

Invited Report
**Survey of Technology and Skills in Demand:
2020 Update**

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Survey of Technology and Skills in Demand: 2020 Update

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ABSTRACT

In the fields of information technology and information systems, faculty must consistently adjust the curriculum to meet the demands of the field. However, a challenge they often face is understanding what should be covered, especially given the limited number of courses most universities are able to offer. This research is a biennial report of the knowledge and skills demanded in the field through a survey of IT/IS workers across a variety of organizational roles. We have expanded the survey to include over 500 participants across the U.S. A new addition to this year's study includes open-ended questions to go beyond the specific technologies covered in the survey by asking participants what they feel are the most important technologies moving forward. Results suggest an increased focus on cloud as its importance saw substantial increases this year. Other findings include an increased importance in the Android platform and a change in the importance of knowledge in the programming languages category.

Keywords: Computing skills, Technologies, Curriculum design & development, Employment

1. INTRODUCTION

A challenge for all information systems (IS) and information technology (IT) instructors is to ensure that the course offerings in our curriculums stay relevant and current to employers. On the positive side, the demand for IS and IT graduates continues to be high. From the U.S. Bureau of Labor Statistics, employment in information technology occupations is projected to grow 11 percent in the 2019-2029 period, much higher than the average for all occupations. Likewise, the Bureau of Labor Statistics details that this growth is being driven from a greater emphasis on cloud computing, collection/storage of big data, and data security (U.S. Bureau of Labor Statistics, 2021).

The Bureau of Labor Statistics indicates a variety of technology occupations will continue to be in high demand for the next 8-10 years. The 10-year projections include Information Security Analyst (+31%), Software Developers (+22%), Data Base Analyst (+10%), Web Developers (+8%), and System Analyst (+7%). Interestingly, employment for computer programmers is projected to drop by 9% in the next 10 years (U.S. Bureau of Labor Statistics, 2021).

Given the rapid growth in a variety of knowledge arenas, the challenge IS and IT faculty encounter is to design and continuously upgrade the curriculum to stay current and relevant to industry needs. The call for research in this area has

been recommended by Legier, Woodward, and Martin (2013). They reported that there are several problem areas for developers of IS/IT curriculums that need to evolve as industry needs change. These challenge areas include:

- How to meet employer needs in the changing IT and IS professions,
- How to determine what knowledge should be included in basic information systems courses,
- How to balance training and certification desires of students with providing a foundational knowledge of a topic area, and
- How to incorporate frequent advances in technology into the same total number of courses.

Increasing this complexity of currency and relevance in the IS field is that many business schools are accredited by the Association to Advance Collegiate Schools of Business (AACSB). This accrediting agency has recommendations and/or restrictions on the breadth of courses that must be offered within accredited schools. This potentially places limits on the number of credits offered in the IS or IT discipline. This may imply even more importance for the need of IS curriculum developers to stay focused on the ever-changing technology environment.

This research reflects a continuing effort over 15 years to survey and understand the industry needs in terms of not only the specific technologies being utilized by organizations and for which college students should acquire a working knowledge prior to graduation, but also the business skills that will enhance their employment possibilities. The goal of the research is to provide IS/IT academics an understanding of what technologies and skills are currently in demand by employers (as well as likely in demand in the next two years) while identifying the changing importance of these technologies that might assist in updating IS/IT curriculums. It also attempts to provide guidance to students in these disciplines on the skills they should attempt to acquire to be desirable to employers.

2. LITERATURE REVIEW

There have been a variety of approaches taken to understand the shifting knowledge and technology needs within the IT industry. These approaches can be generally grouped around: a) searching the job skills desired in IT/IS job postings, b) surveying recent IS/IT graduates on their current jobs and requirements, c) investigating the current course offerings in the IS/IT curriculums, and d) surveying employers and employees in the IS/IT to identify the skills they indicate are important. Interestingly, most of the research also reflects the needs for IS/IT employees to have a working knowledge of business and communication skills. Table 1 provides a summary of similar research and the approach taken.

Authors	Approach
Dong and Triche (2020)	Text mining for job postings related to data analyst positions.
Rhew, Black, and Keels (2019)	Reviewed job postings and compared to AACSB standards.
Burns et al. (2018)	Reviewed the technology related job placement listings on the internet over a four-month period.
Mills, Chudoba, and Olsen (2016)	Examined the course offerings in the technology areas across AACSB schools.
Zaheer et al. (2020)	Surveyed employers of their recent graduates

Table 1. IT/IS Skill and Technology Related Research

The goal of this research was to survey a wide range of working IT professionals with varying levels of experience and identify their current and future technology skills and knowledge required for success in the IT field. This paper is part of a continuing project that surveys IT/IS professionals biennially, with the last survey completed in 2018. In more detail, we consider the current technology needs in the areas of cloud computing, security, data analytics, databases, programming languages, networking, and operating systems platforms, as well as the anticipated changes in the near future.

