000

When examining IT skills requirements, the most obvious skills are technical skills, also known as hard skills. The rapid growth rate of technological changes in the field of IT led to an adjustment of the technical skills (Arregui Pabollet et al. 2019; Aggarwal et al. 2015). In general, technical skills include programming (such as algorithms, data structure, and quality assurance), multiple program languages (e.g. COBOL and SQL), and model application (relational/ hierarchical databases and expert systems/ AI). In the broadest sense, technical skills and the knowledge include the hardware as well the software qualifications (Lee et al. 1995; Leitheiser, 1992; Nelson 1991; Todd et al. 1995). Within the technical skill requirements several knowledges were considered as mandatory for the running business at that time. Initially, the respondents thought that the ability of develop systems, data access, and the use of software packages would be obligatory in this skill category (Leitheiser, 1992; Nelson, 1991). With a focus on programming, COBOL was the leading language in the first decade. Nevertheless, managers expected a decrease in COBOL knowledge and an increase in the demand for SQL and C (e.g. C++ or Smalltalk). Over time, telecommunication also became an important skill (Lee et al. 1995). Additionally, Trauth et al. (1993) found that certain skills that are emphasized at universities are less valued by practitioners. The greatest discrepancy is in the knowledge of COBOL or other third generation languages which are considered to decrease in importance by practitioners. Instead, fourth generation language are marked more valuable.

In contrast to technical knowledge, technology skills are concerned with how and where use the information technologies effectively and cost-efficiently (Swanson 1994). Apart from that, it concludes the ability to use and learn new technologies, ability to understand technological trends, knowledge of system development methodologies, system approach, and more (Lee et al. 1995; Todd et al 1995; Nelson 1991). While Nelson (1991) and Lee et al. (1995) used their survey to find that technological skills could even exceed the need for technical skills, Leitheiser (1992) and Todd et al. (1995) recognize the other way around. Nevertheless, both technical and technological knowledge and skills are highly ranked. Researcher assume that these will grow in demand in the future.

Business and organizational skills were mostly defined in the 1990s as the ability of defining organizational goals and objects, the work unit, and using competitive advantages. The ability to understand the organizational unit and business environment, as well as the ability to detect problems in work units, were classified as the most important skills at the beginning of the first decade (Nelson 1991; Trauth et al. 1993). Other studies such as Lee et al. (1995) and Todd et al. (1995) supported these findings and even stated that future requirements are conceivable. IT graduates in particular who intended to work in user areas had to have strong business as well as interpersonal skills (Lee et al. 1995; Trauth et al. 1993). Some researchers added social and interpersonal skills to the category of business and organizational skill set (Nelson, 1991; Todd et al. 1995). From this fact, it can be deduced that interpersonal skills were considered by some researchers to be of secondary or not important enough to group them independently. Nevertheless, comparing to technical skills, researcher commonly agree that business skills were still needed for the business productivity (Lee et al. 1995; Leitheiser, 1992; Nelson 1991; Todd et al. 1995; Trauth et al. 1993).

As already mentioned, interpersonal skills were not always considered as a skill set that have to be clustered as independent category. But interpersonal skills such as listening, work with others, work independently, presenting and interpersonal behavior as well as communications, become in the 1990s to one of the most demanded skill set with the highest growth rate of importance. Todd et al. (1995) showed that communication skills were not even mentioned in job advertisement in 1970 within his sample but end up being the most frequently mentioned skill requirements by 1990. Hence, the

category became the most important skill set. Similar findings were also derived in 1995 by Lee et al. (1995). Teamwork and interpersonal communication are even seen as key factors for the success of a company's development (Leitheiser 1992). Furthermore, general management and leadership skills were mostly asked on the employment market (Lee et al. 1995; Leitheiser 1992; Nelson 1991; Todd et al. 1995). On the other hand, interpersonal qualification requirements had the greatest disparity between academic and practical priorities. Although the ability to interact with customers or user were viewed by employer as very valuable, there was only little academic treatment (Trauth et al. 1993).

