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In this issue:

- 4. Where We are with Enterprise Architecture**  
Leila Halawi, Embry Riddle Aeronautical University  
Richard McCarthy, Quinnipiac University  
James Farah, Jacksonville University
  
- 14. Dangers of Distracted Driving by Mobile Phone Users: An Experimental Approach**  
Hoon S. Choi, Appalachian State University  
Jason Xiong, Appalachian State University  
B. Dawn Medlin, Appalachian State University
  
- 24. Changes in the Information Technology Field: A Survey of Current Technologies and Future Importance**  
Jeffrey Cummings, University of North Carolina Wilmington  
Thomas Janicki, University of North Carolina Wilmington

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# Changes in the Information Technology Field: A Survey of Current Technologies and Future Importance

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## Abstract

The constantly changing nature of the information technology field can make it challenging for professionals to remain current. This study attempts to address this issue by analyzing the importance of current technologies across organizations as well as anticipated change going forward. A survey designed with a panel of information technology professionals was distributed to evaluate technologies in the areas of database, programming languages, networking/communication, cloud computing and operating systems. The results from the survey are then compared to prior studies evaluating the same areas from the past 15 years (surveys from 2003, 2008 and 2013). Results suggest a move toward more open source technologies, virtualization and cloud computing.

**Keywords:** IT Skills, IT Technologies

## 1. INTRODUCTION

Information Technology (IT) professionals continue to be in high demand. According to the United States Bureau of Labor Statistics (2018), computer and technology jobs are expected to grow by 13 percent between 2016 and 2026. This is higher than the average of all occupations. Specific job categories reported by the Bureau of Labor Statistics indicate a variety of occupations continue to be in high demand. These include Information Security Analyst (+28%), Software Developers (+22%) Web Developers (+15%) Data Base Analyst (+11%) and System Analyst (+9%). In addition to the specific job categories

the specific knowledge sets within and between the categories continue to grow.

The challenge we face as IT professionals is the field is constantly changing and we are required to stay relevant. Research has examined the skills needed for both graduating students and IT professionals in the past. The research presented in this paper focuses on the latter to understand how professionals can stay abreast on the common technologies and software currently being used in organizations. This study examines a breadth of topics including specific applications/programming languages being used (e.g., MySQL, C#, Python, etc.) to general technologies and topics important to

organizations today (e.g., virtualization, data analytics, cloud services, etc.).

The current study expands on previous research conducted to assess organization needs over the past 15 years (Janicki et al., 2004; Janicki et al. 2009, Cummings, et. al., 2014). The goal of the current study is to evaluate the current changes in technologies and skills needed by IT professionals. Additionally, as this is an extension of prior research, the study aims to show trends in organizational needs

## 2. LITERATURE REVIEW

There has been a variety of approaches taken to understand the shifting technology needs within the IT industry. Burns et. al, (2018) approached this challenge by reviewing the technology related job placement listings on the internet over a four month period. Their findings indicated that potential employers are very interested in 'soft skills' such as communications and teamwork as well as specific technical skills. On a similar basis, Sala (2011) examined the technology needs through the lens of IT recruiters. Sala's results indicate a strong need for programmers/developers, project managers and help desk support. Gallaher, et. al (2011) also reported on IT recruiters and their perspectives of IT.

Likewise the research by Aasheim et. al (2009) also indicated that soft skills were desired by IT executives for entry-level IT professionals. Their research was based on a survey of IT managers and workers across the United States. Interesting although they desired soft skills as well as technical skills, they indicated that knowledge of primary business functions (accounting, finance, etc.) was less important.

Mills et. al. (2016) approached their research of employer needs by looking at the course offerings in the technology areas by AACSB schools. They were specifically interested in looking at the changing environment for big data, visualization and business data analytics. Thus, their research builds on the perceived newer technology needs that are being taught at AACSB schools.

Other approaches have included surveying recent graduates was a technique employed by Legier et. al (2013) and Dillion and Kruke (2008). Legier et. al (2013) reported on jobs of their graduates which included end user support, management of computer systems and software development.

