

# JOURNAL OF INFORMATION SYSTEMS APPLIED RESEARCH

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# JOURNAL OF INFORMATION SYSTEMS APPLIED RESEARCH

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# Shifting Technological Landscape: IT Departments and Anticipated Technological Changes

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## Abstract

A constant in the Information Technology field is change. Technologies continue to change at a rapid pace. The need to remain current is essential for all professionals in the IS/IT field. This research presents the results of an employer survey examining the current and anticipated change in the usage of technologies. Technologies evaluated in this work include those in the areas of databases, programming languages, networking, cloud computing and operating systems platforms. Results are discussed and compared to similar surveys conducted in 2008 and 2003. While results found that Microsoft technologies are still dominant, they also suggest an increased emphasis on mobile platforms within the operating systems area and virtualization within the networking area. Within the database area, open source software (MySQL) increased dramatically compared to the prior surveys. Finally, cloud computing was included as a new technology area with mixed results.

**Keywords:** IT Skills, IT Technologies

## 1. INTRODUCTION

The demand for IT professionals continues to increase. Currently, IT-related jobs comprise four of the top ten Fortune Best Jobs of 2013 (US News, 2013). Demand is expected to continue to grow. The United States Bureau of Labor Statistics reports an expected growth of 22% in IT-related jobs for the 2010-2020 period. This outpaces most other fields through

the year 2020 (US Bureau of Labor Statistics, 2011). Concurrent with the demand for general IT professionals is a need for experienced and knowledgeable professionals in a variety of technologies and skills such as databases, servers and programming languages.

The challenge facing any computer information systems professional is staying relevant. The dynamic nature of the IT field compounds the

problem as employer demand for knowledgeable IT professionals continues to evolve as technologies change. This challenge is felt most in the academic community as faculty race to achieve a balance of fundamentals with relevant applied course content to meet the current and future needs of the industry (Richards et al 2011). Research has examined various skills needed by IT/IS graduates including skills within networking, project management and strategy (Janicki et al., 2004; Janicki et al., 2008). The research presented here goes beyond the curriculum to examine technology needs of current IT departments based on those employees interacting directly with the technology.

The goal of the current study is to not only identify the current changes in the usage of technologies and skills needed by employers, but also to capture anticipated changes in the coming years. Our objective is to provide an outline of technologies for current and future IT professionals to stay abreast on organizational needs. A survey was conducted to assess the needs of organization which is a follow-up study to similar surveys conducted in 2003 and 2008 (Janicki et al., 2004; Janicki et al. 2009). As such, this paper details the changes in technologies demanded by the IT industry since the prior surveys.

## 2. LITERATURE REVIEW

The technological environment has always been marked by frequent changes, which, in turn, requires employees to constantly adjust to meet relevant knowledge and skills needed (Lee et al. 1995). More recent technological developments ranging from virtualization to cloud computing has caused these employees to possess a blend of skills, one being a variety of technical knowledge (Byrd et al 2004). A strong background in technological knowledge is even more important in today's IT industry, as positions dealing directly with technology (e.g. network administration) are increasingly in demand with little likelihood of being "offshored" (Atkinson & Andes, 2010). This creates the challenge of developing a list of concrete technical skills needed (He & Freeman, 2010) especially as technical skills become obsolete at a much more rapid pace compared to the past (Prabhakar, et al., 2005).

Prior research has attempted to address the issue of technological needs and employer

demands from a number of perspectives. One approach has been to evaluate the needs of IT management or recruiters. Sala (2011) took the approach of examining IT executives to understand their thoughts on skills in demand. The results from this research suggest programming ranks highest in demand followed project management and help desk support. Another study targeted management and above positions to develop a typology of skills and needs for an IT employee (Gallagher et al 2011). Alternatively, He and Guo (2011) focus on recruiters and their perspective on IT skills needed. However, with all this research, the focus has been on participants that may not directly interact with the technologies being surveyed. Executives and upper management as well as recruiters are not the employees directly interacting with the technologies/skills being utilized. In other words, they are not "in the trenches" of the IT department.

Another approach has been to evaluate technological need by matching the needs of the employer to the curriculum. Surendra and Denton (2009) present a comparison of skills and technologies valued by practitioners to those valued in academics. Leigler et al. (2013) examine students and their perceptions of skills needed. While some studies have focused on recent alumni (Auken et al. 2011), there are still gaps in the evaluation of experienced practitioners concerning current and anticipated skills needed.