#### 4.2. Second Decade: 2001-2010

The work of Todd et al. (1995) who conducted a content analysis for a period of 20 years, is considered as a representative research in the field of IT skill requirements. With the new possibilities of the World Wide Web, further researchers have also started to analyze (online) job advertisement in order to derive their results. Monster.com is predominantly used to control the current employment market. According to the job advertisements, the total number of available IT jobs has increased again by almost 50% since 2002 (Prabhakar et al. 2005). Prabhakar et al. (2005) investigated the job ads in a period of three years from Monster.com, which is considered as "by far the largest and most frequently cited of these sites" (Sedbrook und Warfield 2002). Hereby, they only focused on current requirements of technical skills of IT professionals. According to Prabhakar et al. (2005), Java became a "mainstream [web] programming language", which appeared in one-fifth of all job advertisement between 2002 and 2004. Employees additionally declare C++, SQL programming, and Visual Basics, for many jobs in the field of IT as necessary. In addition, Oracle Database and UNIX were among the top six skills in the current employment market at that time. Although it has been recognized in the last decade that interpersonal skills bring certain benefits and success with the customers, Byrd and Turner (2001) conducted in his survey that technical skills were essential for Chief Information Officers (CIO) to succeed. Especially, programming languages and web development languages such as Javascript, XHTML etc. seemed to decline in its popularity while the awareness of new IT technology trends, followed by knowledge about operating systems, has tended to increase. IT worker should be able to educate themselves independently to get a widespread knowledge of different platforms, tools, operational systems, and technologies (Aasheim et al. 2009). Besides that, in the second decade, companies have started to consider IT offshoring because of the globalization. Studies showed that technical skills are expected, but are often not company-specific, so it can often be outsourced. As a result, entry-level IT personnel should not only rely on technical skills (Bullen et al. 2007; Gallagher et al. 2010; Tambe and Hitt 2012). Overall, the requirements of technological skills were very closely connected to technical skills. Researcher such as Bullen et al. (2007), Lee et al. (2002), and Gallagher et al. (2010) have merged both categories into one.

In the second decade, business and organizational skills are considered to be positively related to IS success factor (Byrd and Turner 2001). While IT professionals rated specific business knowledge and skills as important, IT academics evaluated it as less important (Lee et al. 2002). A similar trend was also carried out by (Aasheim et al. 2009). As part of their study, they found out that organizational and business skills for entry-level IT employees were valued as minor. The skill with the highest rank in this category was the knowledge of the primary business functions (Aasheim et al. 2009; Byrd and Turner 2001). In contrast, (Wu et al. 2004) investigated the critical skill sets of people at IT management levels. Top management position placed a heavier emphasis on business and organizational skill such as aligning the work toward IT organization and using organizational resources strategically.

According to the CIOs, interpersonal skills did not have a positive significant impact on success in 2001. However, the reason for this outcome could be due to the overweight in IT and technical background. The results shift depending on the survey group. Stakeholders such as business managers and end users would be better to assess interpersonal skills for IT success (Byrd and Turner 2001). Besides, the most important skills in this category are project leadership and general management skills, which occurred around 20 % in all job advertisements. Having project management skills would lead to a more effective user expectation, negotiating deadlines with the customer, and communicating potential problems (Gallagher et al. 2010; Wade and Parent 2002). Furthermore, there is a high demand from companies toward IS manager to have educational and training skills (Wu et al. 2004; 2005). Hereby, it is assumed that it would be more effective to undergo an individual and focused educational training rather than a general or informal education (Benamati and Lederer 2001). Only through interpersonal skills IT professional position themselves as valuable asset for the company. Due to these qualifications such as good communication with customers and working with other, they were highly desired in new hires at the time between 2001 and 2010. Communication skills were required along job advertisement in 33% ads, while the ability to work in teams were mentioned in 10% of all ads. With the help of interpersonal skills, IT professional differentiate themselves from others and cannot be outsourced to third-party providers. Thus, these non-technical skills are central for the company's IT department (Gallagher et al. 2010; Tambe und Hitt 2012; Wade and Parent 2002).