Alternatively, the research by Dillion and Kurke (2008) took the approach of matching graduates with the AIS (Accounting Information Systems) model curriculum. Another approach was to focus on recent alumni (Auken et al. 2011). While these approaches are useful, there are still gaps in the evaluation of experienced practitioners concerning current and anticipated skills needed.

The goal of this research was to survey a wide range of 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 extends the survey by Janicki et al. (2004; 2009) and Cummings et al. (2014) which longitudinally assessed the changing needs of the IT community. In more detail, we consider the current technology needs in the areas of databases, programming languages, networking, and operating systems platforms, as well as the anticipated changes in the near future. Finally, we evaluate how these needs have changed compared to the previous studies in 2003, 2008, and 2013. As an interesting sideline, our original research included mobile operating systems like "Palm Pilot" which was originally believed to have continued importance with respondents never anticipating the iPhone operating systems to be developed shortly after our 2013 survey. Needless to say, the technologies surveyed have changed over the past 15 years.

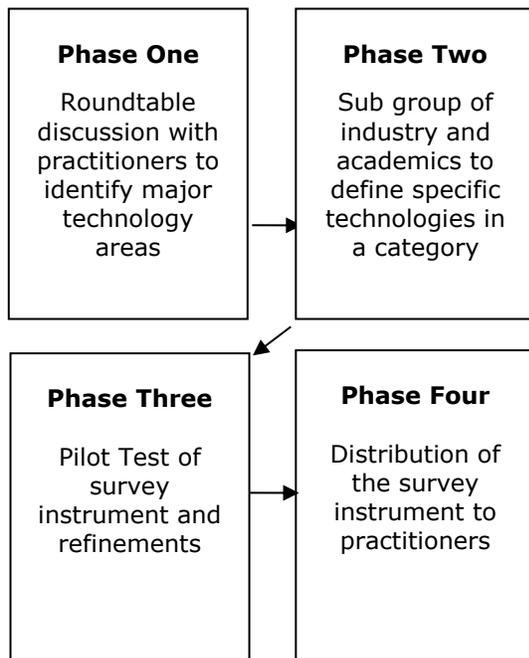
## 3. METHODOLOGY

Similar to prior studies (Janicki et al., 2004; Janicki et al. 2009 Cummings, et. al., 2014), the survey was developed over a four phase process represented by Figure 1.

### Phase I

During this phase, a roundtable discussion was conducted with a corporate advisory board at the university. The advisory board consists of 25 members that represent regional and national organizations of varying sizes (10 employees to over 1000 employees). These members are primarily employees from their respective organization's IT department and interact with many of the technologies included in the survey. The respondents are not entry-level employees but more IT managers who manage and hire entry-level IT professionals. The roundtable goals were to understand what areas were important to IT professionals while identifying major technology areas. Faculty from the Information Systems and Information Technology department

at a large, regional university lead the roundtable discussions.



**Figure 1: Survey Methodologies Stages**

During the first roundtable discussions, a faculty representative worked with advisory board members to identify major trends or changes in technology in their respective fields. Following this discussion, the group walked through previous surveys from the prior studies to evaluate relevancy in the current market as well as expanding in areas not covered in previous studies. The first roundtable discussion resulted in the following categories for technological areas:

- Operating Systems Platforms
- Networking/Communication (Both Software/Hardware)
- Databases
- Development Languages
- Cloud Platforms

Based on these categories, a second roundtable discussion was conducted during phase II.

**Phase II**

During this phase, the broad categories from Phase I were evaluated to develop sub-categories of the technological areas. This discussion occurred during the following advisory board meeting after researchers made adjustments based upon the results from Phase I. In this

phase, specific technologies (including brand names) were identified within each category. The groups went through several iterations and 'pilot testing' with other industry professionals, to ensure all possible sub-categories were captured and there was consistency across areas. The final list of technologies/software was chosen by IT professionals based on their direct experience and thoughts as well as ongoing importance.