The goal of the current study is to cover a broad range of practitioners with varying levels of experience. This paper extends the survey by Janicki et al. (2004; 2009) which longitudinally assessed the changing needs of the IT community. Specifically, 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 and 2008.

## 3. METHODOLOGY

The survey instrument was developed over four phases represented in Figure 1. This methodology was chosen based on prior research conducting surveys in a similar manner (Janicki et al., 2004; Janicki et al. 2009).

**Phase I**

Phase I consisted of a roundtable discussion comprised of 25 professionals and 8 faculty from an corporate/academic advisory board. These advisory board members represent twenty unique companies ranging in size from 5 to 1000 employees. Additionally, all those on the advisory board directly interact with technology at their respective organization and were primarily members of the IS department. The goal was to develop topic areas of importance to IT professionals, specifically focusing on identifying major technology areas. Faculty representatives included members from both the Information Systems and Computer Science departments at a large, regional university.

- Development Languages
- Cloud Platforms

These overarching technology categories were then used as a starting point for phase II.

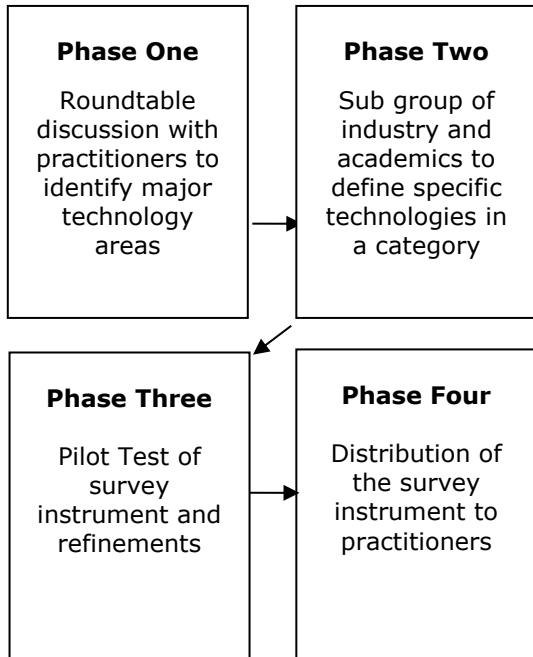
**Phase II**

During this phase, sub-categories of the technological areas were identified to further evaluate technological needs of employees. A sub group of the professionals from Phase I were used to define the specific items and brand names within each technology area. The sub groups went through several iterations and 'pilot testing' with other industry professionals, to ensure all possible sub-categories were captured as well as maintain consistency across areas. Appendix B provides the detail for each technology area and sub category (i.e. product or brand name). 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 were asked to identify specific technologies and brands for the Operating System (OS) platform category. The identified technologies and brands included:

- Windows Family
- Linux/Unix Family
- MacOS
- iOS
- Android

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 scale for the future importance is presented in Table 1.



**Figure 1: Survey Methodologies Stages**

During the roundtable, groups were first tasked with identifying major technology areas within their field. This was then followed by an examination of the previous survey to evaluate the relevance of the technological areas previously included. The team discussions resulted in the following categories for technological areas (Note: Cloud Platforms is a new technology area added to the current survey):

- Operating Systems Platforms
- Networking/Communication (includes both Software/Hardware)
- Databases

| Expected importance to your job in two years |
|--|
| Not at All                                   |
| Less Important                               |
| Same   |
| More Important                               |
| Extremely Important                          |

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

There was one change to the current survey compared to the previous survey conducted in 2008. For the "Programming Languages" technology area, the "level of knowledge desired" was used to capture the current needs of the employer. This was chosen in place of "expected importance" as the sub group of employers and faculty felt it was more relevant to understand the level of knowledge needed for a specific programming language. All other technological area sub categories were asked "expected importance".

After the sub category selection was complete, the survey instrument was finalized to include questions concerning the size of the company, organization type, employee functional area and general demographics (age, gender, location, company size, industry, job title). Additionally, there were questions concerning company location and whether the participant was responsible for hiring or supervising IS/IT professionals.