3. METHODOLOGY

The survey was developed to examine the technologies IS/IT professionals are currently using and expected to use in the future. This is the fifth version of an ongoing study to

understand the changing landscape of IT/IS professionals. The current version of the survey will be compared to the results found in the previous study (Cummings and Janicki, 2020). The goal of the study was to answer the following questions:

- What organizational technologies are currently in use and projected to be used in the future?
- What is the importance of certifications in the technology field, and which ones are most prevalent?
- What IT and non-IT knowledge and skills are required/needed by all IT professionals?
- How have these changed from the prior survey?

The survey was developed using a multi-phase process involving an advisory board of IT professionals and faculty. As this is a biennial survey and the process remains consistent with prior surveys, we have included more details concerning the survey development process at <https://csbweb01.uncw.edu/people/cummingsj/techskills.html>.

There were some changes from the prior survey that are worth noting here. During the roundtable discussion process with the advisory board, they suggested combining the job categories of IT Management and Strategy as well as Data Analyst and Database Analyst. This resulted in the following categories:

- Business/Systems Analyst
- Data Analyst / Database Admin
- Management/Strategy
- Network/Security Analyst
- Project Manager
- Software Developer

Once the survey was developed and finalized, a pilot test was conducted to ensure that (a) the survey questions were clear to participants, (b) all areas were appropriately covered, and (c) average completion time was 10 minutes or less. A preliminary survey was emailed to industry professionals which directed them to complete the online survey and provide feedback. Thirty participants completed the survey during the pilot test. The average completion time was below 8 minutes, and minor changes were made to the survey instrument based on participant feedback before it was deemed ready for distribution.

To ensure a wide spectrum of responses from IS/IT professionals, a nationwide survey company was employed and paid to distribute the survey. Additionally, the survey was distributed to the alumni/employers of the authors' university, and a request to complete the survey was posted on the authors' LinkedIn profiles. The survey was distributed in the second quarter of 2020 and resulted in over 500 respondents. In the following section, the summary statistics will be presented comparing the results from this year's survey to the 2018 results.

4. SUMMARY STATISTICS

A total of 515 IT/IS professionals completed the survey which included a variety of organizational types (Table 2) and sizes (Table 3). Corporations represented 62% of those surveyed, up from 47% in the previous survey, and over 60% of participants

worked within an organization of over 500 employees. Additionally, responses came from across the United States with New York (22%), California (12%), North Carolina (11%), Florida (10%), and Texas (8%) representing the largest number of responses.

Organization Type	2020	2018
Corporation	62%	47%
LLC	7%	10%
Education	5%	8%
Healthcare	7%	11%
Government	7%	19%
Non or Not for Profit	7%	4%
Sole Proprietor or Partnership	5%	1%

Table 2. Organization Type

Number of Employees	2020	2018
< 20	8%	14%
21-100	8%	16%
101-499	22%	21%
500-999	22%	15%
1,000-9,999	28%	18%
10,000+	12%	16%

Table 3. Organization Size

Participant gender remained consistent with prior surveys with females accounting for 24% of participants. Similar to the previous survey in 2018, educational background consisted primarily of participants with a higher degree including those with an Associate’s degree (6%), Bachelor’s degree (IT related at 26% and non-IT related at 12%), Master’s degree (IT related at 37% and non-IT related at 10%), and Ph.D. (6%). Additionally, the average tenure of the participant in their given field was 11 years, with the average years at their current employer being 9 years (consistent with the prior study).

The organizational role was captured as well, including both technical and managerial roles. For 2020, the representation of the various roles changed with a larger portion of participants coming from a software development role and fewer managerial/strategy roles being represented in this year’s survey. Table 4 provides an overview of the organizational roles captured in both 2020 and 2018.

Organizational Role	2020	2018
Business/Systems Analysis	16%	10%
Data Analyst / Database Admin	6%	6%
Management/Strategy	9%	30%
Network/Security Analyst	15%	10%
Project Manager	18%	9%
Software Developer	30%	14%
Other IT	7%	21%

Table 4. Organizational Role

Because some of the roles were combined this year, the percentages from 2018 were combined for those roles in Table 4. In 2018, the Data Analyst role represented 2% and the Database Admin role represented 4% of participants. Likewise

in 2018, the Management role represented 25% and the Strategy role represented 5% of participants.

5. RESULTS

The following sections are organized as follows: first, an examination of the current and future importance of various technologies is discussed, this is followed by a closer look at the specific skills required for professionals in their given fields, and, finally, the impacts of certifications are evaluated in the IT/IS profession.

5.1 Current and Future Technology Importance

Similar to prior surveys, this section asked participants to respond to questions concerning technologies currently used within their organization and the expected importance of these technologies to the field over the next two years. Most sections were completed based on the participant’s role, except for platform and cloud technologies which were completed by all participants. For example, if the participant selected that their organizational role was Network/Security Analyst, they would then be asked to respond to the networking/security technology questions. Since this research parallels prior surveys of IT workers, the results from the 2018 survey are included for a comparison to this year’s results. Starting in 2020, a Likert 4-point scale was suggested by the advisory board, thus all tables and figures display the importance ranking which was calculated as follows: 4 – more important, 3 – same importance, 2 – less important, and 1 – not at all important. Since 2018 included a 5-point scale (5 being extremely important), the results for 2018 presented below has both extremely important and more important calculated as 4.