For example, professionals evaluated the networking category and specific technologies and brands were included as a subcategory. These included:

- Cisco
- Linux/Unix Family
- Virtualization
- VOIP
- Windows

The remainder of the survey was also developed in this phase. Since the target audience is industry professionals, questions centered on whether the technology is currently being used and what the future importance of the technology is. Due to the evolving nature of the IT field, the sub group of academics and industry professionals decided to only focus on a two-year time horizon. The industry professionals felt the scale needed to be adjusted to combine extremely important and more important into one measure. This resulted in a change from the original surveys (which was on a 5 point scale) to a 4 point scale of Important to Not at All (see scale in Table 1 below).

<b>Expected importance to your job in two years</b>
Not at All
Less Important
Same
More Important

**Table 1: Expected Importance Scale of Particular Technologies in two years**

This scale was used across all categories except for the "Development Languages" category. For this category, the scale used was "level of knowledge desired" to capture the current needs of the employer. After the sub category selection was complete, the survey instrument was finalized and included general questions such as company size, organization type, employee functional area and general demographics (age,

gender, location, company size, industry, job title).

**Phase III**

A pilot test was conducted to ensure that the survey questions were clear to participants and that the average completion time was 10 minutes or less. A preliminary survey request was emailed to industry professionals, which directed them to complete the online survey. Twenty-six completed the survey during the pilot test.

The average completion time was below 10 minutes and based upon feedback, minor changes were made to the survey instrument and it was deemed ready for distribution.

**Phase IV**

The last phase included sending the survey to over 2500 IT professionals throughout the US. The survey was distributed to a list of IT managers and above by a professional marketing firm. The survey targeted individuals currently in an IS/IT field. The survey pool consisted of only those directly working with the technologies while supervisors/managers were excluded from the pool. A total of 54 professionals completed the survey.

**4. SUMMARY STATISTICS**

Individuals from a variety of organizational roles participated in the survey (see Table 2).

Organizational Role	%
Business/Systems Analysis	16.5%
Networks/Security	16.5%
Software Development	15%
Project Management	6%
Database Admin/Analyst	5%
Data Analyst	5%
IT Strategy	2%
Management	2%
Other IT	32%

**Table 2: Organizational Role**

**Demographics**

30% of participants were female and 70% were male. This is an increase of 10% in females participating compared to the 2013 survey. Participants had a variety of educational backgrounds with 12% holding Bachelors of Science and 40% with a Master's in a technology

related degree. This is also an increase of over 20% of the respondents with Master Degrees when compared to the 2013 survey. The survey was also completed by those without a technical degree with 14% with a BS and 14% with a master's degree. The remaining respondents held either an Associate or High School Degree. Across all participants, the average tenure within the field was 6 years and employees were at the current employer for 4.5 years.

Participants from a variety of organization types and sizes completed the survey. Over half of the participants came from organizations larger than 1000 employees and a majority identified their organization as being a Corporation. Tables 3 & 4 detail the size and type of the respondent's organization.

Number of Employees	%
<11	4%
11-100	21%
101-499	23%
500-999	11%
1000-9999	26%
10000+	9%

**Table 3: Size of the organizations**

Organization Type	%
Corporation	41%
LLC	28%
Education	11%
Healthcare	9%
Government	7%
Non or Not for Profit	4%

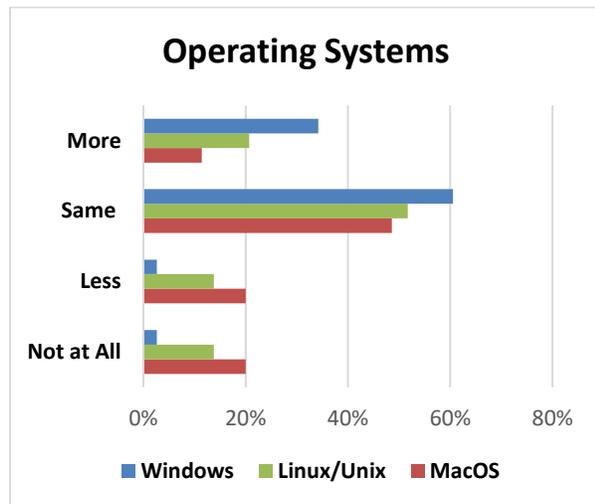
**Table 4: Organization Type**

**5. RESULTS**

In the subsequent sections, the averages across the various categories are evaluated to understand the future importance.