#### 4.3. Third Decade: 2011-2020

Thanks to the new and widespread application of technologies in the labor market, there is a certain fear of workers. The fear is based on the replacement of their job with machines and automation. Due to the changes in technology, the requirements of IT skills on employees are also changing. With the increase of machine learning and AI, there are higher requirements of digital and analytical skills (Aasheim et al. 2012; Arregui Pabollet et al. 2019). According to Ahmed et al. (2012), the five most important technical skills are operating systems, security, hardware, networking, and data bases which have been already conducted in their researches from 2006. Programming skills declined minimally. The lowest average ratings are ERP and virtualization in this category (Aasheim et al. 2012).

Technology skills are in comparison higher ranked than technical skills. The ability to be aware of IT technology trends and the awareness of the impact of IT on individuals, community, or globally is evaluate as necessary for IT professionals (Aasheim et al. 2012). Adapting new technologies can result in new forms of work. For instance, technology can lead to greater standardization of work while monitoring and supervisory costs are reduced. By being aware of the development of technologies and the trend, IT professional can adapt further skill and job requirements more quickly to gain a higher competitive advantage (Arregui Pabollet et al. 2019).

As part of the study by Kappelman et al. (2016), they examined similar findings. CIOs tend to require more business and organizational skills. However, strategic planning plays a larger role than the other study. Apart from that, IT middle management focuses more on interpersonal and as well as technical skills rather than business skills which are still considered as relevant. In contrast, CIOs demand from IT professionals mainly technical knowledge as well as problem solving. From their perspective, they think managerial skills overcome business and organization skills while IT middle management employees should have these skill set in their skills portfolio (Kappelman et al. 2016). Overall, the literatures evaluate that organizational and analytical skills, such as problem solving, differ in the different job positions. Nevertheless, the demand for these skills in all positions, such as system analysts and software designers, is only moderate (Ahmed et al. 2012).



In the category of interpersonal skills, leadership skills remain also in the third decade as the most important skill, but also in the overall rank of skill requirements. Followed by general management and project planning which also enjoy a rank in the top five of required skills. Further business knowledge such as the ability to identify stakeholders or document process are requested within the study of Keil et al. (2013). Most studies on the question of IT skill requirements were carried out by IT personnel themselves, who are supposed to assess the current demand. Depending on the position they have, they will have different prioritization (Kappelman et al. 2016). Although communication skills and interpersonal skills have been considered more relevant in recent years, there are still discrepancies in the self-assessment of some IT positions. While these two skills, especially for designers and programmers, seem to be vital to survival, CIOs rate them as less important for middle IT management and IT professionals. In the CIO's perceptions, IT professionals should have the ability to work in teams in their skill portfolio in addition to their technical knowledge. Communication skills are more secondary (Kappelman et al. 2016). However, other studies show that interpersonal skills have become the most important skills even for entry-level IT workers. (Kappelman et al. 2016; Keil et al. 2013; Ahmed et al. 2012). Interpersonal skills such as communication and teamworking, but also organizational skills, such as planning and problem solving, will dominate the skill requirements of emerging jobs in the future. In the future, these skill sets are expected to be requested not only by IT professionals, but also from all employees (Ahmed et al. 2012; Keil et al. 2013; Arregui Pabollet et al. 2019). Overall, the higher the job position and responsibilities for others, the greater the need for managerial skills (Kappelman et al. 2016).

Skill Category	Development tendency		
	1990-2000	2001-2010	2011-2020
Technical Skills	++	+	+
Technology Management Skills	++	++	++
Business and Organizational Skills	+++	++	+
Interpersonal and Management Skills	++++	+++	++++

Figure 5 Development tendency of the skill categories, range: + (important) until ++++ (most important)