5.1.1 Operating systems platform expectations. All survey participants responded to the questions concerning OS platforms. Consistent with prior years, Windows remained the platform rated with the highest importance based on those participants stating it would remain the same or be more important moving forward. However, the importance for both MacOS and Linux/Unix increased dramatically from the 2018 results with MacOS seeing the largest increase of importance (from 14% more important in 2018 to 57% more important in 2020). Finally, we also see a substantial increase in Linux/Unix being more important in the next two years compared to 2018 results. For a comparison of 2018 and 2020 ratings of same or more importance, see Figure 1.

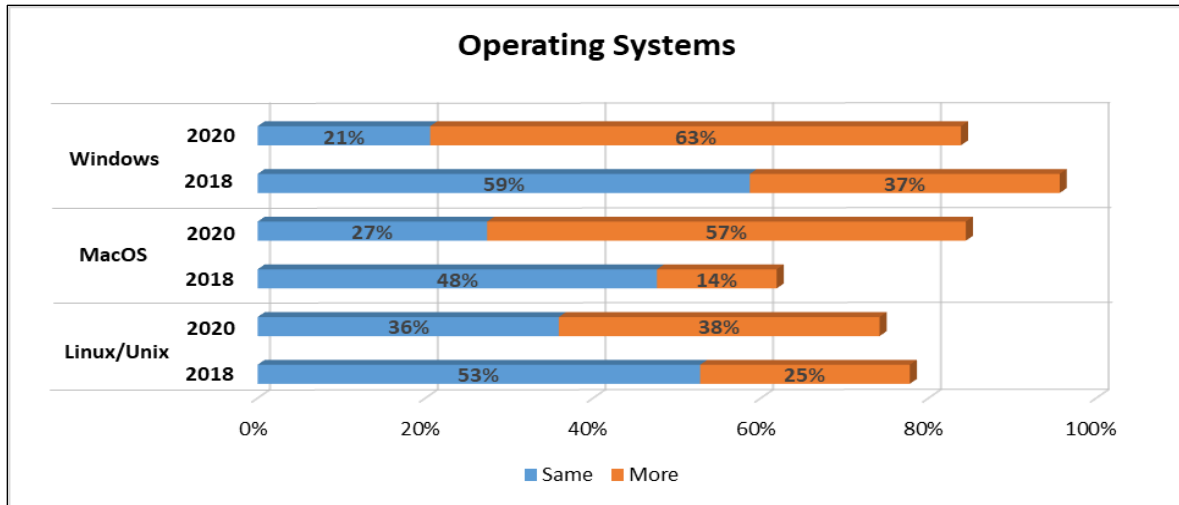


Figure 1. Operating System Expected Importance in Two Years

Mobile operating systems were evaluated separately. The results suggest an increased importance in the utilization of the Android OS over the next two years compared to iOS. Fifty-two percent of participants stated that the Android OS will be more important in the next 2 years while iOS was at 47%. While this may not be a large difference between the two operating systems, this does represent an increase in the importance of the Android OS compared to 2018. Those rating the Android OS as more important moving forward increased from 40% in 2018 to 52% in 2020. For a comparison of mobile operating systems, see Figure 2.

the popularity of iOS remaining strong within the U.S. and the domination of Android internationally, especially in China and India (Cohen, 2020).

Another interesting finding was the increased importance of MacOS in this year's results. MacOS had the largest increase from 2018 in this year's results. MacOS had the largest increase from 2018 in non-mobile platforms. Finally, while Linux/Unix had one of the largest increases in 2018, the current survey saw only a minor increase in average importance in 2020 followed closely by Windows (see Table 5 for a full listing of average importance across all platforms).

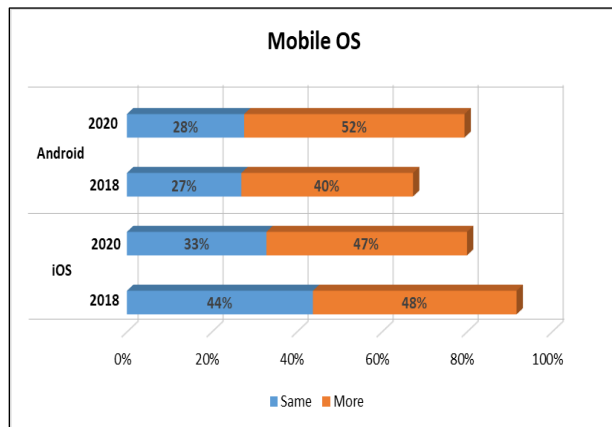


Figure 2. iOS and Android Expected Importance in Two Years

The final analysis of operating systems examined the average importance rating across all operating systems compared to the prior survey. Overall, there was an increase in importance in all operating systems evaluated except for one (iOS). The average importance for iOS fell from 3.35 in 2018 to 3.12 in 2020. This is an interesting finding as the survey results from 2018 saw the largest increase in iOS compared to all other platforms. Thus, the current survey suggests that both mobile platforms (i.e., Android at 3.16 and iOS at 3.12) can be seen as equally important moving forward, especially as we see

Operating System	2020	2018
Windows	3.33	3.30
Mac OS	3.31	2.57
Android	3.16	2.81
iOS	3.12	3.35
Linux/Unix	2.96	2.92

Table 5. Operating Systems Rankings of Importance

5.1.2 Cloud platform. The current study surveyed all participants regarding cloud technologies at their organization. Results (see Figure 3) show an increase across all platforms. For both AWS and Azure, 84% of participants rated these platforms as either the same or more important over the next 2 years, with Google following closely behind at 82%. Finally, Salesforce continues to remain important as 71% state its importance will remain the same or increase. All of the platforms have shown an increase compared to 2018, with both AWS and Azure seeing an increase of 28% and Google seeing a 47% increase compared to the prior study's importance.