**5.1 Operating Systems Platform Expectations**

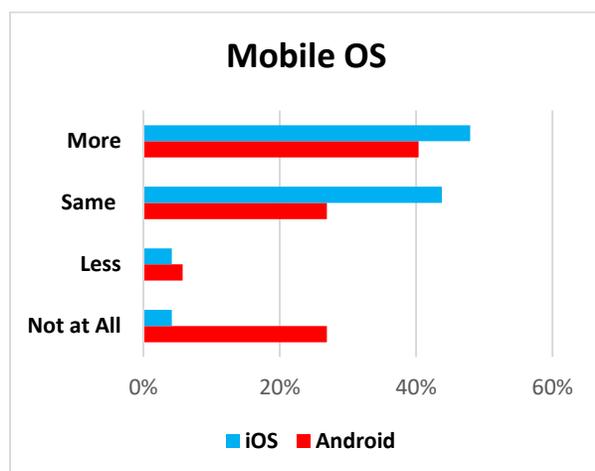
As in the past surveys, expectations of five different OS Platform (including Mobile Platforms) were surveyed to understand their importance over the next 2 years.



**Figure 2: Expected Importance of Windows Platforms**

As with previous surveys, the Windows platform was rated as the highest importance followed by Linux/Unix. MacOS still trails rated with the third highest importance in operating systems (see Figure 2).

Mobile operating systems were also evaluated. iOS appears to have a greater importance compared to Android. However, both rated high with the importance over the next 2 years staying the same or increasing for both iOS and Android at 90% and 67%, respectively. The lower importance of Android may be due to the participants in the study stating they more frequently use iOS compared to Android. Figure 3 shows the results for mobile operating systems.

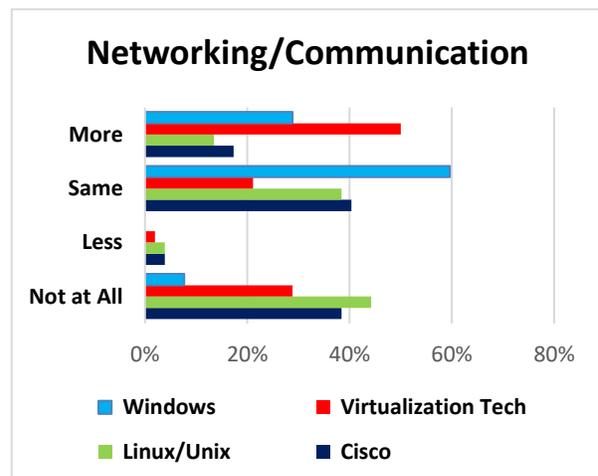


**Figure 3: Expected Importance of Android & iOS Platforms**

### 5.2 Networking/Communication

With the Networking and Communication category, the survey captured both software and hardware. For example, software technologies such as Windows Networking were included as well as hardware products like Cisco Technologies. The goal of doing so was to understand if there are benefits of certifications in a particular technology.

Windows networking continues to be important in this category with 88% stating the importance going forward will remain the same or increase (see Figure 4). However, virtualization had the highest rating of increased importance at over 40%, showing a potential need for professionals with virtualization experience going forward. For a comparison of all the technology in this category, see Figure 4.