### **Phase III**

Clarity and completion time of the survey was an important aspect given that our target participant audience was professionals. A pilot test was conducted to ensure that the survey would be clear to the participants and would also have a completion time of 10 minutes or less. A preliminary survey request was emailed to twenty five industry professionals, which directed them to complete the online survey. Additional instructions were included asking all the pilot participants to record their completion time and any misleading or confusing questions. From the 25 requests, 14 completed the pilot study.

Based on pilot testing feedback, minor changes were made to the survey instrument and it was deemed ready for distribution.

### **Phase IV**

The final phase was the distribution of the survey, via email, to over 3500 individuals either in the IS/IT field or known to potentially hire IS/IT professionals. Only those working directly on technologies were included in our survey pool so supervisors/managers were not directed to respond to the technology questions. From the remaining individuals, a total of 108 IT professionals completed the entire technology section of the survey. The survey's mailing list included the membership roster of the

Association of Information Technology Professionals (AITP), alumni from the research institution, and various IT professional attendees of at least one conference held at the research institution. The goal was to poll a variety of individuals across numerous companies, geographic regions, and industries.

## **4. SUMMARY STATISTICS**

Participants consisted of IT professionals who had direct interaction with the technologies surveyed. This included a variety of organizational roles with Software Development and Other IT leading the roles represented. A complete list of the professional roles of participants is included in Table 2.

| <b>Organizational Role</b> | <b># of Respondents</b> | <b>%</b> |
|----------------------------|-------------------------|----------|
| Software Development       | 19                      | 18%      |
| Business/ Systems Analysis | 11                      | 10%      |
| IT Strategy                | 11                      | 10%      |
| Networks/ Security         | 11                      | 10%      |
| Database Admin/ Analyst    | 10                      | 9%       |
| Management                 | 7                       | 7%       |
| Project Mgmt               | 4                       | 4%       |
| Big Data / BI              | 3                       | 3%       |
| Other IT                   | 31                      | 29%      |

**Table 2: Organizational Role**

In the subsequent sections, the demographics are first discussed followed by the results of the importance of various technologies (by area) employed at the participant's organization.

### **Demographics**

The participants consisted of 20% female and 80% male respondents. Education varied with a large majority of participants holding either a Bachelors of Science or Master's degree in an IT related field (30% and 19% respectively). Those with non-IT related degrees consisted of 16% with a BS and 16% with a master's degree. The overall average tenure within the industry was 15 years with employees averaging 6 years or less with their current employer.

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 | # of Respondents | %   |
|---------------------|------------------|-----|
| <11                 | 4                | 4%  |
| 11-100              | 12               | 11% |
| 101-499             | 24               | 22% |
| 500-999             | 10               | 9%  |
| 1000-9999           | 31               | 28% |
| 10000+              | 28               | 26% |

**Table 3: Size of the organizations**

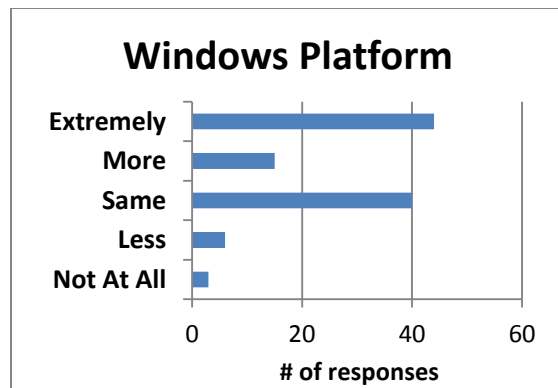
| Organization Type     | # of Respondents | %   |
|-----------------------|------------------|-----|
| Corporation           | 55               | 50% |
| Education             | 26               | 24% |
| Government            | 8                | 7%  |
| Healthcare            | 8                | 7%  |
| LLC                   | 5                | 5%  |
| Non or Not for Profit | 4                | 4%  |

**Table 4: Organization Type**

## 5. RESULTS

### 5.1 Operating Systems Platform Expectations

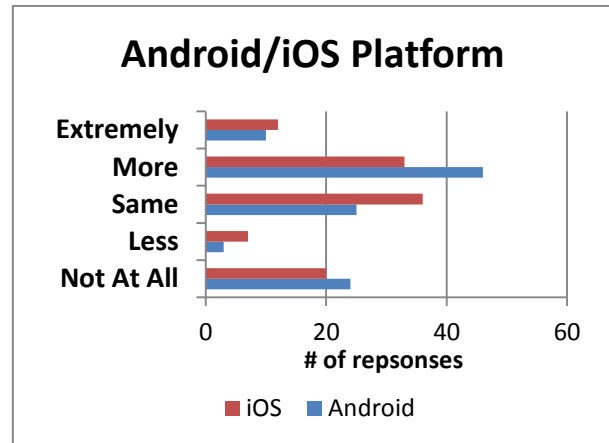
OS Platform expectations were surveyed across five different platforms to understand the importance of these platforms in the next 2 years. As stated earlier, the platforms included in the survey were determined by a panel of industry and advisory board professionals. In Figures 2 through 5, the x-axis represents the number of responses.