When evaluating the average scores across platforms (see Table 6), the increase is more evident, especially with Google. The average score for Google in 2018 was 1.94 with the average

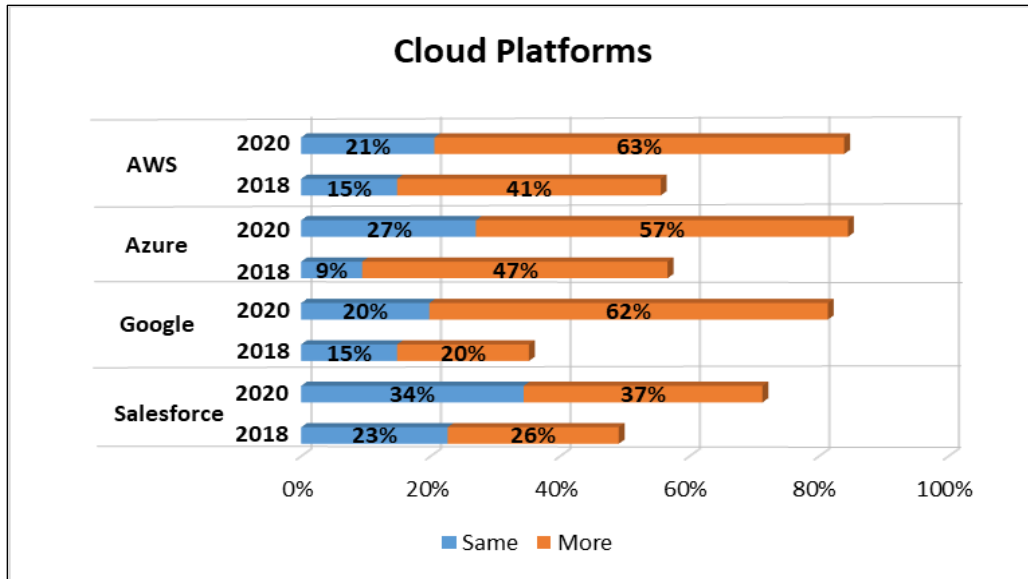


Figure 3. Cloud Platform Rankings of Importance in Two Years

increasing to 3.29 in 2020. In addition to Google, both AWS and Azure saw increases of over half a point. The results confirm the overall increase in reliance on the cloud infrastructure by many organizations with AWS, Azure, and Google being the most commonly used cloud providers in 2020 (Flexera, 2020). Salesforce made moderate gains from 2018 but ranked lowest out of the technologies surveyed.

In addition to the technologies above, an additional question was included that asked about technologies not captured in the survey. This was an open response question so participants could add any technologies they felt were important. Technologies reported to also be important included IBM Cloud, how platforms are used (e.g., SaaS), and governance frameworks for cloud technologies. A few participants stated that Salesforce may not be as dominant moving forward and we should consider removing it from future surveys. Based on this feedback, additional technologies may be included in future surveys, including questions about how cloud is utilized by the participant’s organization (e.g., SaaS).

Cloud Platform	2020	2018
AWS	3.33	2.56
Google	3.29	1.94
Azure	3.28	2.62
Salesforce	2.87	2.26