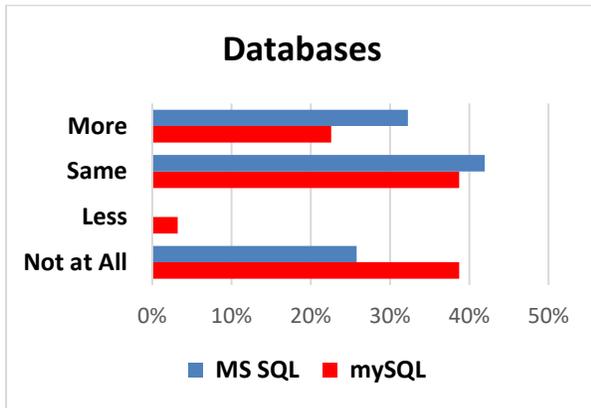


**Figure 4: Expected Importance of Networking/Communication Software**

### 5.3 Databases

The number of respondents for the database category were reduced to 38, as many of the respondents did not work with database technologies. Thus, the respondents that were excluded did not have experience with databases and could not judge their importance going forward.

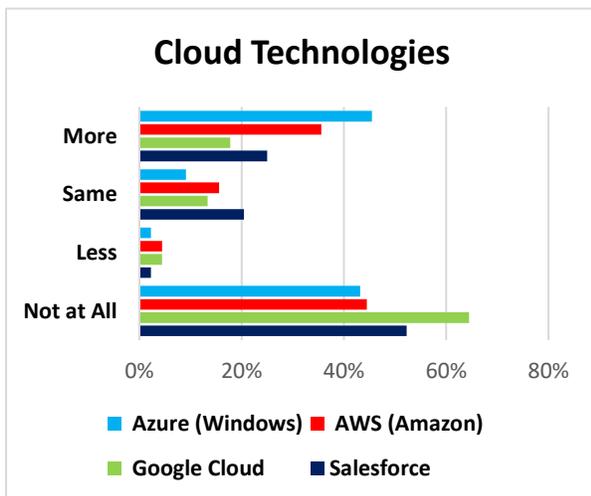
For the remaining participants, MS SQL was rated the highest database platform having the highest importance moving forward with 74% stating the importance will either remain the same or increase in the next two years. MySQL followed this closely at 61% while Oracle and DB2 decreased in importance from previous studies (see comparison in the next section) (see Figure 5 for the MS SQL and MySQL results).



**Figure 5: Expected Importance of MS SQL and MySQL Server**

#### 5.4 Cloud Platform

In the previous study (Cummings et. al, 2014), cloud platform technologies were introduced into the survey. The survey again asked the importance to understanding cloud technologies moving forward. The results (see Figure 6) suggest mixed results for the importance of cloud technologies in the next couple of years. While slightly over 50% of respondents feel AWS and Azure importance will remain the same or greater in the next two years, the results suggest Google Cloud and Salesforce will be less important moving forward. The results from the current study and the prior study will be compared and discussed further in the subsequent sections.



**Figure 6: Cloud Platform Rankings of Importance**

#### 5.5 Development Languages

Development languages were evaluated differently from the previous categories. Participants were asked to rate the level of knowledge needed across 13 different programming languages. The scale included no experience (rating 1), fundamental (rating 2), working (rating 3) and expert (rating 4). Results are included in Table 5 below:

Rank	Product	Rating
1	JavaScript	2.41
2	HTML 5	2.29
3	CSS 3	2.18
4	C#	2.00
5	XML	2.00
6	jQuery	1.82
7	ASP.NET MVC	1.76
8	PHP	1.65
9	Java	1.59
10	ASP.NET	1.59
11	C++	1.41
12	Python	1.35
13	JSP	1.18

**Table 5: Development Language Level of Knowledge Importance**

The results suggest professionals should not have expert knowledge in one specific language. However, web development languages appeared to be important as participants suggested a fundamental to working knowledge in JavaScript, HTML4 and CSS3. It should be noted that many of languages were rated closely.