## 5. Discussion

### 5.1. Limitations

The literature review and its findings are limited due to four different aspects. First, unfortunately, there are only very few scientific papers with high ranking regarding the topic of critical IT skills in today's decade. Therefore the paper represents a limited amount of perspectives and researches. Second, the most existing literatures examine the required IT skills without differentiating the various job position and responsibilities. Rather they investigated the demanded skill for IT worker in general. This cause the risk that the weighting of the individual skills changes depending on the group surveyed and does not lead to a clear solution for practitioner. The third limitation is caused by the different skill categories and the item measures. Many researches do not provide unmistakable item measures (e.g. "Interpersonal behavior") which leave room for interpretation for the respondent. The last limitation relates to the distribution of the interviewees. The studies do not always indicate which group of people was interviewed. Rather, they researcher group the interviewees in "IT personnel" and indicate the represented industries of the company. However, it would have been more helpful to assess the studies if the distribution of the job positions were named. In addition, "simple" IT workers were often asked to express their perception on the current demand for IT skills and thus somehow evaluate themselves. In my opinion, it would be more meaningful if only CIOs or IT managers were interviewed to examine which critical skills IT employees require.

## 5.2. Implication

The result of this literature review gives implications for businesses, educational institutions, and other researchers. In the future, companies can expect that some job categories but also requirements can change. Ultimately, we can assume that interpersonal skills will rise further in demand in the future. Most important skills are leadership, teamwork, communication, motivation to educate yourself further, and being aware of new technology trends.

This work also helps prepare future IT professionals and provides a basis for orientation for further training. With the help of this, they know which current skills requirements are in demand on the employment market, which have developed over the three decades in terms of urgency. Furthermore, both employees and employers should consider the importance of interpersonal skills in their agenda and intensify them, for example, as part of training courses.

For educational institutions it is also recommended continuously adapting their module handbook to the labor market. While the skill category business and organization are falling, interpersonal skills such as communication skills and working effectively in teams are moving more to the fore in practice. Additionally, academic institutions should also emphasize the advantages in flexible and creative thinking in organization. Due to the increasing technological possibilities, the number of new technologies and application also increases. Academics should be prepared for the fact that not all technologies can be taught as part of the course. Rather, the willingness and motivation to educate yourself continuously must be taken up independently for instance through practitioner-oriented publications or additional courses that teach different platforms, operating systems, tools, and technologies.

Furthermore, companies are recommended to take a stronger focus on leadership and general management skills when searching for IT manager. While entry-level IT worker should bring more technical as well as interpersonal skills, IT manager are required to stand out with interpersonal skills. Unlike entry-level IT worker, IT manager need to have the ability to communicate, manage teams and projects. Through different trainings for instance developing leadership skills or presentations for verbal communication, etc. it is possible to nurturing these core skills which are essential for IT manager.

## 6. Conclusion

The aim to identify skill requirements for IT professional such in general is difficult because these skills are evolving in a continuous process and are job- as well organizational-specific (Lee et al. 1995). The ensemble between technical, technological, business and organization, and interpersonal skills changes by time in response to changing business and technology conditions (Arregui Pabollet et al. 2019; Aggarwal et al. 2015). Over the three decades, the requirements of skill have changed in all categories in their importance. While technical skills and technological skills were expected in the past as most demanded skill set, the actual most important skill set was the interpersonal and management skills. Researcher such as Leitheiser (1992), Lee et al. (1995), and Todd et al. (1995) could verify already in the 1990s the urgency of skilled IT professional with a great focus on interpersonal skills. Most demanded skill was the ability to communicate with others and especially with customer. But business and organizational skills enjoyed a great demand at that time period due to the changing technology trends as well. After the turn of the century, all skill categories seem to lose in demand although all skill sets are still essential as an IT specialist. Besides, technological skills are no longer particularly expressed. Rather, the companies outsourced IT for cost reasons. Without additional interpersonal skills, the workers were even interchangeable. Nevertheless, there were some studies

such as by Byrd and Turner (2001) that measured the effect of individual skills on IT success. The study revealed that interpersonal skills would not have a significant effect on success. However, leadership and educational skills were highly demanded from IT managers but with time also from entry-level IT workers. Since the third and the last decade, technical skills were still important but with no high emphasis. Due to the rapid change in the technology, it was more necessary to be able being aware of new technologies and their possibilities. Apart from that, understand the technological trends are very required by managers. Therefore, nowadays it is not necessary to have the ability over all possible technical skills but rather be able to adapt if new technologies enter the market. Further, business and organizational skills are not thematized in many studies leading to an assumption of a decline in demand.