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

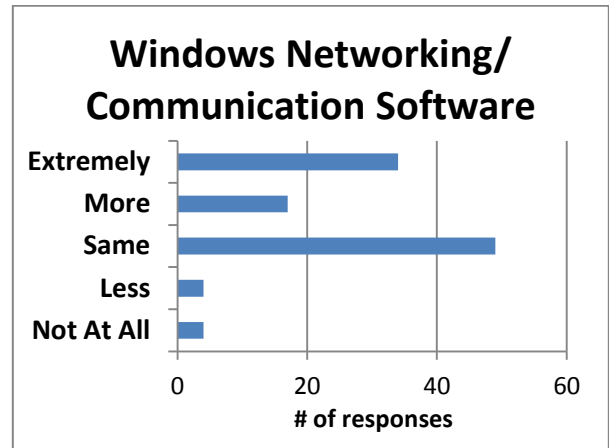
The Windows platform was rated as the highest importance in this category. However, two new

platforms introduced in this survey scored high on future importance. Both Android and iOS platforms scored the next highest ratings of importance after Windows. Figures 2 and 3 detail the top three platforms expected to have "more" or "extremely more" importance to IT professionals in the next two years. Appendix B details the responses of all platforms surveyed.



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

### 5.2 Networking/Communication



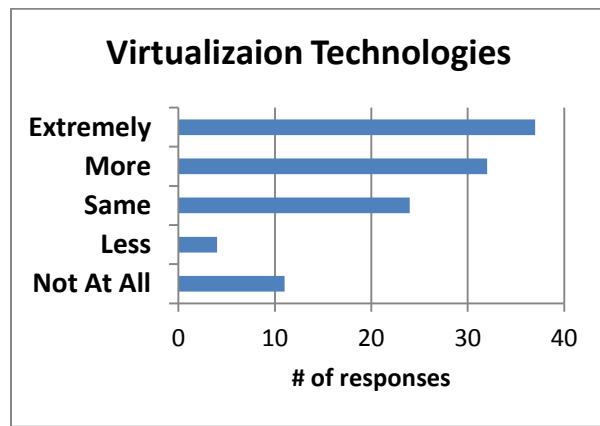
**Figure 4: Expected Importance of Windows Networking/Comm. Software**

The Networking and Communication category was created to include both software products (e.g. Windows Networking) and hardware products (e.g. Cisco Technologies). We included both of these to ensure we not only captured the primary software organizations use but also the popularity of as specific technology. This would help IS professionals understand the benefits of certifications in a particular technology. From this technology category, Windows networking



and communications software had the highest average level of importance (detailed in Figure 4).

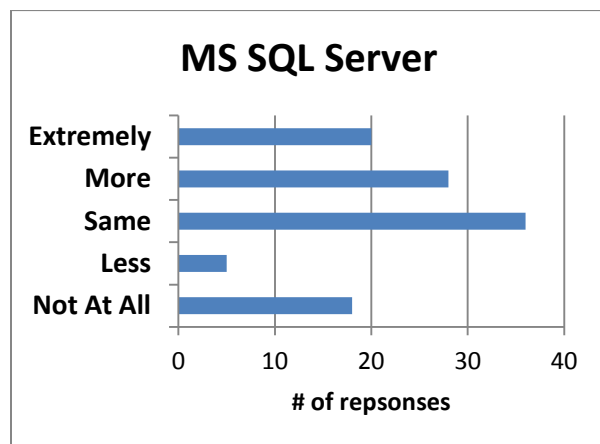
While Windows Networking averaged the highest ratings, Virtualization Technologies scored higher for both "More Important" and "Extremely Important" ratings than any other technology (shown in Figure 5). This shows the increasing importance placed on virtualization at organizations. Appendix B provides a complete list of the technologies surveyed included their ratings of importance.