#### 6. COMPARISON TO PRIOR SURVEYS

This research parallels prior surveys of IT workers conducted in 2013, 2008 and 2003. The prior surveys were similar to the current with slight adjustments. These included changing the scale by removing "extremely important" and only have "more important" based on feedback from the panel. Additionally, technologies were added as well per advisory board suggestions.

The subsequent sections compare the changes to levels of importance across the previous surveys. All tables display the importance ranking which was calculated as follows: 5 for extremely important, 4 for more important, 3 for same importance, 2 for less important and 1 for not at all. Since the scale for the current study was changed to 4 points (i.e., extremely important was removed), the importance rankings for 2018 have been adjusted to be representative of a 5-

point scale for comparison reasons. Additionally, programming languages is excluded because of the question changes to this technology area. (Note, a '--' in the tables below indicates any products that were not surveyed in the respective year.)

### 6.1 Operating System Platforms

There was an increase in importance across all operating systems platforms compared to 2013. Interestingly, the largest increase was from the iOS platform suggesting the continued importance of mobile platforms. In fact, iOS and Windows had equivalent scores of importance this year for the first time. Another significant finding was the increased importance of Linux/Unix, which had the second largest increase behind iOS. This increase may be from a variety of reasons from the open source nature of Linux to its use on various hardware devices. Further research is needed to understand the exact reasons behind these increases.

Product	2018	2013	2008	2003
Windows	4.1	3.8	3.9	3.9
iOS	4.2	3.1	--	--
Android	3.5	3.1	--	--
Linux/Unix	3.6	2.9	2.6	2.9
Mac OS	3.2	2.6	1.5	--

**Table 6: Operating Platforms Rankings of Importance**

### 6.2 Networking & Communications

An interesting finding in this category was the only product appearing to increase in importance from the prior study was Windows (see Table 7 for details). Virtualization fell slightly in importance from previous years but remains important to organizations moving forward. Linux/Unix remained the same from the previous study. Surprisingly, Cisco products appeared to fall the most from 2013. This may be from the availability/popularity of other networking technologies available or participants this year may not use these technologies in their existing position. Further analysis of the data confirmed that survey respondent this year did not currently use Cisco technologies in their organization, which may explain the drop in importance. VOIP dropped slightly from the previous study.

Product	2018	2013	2008	2003
Windows	3.9	3.7	3.5	3.9
Virtualization	3.6	3.7	--	--
VOIP	3.2	3.4	--	--
Cisco	3.0	3.2	2.4	3.9
Linux/Unix	2.8	2.8	2.3	2.9

**Table 7: Networking/Communication - Rankings of Importance**

### 6.3 Databases

Within database products, both MS SQL Server and PostgreSQL increased from previous years. The increase in PostgreSQL and the consistent importance of MySQL suggest the increase popularity of open source within organizations (which may also be the reason for the results concerning Linux). DB-Engine (<https://db-engines.com/en/>) is an online resource ranking database products by popularity, jobs available, number of technical discussions, etc. This site found an increased popularity of PostgreSQL, doubling in popularity from 2013 to 2018. Other products remained consistent from previous studies.

Product	2018	2013	2008	2003
MS SQL Server	3.6	3.3	3.0	3.6
MySQL	3.2	3.3	2.1	2.1
Oracle	2.8	2.8	2.7	2.9
IBM DB2	2.2	2.2	1.8	1.6
PostgreSQL	2.6	2.1	1.6	1.6

**Table 8: Database Rankings of Importance**

### 6.4 Cloud Technologies

Cloud technologies were originally introduced to the survey in 2013 which now gives us the opportunity to analyze the change in importance over the past 5 years (see Table 9). There appears to be a shifting importance from Google to AWS and Azure compared to the previous survey. Salesforce also appears to be gaining importance since the 2013 survey.

Product	2018	2013
AWS	3.2	2.6
Azure	3.3	2.6
Google	2.4	2.9
Salesforce	2.8	2.2

**Table 9: Cloud Rankings of Importance**

## 7. CONCLUSIONS

Technologies and their importance in the field continually change and IT professionals must stay abreast to this changing world to remain competitive. Much like prior studies, the current results suggest the importance of Microsoft products remains across many of the categories analyzed. However, increased importance in PostgreSQL and consistent importance in Linux suggest that open source technologies are gaining importance.