## References

- Aasheim, Cheryl; Shropshire, Jordan; Li, Lixin; and Kadlec, Christopher (2012): Knowledge and Skill Requirements for Entry-Level IT Workers: A Longitudinal Study. In: *Journal of Information Systems Education* 23 (2), S. 193–204.
- Aasheim, Cheryl L.; Williams, Susan; Butler, E. Sonny (2009): Knowledge and Skill Requirements for it Graduates. In: *Journal of Computer Information Systems* 49 (3), S. 48–53.
- Aggarwal, Rohit; Kryscynski, David; Midha, Vishal; Singh, Harpreet (2015): Early to Adopt and Early to Discontinue: The Impact of Self-Perceived and Actual IT Knowledge on Technology Use Behaviors of End Users. In: *Information Systems Research* 26 (1), S. 127–144. DOI: 10.1287/isre.2014.0564.
- Ahmed, Faheem; Capretz, Luiz Fernando; Campbell, Piers (2012): Evaluating the Demand for Soft Skills in Software Development. In: *IT Prof.* 14 (1), S. 44–49. DOI: 10.1109/MITP.2012.7.
- Arregui Pabollet, E.; Bacigalupo, M.; Biagi, F.; Cabrera Giraldez, M.; Caena, F.; Castano Munoz, J. et al. (2019): The changing nature of work and skills in the digital age. Hg. v. I. Gonzalez Vazquez, S. Milasi, S. Carretero Gomez, J. Napierala, N. Robledo Bottcher, K. Jonkers und X. Goenaga. Luxembourg: Publications Office of the European Union (EUR, 29823).
- Benamati, John; Lederer, Albert L. (2001): Coping with rapid changes in IT. In: *Commun. ACM* 44 (8), S. 83–88. DOI: 10.1145/381641.381664.
- Benbasat, Izak; Goldstein, David K.; Mead, Melissa (1987): The Case Research Strategy in Studies of Information Systems. In: *MIS Quarterly* 11 (3), S. 369. DOI: 10.2307/248684.
- Bullen, Christine V.; Abraham, Thomas.; Gallagher, Kevin.; Kaiser, Kate M. (2007): Changing IT skills. In: *Journal of Electronic Commerce in Organizations* 5 (2), S. 24–46. DOI: 10.4018/jeco.2007040102.
- Byrd, Terry Anthony; Turner, Douglas E. (2001): An Exploratory Analysis of the Value of the Skills of IT Personnel: Their Relationship to IS Infrastructure and Competitive Advantage. In: *Decision Sciences* 32 (1), S. 21–54. DOI: 10.1111/j.1540-5915.2001.tb00952.x.
- Clark, Charles E.; Cavanaugh, Nancy C.; Brown, Carol V.; Sambamurthy, V. (1997): Building Change-Readiness Capabilities in the IS Organization: Insights from the Bell Atlantic Experience. In: *MIS Quarterly* 21 (4), S. 425. DOI: 10.2307/249722.
- Gallagher, Kevin P.; Kaiser, Kate M.; Simon, Judith C.; Beath, Cynthia M.; Goles, Tim (2010): The requisite variety of skills for IT professionals. In: *Commun. ACM* 53 (6), S. 144–148. DOI: 10.1145/1743546.1743584.
- Gallivan, Michael J.; Truex, Duane P.; Kvasny, Lynette (2004): Changing patterns in IT skill sets 1988–2003. In: *SIGMIS Database* 35 (3), S. 64–87. DOI: 10.1145/1017114.1017121.
- Kappelman, Leon; Jones, Mary C.; Johnson, Vess; McLean, Ephraim R.; Boonme, Kittipong (2016): Skills for success at different stages of an IT professional's career. In: *Commun. ACM* 59 (8), S. 64–70. DOI: 10.1145/2888391.
- Keil, Mark; Lee, Hyung Koo; Deng, Tianjie (2013): Understanding the most critical skills for managing IT projects: A Delphi study of IT project managers. In: *Information & Management* 50 (7), S. 398–414. DOI: 10.1016/j.im.2013.05.005.
- Lee, Denis M. S.; Trauth, Eileen M.; Farwell, Douglas (1995): Critical Skills and Knowledge Requirements of IS Professionals: A Joint Academic/Industry Investigation. In: *MIS Quarterly* 19 (3), S. 313. DOI: 10.2307/249598.