Table 6. Cloud Platform Rankings of Importance

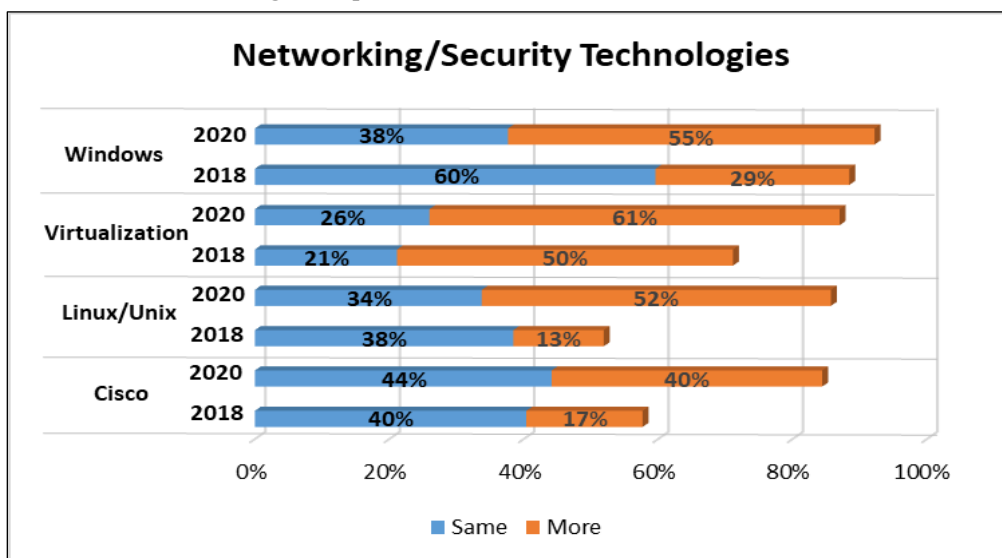


Figure 4. Networking/Security Expected Importance in Two Years

5.1.3 Networking and security. Starting with the Networking and Security technologies, only those participants self-selecting into this organizational role completed these questions as opposed to everyone answering the platform and cloud technologies questions. This included a total of 77 participants in the networking and security role. Both software (e.g., Windows networking) and hardware (e.g., Cisco) technologies were included in this category.

Looking at Figure 4, Windows networking continues to be rated highest with 93% of participants stating it will remain the same or increase in the next 2 years. Interestingly, the “more important” category increased from 29% in 2018 to 55% this year. All the other technologies surveyed were rated over 80% important or more important including Cisco (86%), Linux/Unix (86%), and Virtualization (87%). The technology rated the highest among the technologies for increased importance over the next 2 years was Virtualization at 61%.

Compared to 2018, the averages across all technologies increased in overall importance (see Table 7 for average importance by technology). This was a stark difference compared to the prior survey which saw a decline in all categories (except Windows) from 2013 to 2018. The largest gains were with both Linux/Unix (increased average by 1.06) and Cisco (increased average by 0.81). Both Virtualization and Windows saw modest average gains of 0.51 and 0.29, respectively.

Product	2020	2018
Windows	3.43	3.14
Virtualization	3.42	2.91
Linux/Unix	3.27	2.21
Cisco	3.18	2.37

Table 7. Networking/Security Rankings of Importance

As with other categories, participants had the opportunity to include additional technologies of importance for this category. One technology that was mentioned by a number of participants was Remote Management and Monitoring (RMM) tools. This survey was originally designed in early 2020 and then distributed as we were just starting to feel the impacts of the COVID-19 pandemic. RMM tools were not originally

included in the survey; however, this technology should be included on future surveys. Other technologies mentioned include RedHat OpenShift and data analytic tools/techniques for cybersecurity analytics.

5.1.4 Databases. With over 90% of participants stating importance will remain the same or increase in the next two years, PostgreSQL was rated the highest database platform in this year’s survey by the 32 participants stating they are in this field. This was followed closely by MySQL (85%), Oracle (84%), and MS SQL (84%). IBM DB2 had the lowest importance but was still relatively high at 72%. For a comparison of databases surveyed, see Figure 5.

The results compared to previous surveys showed a dramatic difference in the importance of databases (see Table 8). During 2018, there was a clear division showing the importance of MySQL and MS SQL was greater than the other database technologies. This year’s results showed a substantial increase in importance (i.e., same or more importance) for both PostgreSQL (an increase of 1.26) and Oracle (an increase of 1.02). This may have been due to the increased number of database administrator participants in 2020 (n = 32) compared to 2018 (n = 9). In addition to the technologies surveyed, participants mentioned the need to capture analytical tools such as Tableau which will be included in future data collections.

Database Product	2020	2018
PostgreSQL	3.31	2.05
Oracle	3.28	2.26
MySQL	3.19	2.58
MS SQL Server	3.06	2.89
IBM DB2	2.97	1.77

Table 8. Database Rankings of Importance

5.1.5 Development languages. The software developer role represented the largest number of participants (n = 152) in this year’s survey. This role was asked to rate the level of knowledge needed by IT professionals across 12 different products. The scale consisted of no experience (rating 1), fundamental (rating 2), working (rating 3), and expert (rating 4) (see Table 9).

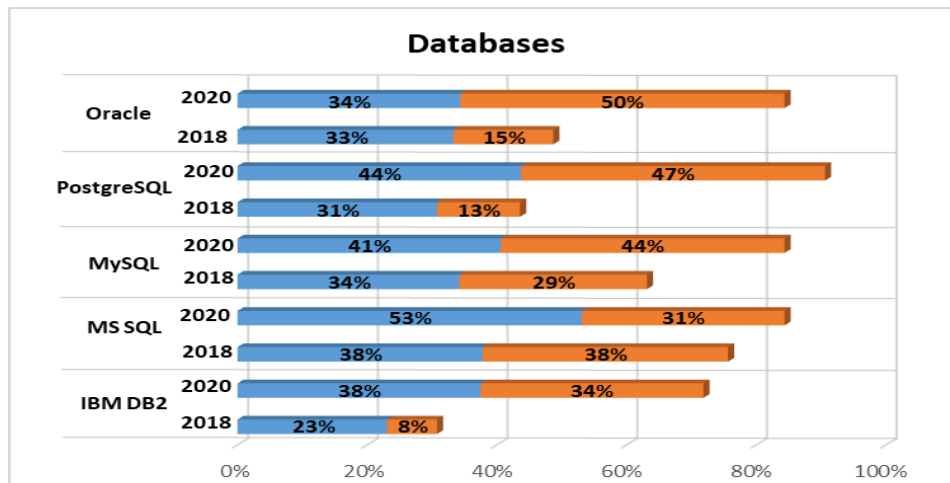


Figure 5. Database Expected Importance in Two Years

Development Language	Rating	2020 Rank	2018 Rank
JavaScript	2.95	1	1
HTML5	2.84	2	2
Java	2.84	3	9
C++	2.72	4	11
C#	2.68	5	4
Python	2.66	6	12
jQuery	2.63	7	6
XML	2.63	8	5
CSS3	2.62	9	3
ASP.NET (including MVC)	2.55	10	7
PHP	2.53	11	8
JSP	2.41	12	12