**Figure 5: Expected Importance of Virtualization Technologies**

**5.3 Databases**

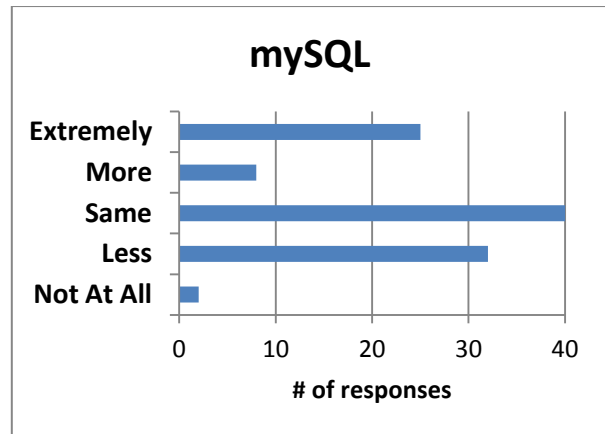
MS SQL was again the leader in the database category followed by Oracle and mySQL Figure 6 provides the detailed responses for MS SQL.



**Figure 6: Expected Importance of MS SQL Server**

One significant change from previous surveys was the results for mySQL. This database

technology increased in importance with a large number of respondents stating this importance will remain or increase in the future.



**Figure 7: Expected Importance of MySQL Server**

**5.4 Development Languages**

For Development Languages, participants were asked about (1) overall level of knowledge in development/programming and (2) desired knowledge in a specific language survey. There were a total of 9 different languages including recent languages introduced such as HTML5.

| Rank | Product     | Rating |
|------|-------------|--------|
| 1    | ASP.Net     | 1.77   |
| 2    | PHP         | 1.72   |
| 3    | C#          | 1.61   |
| 4    | HTML5       | 1.60   |
| 5    | JavaScript  | 1.57   |
| 6    | XML         | 1.56   |
| 7    | ASP.Net MVC | 1.54   |
| 8    | Java        | 1.52   |
| 9    | JQuery      | 1.51   |
| 10   | Python      | 1.42   |
| 11   | CSS3        | 1.36   |
| 12   | C++         | 1.35   |
| 13   | JSP         | 1.34   |

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

The survey results found that participants indicated a need to have, at a minimum, a fundamental knowledge of software development with some suggesting working knowledge is needed as well. For the specific languages queried, ASP.Net, PHP, C# and HTML5 ranked highest of the development languages (details in Table 5). While the

languages above did rank highest, the overall ratings for all languages were close, suggesting that employers are looking for individuals who have the ability to understand programming but no particular language.

**5.5 Cloud Platform**

A new technology area was defined for this survey that was not included in the previous surveys. Cloud Platforms were surveyed to understand the importance of using these services in the future. Surprisingly, participants responded that the expected importance of cloud platforms will remain the same or slightly less (see Table 6). These results show an average importance of 2.6 which is between the same importance in the future and less important (note: this is out of a 5 point scale with 1 being highest and 5 the lowest).

| Product         | Average Rating |
|-----------------|----------------|
| AWS (Amazon)    | 2.6            |
| FORCE           | 2.2            |
| Google Web      | 2.9            |
| Azure (Windows) | 2.6            |

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

A closer examination of the results shows that participants are divided concerning the importance of Cloud Services (Appendix B contains the details of responses). Across all platforms, 63% of participants rated the anticipated importance of cloud computing would remain the same or increase in importance. However, 37% of participants rated cloud services importance declining in the next two years. These results are further discussed in Section 7.

**6. COMPARISON TO PRIOR SURVEYS**

This research parallels prior surveys of IT workers conducted in 2008 and 2003. The number of respondents increased this year to 108 compared to 79 from the survey in 2008. These surveys were similar to the current one in context and format. However, changes were made per the suggestions of the advisory board concerning their use of technologies across those organizations.

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, 2 for less, and 1 for not at all. A '--' indicates any products that were not surveyed in the respective year. Two of the technology areas are excluded from the comparisons. Cloud computing is not included in this section as this is a new category included in the current survey. Additionally, programming languages is excluded because of the question changes to this technology area.