- Lee, Sooun; Koh, Seokha; Yen, David; Tang, Hung-Lian (2002): Perception gaps between IS academics and IS practitioners: an exploratory study. In: *Information & Management* 40 (1), S. 51–61. DOI: 10.1016/S0378-7206(01)00132-X.
- Leitheiser, Robert L. (1992): MIS Skills for the 1990s: A Survey of MIS Managers' Perceptions. In: *Journal of Management Information Systems* 9 (1), S. 69–91. DOI: 10.1080/07421222.1992.11517948.
- Levina, Natalia; Xin, Mingdi (2007): Research Note—Comparing IT Workers' Compensation Across Country Contexts: Demographic, Human Capital, and Institutional Factors. In: *Information Systems Research* 18 (2), S. 193–210. DOI: 10.1287/isre.1070.0121.
- Nelson, R. Ryan (1991): Educational Needs as Perceived by IS and End-User Personnel: A Survey of Knowledge and Skill Requirements. In: *MIS Quarterly* 15 (4), S. 503. DOI: 10.2307/249454.
- Prabhakar, Bipin; Litecky, Charles R.; Arnett, Kirk (2005): IT skills in a tough job market. In: *Commun. ACM* 48 (10), S. 91–94. DOI: 10.1145/1089107.1089110.
- Rada, Roy (1999): Sharing Standards: IT skills standards. In: *Commun. ACM* 42 (4), S. 21–26. DOI: 10.1145/299157.299162.
- Sedbrook, Tod; Warfield, James (2002): The Downturn in Programmer Demand: A Wavelet Analysis. In: *Journal of Computer Information Systems* 42 (3), S. 1–10.
- Strout, Elizabeth (1971): The Activities and Education of Systems Analysts. In: *Journal of Systems Management* 22 (1), S. 37–40.
- Swanson, E. Burton (1994): Information Systems Innovation Among Organizations. In: *Management Science* 40 (9), S. 1069–1092. DOI: 10.1287/mnsc.40.9.1069.
- Tambe, Prasanna; Hitt, Lorin M. (2012): Now IT's Personal: Offshoring and the Shifting Skill Composition of the U.S. Information Technology Workforce. In: *Management Science* 58 (4), S. 678–695. DOI: 10.1287/mnsc.1110.1445.
- Todd, Peter A.; McKeen, James D.; Gallupe, R. Brent (1995): The Evolution of IS Job Skills: A Content Analysis of IS Job Advertisements from 1970 to 1990. In: *MIS Quarterly* 19 (1), S. 1. DOI: 10.2307/249709.
- Trauth, Eileen M.; Farwell, Douglas W.; Lee, Denis (1993): The IS Expectation Gap: Industry Expectations versus Academic Preparation. In: *MIS Quarterly* 17 (3), S. 293. DOI: 10.2307/249773.
- Wade, Michael R.; Parent, Michael (2002): Relationships Between Job Skills and Performance: A Study of Webmasters. In: *Journal of Management Information Systems* 18 (3), S. 71–96. DOI: 10.1080/07421222.2002.11045694.
- Wu, Jen-Her; Chen, Yi-Cheng; Chang, J. (2005): The IS Manager: A Study of Critical Professional Activities and Skills/Knowledge. In: Proceedings of the 38th Annual Hawaii International Conference on System Sciences. 38th Annual Hawaii International Conference on System Sciences. Big Island, HI, USA, 03-06 Jan. 2005: IEEE, 266c-266c.
- Wu, Jen-Her; Chen, Yi-Cheng; Lin, Hsin-Hui (2004): Developing a set of management needs for IS managers: a study of necessary managerial activities and skills. In: *Information & Management* 41 (4), S. 413–429. DOI: 10.1016/S0378-7206(03)00081-8.