Table 9. Development Language Level of Knowledge Importance

Overall, there was not one specific language that participants felt IT professionals should have expert knowledge in. The highest average rating was for JavaScript at 2.95, which was the closest language to the working knowledge rating. The top two languages (JavaScript and HTML5) remained the same from 2018, which suggests the importance of having fundamental knowledge of client-side web development. However, the languages rated just below changed dramatically from the 2018 survey.

Participants rated Java, C++, C#, and Python as 3-6 which was an increase in overall rating as these languages, except for C#, were all rated at the bottom in the previous survey. The increase in importance in Java and C++ may be attributed to the continued use at many organizations, including both current and legacy systems. Java continues to be used as a popular server-side language for back-end developers as well as for machine learning and big data projects (Sagar, 2020). For C++, many legacy systems are coded in this language which is one of the reasons this language often appears at the top of historically used languages (Tiobe, 2021). Python’s increased importance may be due to the popularity of the language in the fields of data science and machine learning. It can also be found in web development and back-end programming which aligns with the other popular web development languages surveyed in our study.

In addition to the languages surveyed, participants were able to suggest other important languages that were not included in the list. These languages included R, Angular, React, and Vue. This suggests that future surveys should include additional languages concerning analytics as well as expanding to various frameworks for languages such as JavaScript.

5.2 Skills by Role

While the previous sections focused on specific technologies, the survey also collected skills needed for those working in various roles (e.g., Business/Systems Analyst). The number of respondents per category will vary based on the participant’s job role selection at the beginning of the survey. This ensured that only those working in the field responded to the questions regarding knowledge areas in their role. One job category, Strategy/Management (n = 45), was not asked specific

knowledge area questions as it would be difficult to capture all the various managerial roles and duties of participants falling into this category. Table 10 represents the top 5 skills needed based on job category. Each job category is discussed in more detail below.

Job Category	Knowledge Area (in order of importance) 2020 Results	2018 Results
Business/ Systems Analyst (n = 80)	Software as a Service (SaaS)	Requirement Analysis
	Requirement Analysis	Process Analysis
	Process Analytics / Modeling	System Design
	System Design	Process Modeling
Network/ Security (n = 77)	Data Modeling	Web Services
	Desktop Security	TCP/IP
	Data Security	Network Admin
	Network Security	Windows Admin
	Network Admin	Network Security
Software Dev. (n = 152)	Windows Admin	Desktop Security
	Cloud / Virtualization Concepts	Object Oriented Programming
	Data Structures	Data Structures
	Design Patterns	Development Languages
	Object Oriented Programming	Design Patterns
Project Mgmt. (n = 93)	Version Control Mgmt	Version Control Mgmt
	Team Management	Change Management
	Planning and Scheduling	Inter-Organization Relationships
	Risk Management	Risk Management
	Resource Scheduling	Team Management
Data Analyst / Database Admin (n = 32)	Change Management	Planning and Scheduling
	Analytic Tools (SSIA/SSAS/SSRS)	SQL Query
	DB Programming	Raw Unstructured Data
	NoSQL / Object Storage	SQL Reporting
	Raw Unstructured Data	DB Programming
	SQL Query / Reporting	Data Warehousing

Table 10. Knowledge Skills by Job Role

5.2.1 Business/systems analyst. Software as a Service (SaaS) moved from not being included in the top five during 2018 to the most important knowledge area in 2020. As previously mentioned in the cloud computing section, many companies are including cloud as a primary area of growth and importance

which is why we see an increase in importance for analysts. Other knowledge areas remained important with data modeling being the only new area making the top five list for 2020. In addition to the skills listed in Table 10, business/system analysts also suggested that these professionals should have a good understanding of project management concepts, including the various approaches such as SCRUM and Agile.

5.2.2 Network/security. Security skills moved up in importance for 2020 as the top three knowledge areas all related to security with administration (Network and Windows) immediately following. While security was in the top skills for 2018 (listed as 4th and 5th), this year’s results suggest an increased importance that all network and security professionals should focus on these skills. Other skills mentioned by participants include an understanding of various regulations/standards, knowledge in identity and access management, and soft skills, such as increased end user interaction and education.

5.2.3 Software development. Similar to analyst skills, software developers need to have a solid foundation of skills in cloud/virtualization concepts which is listed as the most important skill for 2020. This skill did not make the top five in the previous survey. The rest of the skills ranked within the top five did not change dramatically with the exception of general development languages knowledge being absent from the current list. Other skills listed by developers tend to focus on soft skills like logical and critical thinking as well as troubleshooting. Technical writing, database knowledge, and Agile environments are additional skills listed by participants.