Under operating systems, mobile continues to increase with importance. iOS had significant gains in importance with participants suggests that iOS importance will remain the same or increase in the next 2 years. We also see the importance of Virtualization remaining consistent (with a slight decrease) as well as Windows in the Networking and Communication category.

The results from programming languages remained similar to the prior survey that showed an increased importance of web based technologies. However, the top programming languages did change. The 2013 survey had ASP.Net, PHP and C# as the top programming language professionals should have a fundamental knowledge in. The current suggests more general knowledge in web programming is important. This is reflected in the top languages being JavaScript, HTML5 and CSS3.

Finally, we were able to compare cloud computing to the prior survey to understand any differences in importance from 5 years ago. As previously mentioned, there appears to be a shift in importance toward AWS and Azure when compared to Google.

## 8. FUTURE RESEARCH AND REMARKS

Future research includes adapting the current survey as technologies change. While we tried to capture as many different technologies, we are still limited on number of technologies surveyed. We focused on the suggestions of the advisory board to the technologies they felt were significant in the future expanding the technologies surveyed and including additional employers.

There were some limitations to the current study worth noting. Compared to previous studies, we approached this study by reaching out beyond the

east coast for participants. However, many of the participants came from eastern US. In subsequent studies, we will continue to strive for a broader set of participants. Another limitation concerns the categories chosen to evaluate. While there are numerous emerging technologies, we limited the technologies in the survey to those identified by the advisory board. As data analytics continues to gain importance, future studies will examine the importance of these technologies moving forward.

## 9. REFERENCES

- Asheim, C.L., Williams, S. and Butler, E. Sonny (2009). Knowledge and Skill Requirements for IT Graduates. *The Journal of Computer Information Systems*. 49(3). 48-53.
- 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.
- Dillion, T. and Kruck S.E. (2008) Identifying Employer Needs from Accounting Information Systems Programs *Journal of Information Systems Education*, 19(4), 403-410.
- Cummings, J., Janicki, T., Kline, D. M. (2014). Shifting Technological Landscape: IT Departments and Anticipated Technological Changes. *Journal of Information Systems Applied Research*, 7(4) pp 37-49. <http://jisar.org/2014-7/> ISSN: 1946-1836.
- He, J., and Freeman, L. (2010) Understanding the formation of general computer self-efficacy, Communications of the *Association for Information Systems*, 26(12), 225-244.
- Janicki, T., Kline, D., Gowan, J., and Konopaske, R. (2004) Matching Employer Needs with IT Curriculum: An Exploratory Study , *Information Systems Educators Journal* , 2004; V. 2 N. 21 ;
- Janicki, T. N., Yaylacicegi, U., Mahar, S., & Logan, R. (2009) Anticipated changes to technologies employed by IT departments in 2009. *Journal of Information Systems Applied Research*, 2(9).

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.

Sala, R. (2011, September 30). 9 hot IT skills for 2012: IT hiring ticks up for the third straight year, and IT pros with programming skills will be first in line for jobs. *ComputerWorld.com*.

Retrieved from [http://www.computerworld.com/s/article/358381/9\\_Hot\\_Skills\\_for\\_2012?taxonomyId=14&pageNumber=1](http://www.computerworld.com/s/article/358381/9_Hot_Skills_for_2012?taxonomyId=14&pageNumber=1) Retrieved 5/28/2013.

United States Bureau of Labor Statistics, U.S. Department of Labor, Occupational Outlook Handbook. Retrieved June 12, 2018, <https://www.bls.gov/ooh/computer-and-information-technology/home.htm>

Zhu, K. and Zhou, Z., 2012 "Lock-In Strategy in Software Competition: Open-Source Software vs. Proprietary Software" *Information Systems Research*, 23(2), 536-54