**6.1 Operating System Platforms**

The Windows family of operating platforms has remained close to the same level of importance from previous surveys (see Table 7, higher scores indicate greater importance). However, the new products added in 2013 (i.e. iOS and Android) have the largest importance behind Windows. This suggests the increased importance companies have been placing on mobile platforms. Linux has remained consistent while Mac OS has increased significantly from 2008. Finally, the Palm and Windows CE platforms were dropped from the 2013 study.

| Product    | 2013 | 2008 | 2003 |
|------------|------|------|------|
| Windows    | 3.8  | 3.9  | 3.9  |
| iOS        | 3.1  | --   | --   |
| Android    | 3.1  | --   | --   |
| Linux/Unix | 2.9  | 2.6  | 2.9  |
| Mac OS     | 2.6  | 1.5  | --   |
| Palm       | --   | 1.7  | 2.2  |
| Windows CE | --   | 1.7  | 1.9  |

**Table 7: Operating Platforms Rankings of Importance**

**6.2 Networking & Communications**

All products surveyed in the networking and communications software category increased in importance from 2008 (see Table 8 for details). Virtualization and VOIP were both added to the current survey. Importance for both products was high with Virtualization tying with Windows for the highest level of importance. This may be related to organizations changing emphasis to a virtualized environment as well as security concerns that arise from these environments. Due to the decreased importance of Netware

and Juniper from 2008, these products were dropped from the current survey.

| Product        | 2013 | 2008 | 2003 |
|----------------|------|------|------|
| Windows        | 3.7  | 3.5  | 3.9  |
| Virtualization | 3.7  | --   | --   |
| VOIP           | 3.4  | --   | --   |
| Wireless       | 3.4  | 3.2  | 3.2  |
| Cisco          | 3.2  | 2.4  | 3.9  |
| Linux/Unix     | 2.8  | 2.3  | 2.9  |
| Netware        | --   | 1.6  | --   |
| Juniper        | --   | 1.5  | --   |

**Table 8: Networking/Communication - Rankings of Importance**

### 6.3 Databases

For Database Products, there was an increase in importance for all products compared to the prior surveys. Microsoft SQL had the highest level of importance with MySQL and Oracle the next highest. This could be the impact of additional data analysis and the need to store more data in a variety of formats. Table 9 displays all product rankings and survey results.

| Product       | 2013 | 2008 | 2003 |
|---------------|------|------|------|
| MS SQL Server | 3.3  | 3.0  | 3.6  |
| MySQL         | 3.3  | 2.1  | 2.1  |
| Oracle        | 2.8  | 2.7  | 2.9  |
| IBM DB2       | 2.2  | 1.8  | 1.6  |
| PostgreSQL    | 2.1  | 1.6  | 1.6  |
| Filemaker Pro | --   | 1.4  | 1.3  |
| CA Ingress    | --   | 1.3  | 1.3  |

**Table 9: Database Rankings of Importance**

As mentioned previously, MySQL had the highest increase in importance from the previous survey. This suggests open source software may be gaining ground in organizations. This supports prior research finding the increasing popularity of open source at organizations (Zhu and Zhou, 2012).

## 7. CONCLUSIONS

A closer look at technologies and software at organizations has shown a dynamic landscape with some core technologies remaining important as well as newer technologies impacting the landscape. The current survey still suggests a dominance of Microsoft products across many of the technology areas surveyed. This includes the Operating Platforms

(Windows), Networking/Communication, and Database (MS SQL).

However, we did see some significant shifts in a number of technology areas. While Windows still dominates Operating Platforms, mobile platforms are increasing in importance with iOS and Android leading the way. This parallels the shift seen in organizations to focus on the mobile environment.

Windows products for networking / communication were again found to have high anticipated importance. However, the importance organizations have been placing on virtualization is shown as this was ranked as important as Windows. VOIP and Wireless also saw higher anticipate importance for organizations moving forward.

Finally, the results from programming languages and cloud computing questions provided interesting insights into the anticipated importance of these technologies. There is still a high anticipated importance of knowledge in general programming/development skills moving forward. However, the results for the languages queried suggest there may not be one language that stands out. Instead, programmers need to understand the fundamentals of programming in general as well and be able to learn and adapt to the primary language used at the organization.

As previously mentioned, the results for cloud computing were mixed. While a majority of participants rated cloud service importance as remaining or increasing, we still found 37% participants rating these services as reducing in importance. This may be a result of the participant's role not being directly impacted by cloud services. Another explanation may be the employee's organization as some of the organizational types are not known to use cloud services.