5.2.4 Project management. Team management moved up to the top spot for knowledge importance in 2020. Scheduling also appears to be important this year as planning/scheduling and resource scheduling were included in the top five. Other skills mentioned by participants included soft skills such as relationship building.

5.2.5 Data analyst/database admin. As more companies are trying to leverage their data, analytical tools was considered to be the most important skill for these professionals in 2020. Knowledge in programming and queries is still needed but there is evidence of the importance of data and the tools to analyze that data within the results this year. Another skill mentioned was the ability to not only analyze the data but to effectively visualize it as well.

5.3 Professional Certifications

The importance of certifications in the information technology/systems fields is clearly evident in this year’s survey. Of the participants surveyed, 89% stated they had at least one certification which is well above the 62% from the 2018 survey. Of the certifications included in the list, Microsoft CSE ranked highest this year with almost 44% of participants (n = 227) stating they have this certification. Other certifications that remained important this year included those concerning networking and security which ranked second through fourth. The one certification that saw the largest decline was PMP, which fell from 2nd in 2018 to 10th in 2020. Less than 8% of respondents held this certification, suggesting that

alternate certifications in project management (e.g., Scrum Master) may be gaining in popularity and should be evaluated further in future surveys.

Important Certs	2020 Rank	2018 Rank
Microsoft CSE	1	2 (tie)
CompTIA A+ Tech	2	4
CISCO CNA	3	1
CompTIA Network+	4	5
AWS Solutions Architect	5	7
Certified Risk IS Control	6	9
CISM	7	8
CISSP	8	6
CIS Auditor	9	10
PMP	10	2 (tie)

Table 11. Professional Certifications Held by Participants

In addition to the certifications listed in Table 11, participants were given the opportunity to include any additional certifications they have that were not included in the survey. These included Security+, Scrum Master, Pentest+, AWS Cloud Practitioner, and Tableau Qualified Associate. This suggests that additional certifications surrounding security, project management, and analytics should be considered for the next survey.

6. IMPLICATIONS FOR EDUCATORS

There are a number of implications for educators based on this year’s results. First, educators should evaluate their approach to the technologies used within their courses. When it comes to platform technologies, the increase in the importance of MacOS suggests that courses covering platforms should include both Windows and MacOS. In a 2019 User Conference, Apple reported that 100% of Fortune 500 companies have at least some Apple products at their organization, suggesting that enterprises are embracing a multi-platform environment (Sohail, 2019). Thus, MacOS products are cutting into the dominance of Windows-based machines in organizations. Another area of change was with mobile platforms. Results suggest that both Android and iOS will have equal importance moving forward. Courses in mobile development should consider including multiple platforms if they do not do so already.

The increase in importance of cloud, virtualization, and security suggests educators should take a closer look at traditional telecommunications courses. Based on the results, these courses should include more emphasis on working with cloud and virtualization technologies with an increased focus on security around the network. We are not suggesting that the traditional topics are not appropriate for the course. Instead, the importance of these new areas warrants a re-evaluation of current topics covered in the course to meet the needs of industry.

Most degrees require a minimum of one database course in their current curriculum (Feinstein, Longenecker, and Shresthat, 2014). The challenge with these courses is choosing the most appropriate database to cover. Most of the databases included in the survey appear to be equally important, suggesting that courses should not change their approach based

upon these results. However, students may benefit from limited exposure to the other database platforms they may encounter given the relatively even importance across all platforms.

An interesting result from the survey comes from the last technology covered – software development. While JavaScript was rated highest across all products, all development languages covered were not dramatically different (the rating difference between the highest and lowest rated language was approximately 0.50). This suggests students don't have to be experts in a specific language, but rather have a working knowledge of different languages to be more adaptable to a changing environment. The goal as educators should be to provide a strong foundation in programming skills that could be transferrable to other languages.

In addition to specific technologies, the survey also included general IT and business knowledge that professionals should possess. The results from 2020 changed dramatically from 2018 when it comes to IT knowledge (see Table 12). While Business/Systems Analysis moved from 3rd to 1st, we saw the largest increase in data analytics and software development. Data analytics increased five positions, suggesting that IT professionals need to understand how to leverage data. Software development was tied for 2nd with analytics, an increase in four positions this year. The Bureau of Labor Statistics found that software developers continue to be one of the fastest growing fields in IT, which may explain the increase in importance (U.S. Bureau of Labor Statistics, 2021).

IT Knowledge	2020 Rank of Importance	2018 Rank of Importance
Business / Systems Analysis	1	3
Data Analytics	2 (tie)	7
Software Development	2 (tie)	6
Networks / Security	4	4
Project Management	5	5
Database Skills	6	1 (tie)
Cloud / Virtualization Concepts	7	8
Systems Administration	8	1 (tie)
Business Knowledge		
Management	1	4 (tie)
Communications – Written	2	2
Communications – Oral	3	1
Data Analytics	4	3
Statistics	5	7
Finance	6	6
Economics	7	10
Supply Chain / Logistics	8	8
Marketing	9	9
Accounting	10	4 (tie)

Table 12. IT and General Business Skills by Rank of Importance

The survey also asked about general business knowledge (also in Table 12). Results suggest a good foundation in management skills is important for IT/IS professionals. Along with written and oral communications, the results show the need for our students to build on their soft skills during their education. Educators should evaluate their coursework to increase the opportunity for students to manage project teams as well as prepare and present reports of their findings.

Finally, as educators, we need to evaluate the benefits of certifications within our curriculum. This has been an issue for many educators as there is an ongoing debate of whether certifications should be included in an undergraduate degree program. With almost 90% of participants having at least one certification, this is a question that should be addressed in the current curriculum. Some certifications, such as associate certifications, are now available that offer students the opportunity to be tested and qualify for the certification before entering the job market. At a minimum, the pros and cons of certifications should be discussed in courses with the decision to sit for these certifications being left to the student.

7. CONCLUSIONS

The results from this year's survey provide some new insights for both educators and professionals. Students as well as IT professionals need to adapt to a multiple-platform environment whether that be the increased use of MacOS in organizations or the increased reliance on cloud platforms moving forward. Security continues to be an area of focus for networking professionals as well as IT professionals in general. Finally, educators need to go beyond just focusing on technical skills and begin implementing more opportunities for students to practice soft skills, such as management and written/oral communication.

8. FUTURE RESEARCH AND REMARKS

Based on the suggestions from the prior survey (Cummings and Janicki, 2020), changes were made to include additional questions and expand the pool of participants. However, there are a number of changes that will be made for the next iteration to keep up with the changing environment. These include broadening questions surrounding cloud to include how respondents utilize these services (e.g., SaaS) as well as changes to include more analytics platforms.

There were some limitations to the current study worth noting. While the survey reached many different professionals throughout the country, we were limited to the contacts at the survey company. While there are numerous emerging technologies, we limited the technologies in the survey to those identified by the advisory board but plan to expand based upon suggestions from this year's survey.

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10. REFERENCES

- Cummings, J. & Janicki, T. (2020). What Skills Do Students Need? A Multi-Year Study of IT/IS Knowledge and Skills in Demand by Employers. *Journal of Information Systems Education*, 31(3), 208-217.
- Burns, T. J., Gao, Y., Sherman, C., & Klein, S. (2018). Do the Knowledge and Skills Required by Employers of Recent Graduates of Undergraduate Information Systems Programs Match the Current ACM/AIS Information Systems Curriculum Guidelines? *Information Systems Education Journal*, 16(5), 56-65.
- Cohen, J. (2020). iOS More Popular in Japan and US, Android Dominates in China and India. *PC Magazine*. Retrieved April 1, 2021, from <https://www.pcmag.com/news/ios-more-popular-in-japan-and-us-android-dominates-in-china-and-india>.
- Dong, T. & Triche, J. (2020). A Longitudinal Analysis of Job Skills for Entry-Level Data Analysts. *Journal of Information Systems Education*, 31(4), 312-326.
- Feinstein, D., Longenecker, B., & Shresthat, D. (2014). A Study of Information Systems Programs Accredited by ABET In Relation to IS 2010. *Information Systems Education Journal*, 12(3), 76.
- Flexera (2020). Flexera 2020 State of the Cloud Report. Retrieved April 1, 2021, from https://info.flexera.com/SLO-CM-REPORT-State-of-the-Cloud-2020?utm_source=Blog&utm_medium=Blog&utm_campaign=Computing%20Trends&id=Computing-Trends-Blog.
- Legier, J., Woodward, B., & Martin, N. (2013). Reassessing the Skills Required of Graduates of an Information Systems Program: An Updated Analysis. *Information Systems Education Journal*, 11(3), 78-89.
- Mills, R. J., Chudoba, K. M., & Olsen, D. H. (2016). IS Programs Responding to Industry Demands for Data Scientists: A Comparison Between 2011-2016. *Journal of Information Systems Education*, 27(2), 131-140.
- Rhew, N., Black, J., & Keels, J. (2019). Are We Teaching What Employers Want? Identifying and Remediating Gaps between Employer Needs, Accreditor Prescriptions, and Undergraduate Curricular Priorities. *Industry and Higher Education*. 33(6), 362-369.
- Sagar, V. (2020). Why Learn Java in 2020? Retrieved April 1, 2021, from <https://pattendigital.com/insight/java-development-2020>.
- Sohail, O. (2019). Apple Says That 100% of Fortune 500 Companies Now Use Its Products, With 2019 Seeing More Devices Come Online. Retrieved April 1, 2021, from <https://wccftech.com/apple-products-used-fortune-500-100-percent-companies/>.
- TIOBE. (2021). TIOBE Index for January 2021. Retrieved April 1, 2021, from <https://www.tiobe.com/tiobe-index/>.
- United States Bureau of Labor Statistics. (2021). *U.S. Department of Labor, Occupational Outlook Handbook*. Retrieved January 8, 2021, from <https://www.bls.gov/ooh/computer-and-information-technology/home.htm>.

Zaheer, M. I., Ajayi, S. O., Zulu, S. L., Oyegoke, A. & Kazemi, H. (2020). Understanding the Key Competencies of Market-Ready Building Surveying Graduates from Employers' Perspectives. *Journal of Engineering, Design and Technology*.

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