## 8. FUTURE RESEARCH AND REMARKS

Future research includes expanding the technologies surveyed and including additional employers. While there are numerous emerging technologies (especially in areas such as cloud services), we limited the technologies in the survey to those identified by the advisory board. There are additional areas we would like to query in future surveys including social media and data analytic products. Social media adoption within the organization has potential

impacts (see Cummings, 2013 for social networking adoption) so understanding the widespread use of technologies would be beneficial. Also, our data primarily came from the east coast so future research may include partnerships with organizations to include a variety of participants throughout the country.

One limitation to the survey was that the participant mailing list included a large number of supervisors/managers which were not directly asked questions on anticipated use. Future surveys will include these individuals for comparison purposes to examine what employees anticipate as important compared to their supervisors/managers. Another limitation concerned the cloud services surveyed. The survey focused on specific cloud services (e.g. vendors) without discussing cloud offerings in general. Future research is needed asking general questions concerning cloud services (software-as-a-service) to understand their importance beyond vendor specific offerings. Lastly, while the current research focuses on technology used by IT/IS professionals, we would like to evaluate the impact of technological changes on IT curriculum. In order to meet industry expectations going forward, the academic environment needs to prepare graduates by updating the curriculum and skills of their faculty (Medlin et al., 2007). Furthermore, it touches on the question of what role should higher education play in IT skills. Should we move towards specific products and certifications, because of their high perceived value on graduates' resumes? Or do we focus on fundamental skills that are not product-specific and let organizations train graduates in the products that they use?

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## APPENDIX A

### Sample Survey Page

Please indicate what technologies you are currently using and your expected change in importance of these technologies.

#### PLATFORMS

| Item              | Currently Used                                     | Expected Importance to your Job in 2 Years  |
|-------------------|--|---|
| Windows Family    | <input type="radio"/> Yes <input type="radio"/> No | <input type="radio"/> Extremely <input type="radio"/> More <input type="radio"/> Same <input type="radio"/> Less <input type="radio"/> Not at All |
| Linus/Unix Family | <input type="radio"/> Yes <input type="radio"/> No | <input type="radio"/> Extremely <input type="radio"/> More <input type="radio"/> Same <input type="radio"/> Less <input type="radio"/> Not at All |
| MacOS             | <input type="radio"/> Yes <input type="radio"/> No | <input type="radio"/> Extremely <input type="radio"/> More <input type="radio"/> Same <input type="radio"/> Less <input type="radio"/> Not at All |
| iOS               | <input type="radio"/> Yes <input type="radio"/> No | <input type="radio"/> Extremely <input type="radio"/> More <input type="radio"/> Same <input type="radio"/> Less <input type="radio"/> Not at All |
| Android           | <input type="radio"/> Yes <input type="radio"/> No | <input type="radio"/> Extremely <input type="radio"/> More <input type="radio"/> Same <input type="radio"/> Less <input type="radio"/> Not at All |

#### NETWORKING

| Item                        | Currently Used                                     | Expected Importance to your Job in 2 Years  |
|-----------------------------|--|---|
| Windows                     | <input type="radio"/> Yes <input type="radio"/> No | <input type="radio"/> Extremely <input type="radio"/> More <input type="radio"/> Same <input type="radio"/> Less <input type="radio"/> Not at All |
| Cisco                       | <input type="radio"/> Yes <input type="radio"/> No | <input type="radio"/> Extremely <input type="radio"/> More <input type="radio"/> Same <input type="radio"/> Less <input type="radio"/> Not at All |
| Linux/UNIX                  | <input type="radio"/> Yes <input type="radio"/> No | <input type="radio"/> Extremely <input type="radio"/> More <input type="radio"/> Same <input type="radio"/> Less <input type="radio"/> Not at All |
| Virtualization Technologies | <input type="radio"/> Yes <input type="radio"/> No | <input type="radio"/> Extremely <input type="radio"/> More <input type="radio"/> Same <input type="radio"/> Less <input type="radio"/> Not at All |
| VOIP                        | <input type="radio"/> Yes <input type="radio"/> No | <input type="radio"/> Extremely <input type="radio"/> More <input type="radio"/> Same <input type="radio"/> Less <input type="radio"/> Not at All |

**APPENDIX B**

**Technology Area Survey Results for Expected Importance**

