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Entry Level Technology Positions: No Degree Required

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ABSTRACT

Employers demand for skilled technology workers has never been higher. Opportunities for individuals interested in working in technology to acquire the requisite skills have expanded to meet the increased demand. The expansion of training offerings calls into question the quality of new ventures such as coding academies and the necessity of traditional academic pathways. This research addresses concerns by exploring how employers value different forms of skill acquisition within the information technology environment defined as: academic degrees, certifications, and work experience. IT executives and HR managers surveyed give insight into how they relatively value the various sources for their new and experienced employees. Using non-parametric methods and correspondence analysis, an overall picture of employers' valuations were obtained. Additionally, subsections were analyzed across employer size and industry type. Results from the analysis identified expected general valuations by the employers. However, employer responses to the valuations identified unexpected actions that have potential negative impacts on institutions of higher education.

Keywords: Job skills, Employment skills, Work experience, Certifications, Academic degree

1. INTRODUCTION

Demand for technology workers has never been higher. New advances such as cloud computing, mobile applications, the Internet of Things, and increased requirements for IT security professionals have resulted in increased demand without an accompanying increase in supply for IT professionals.

From the fall of 2000 through the spring of 2015, academic institutions have graduated over 765,000 students in the field of computer and information sciences (Snyder et al., 2016). Over that same period of time, over 1,445,000 computing related jobs have been created (BLS occupation code 11-3021 and OES occupation code 15-0000). Who filled the remaining 680,000 positions, and how did they obtain the skills to perform those jobs?

While a significant amount of research has been written evaluating the ever-changing prospective employee skill sets associated with expanding technology, no one has looked at how employers value the source of those skill sets. The authors believe that, while valuable and informative, focusing on granular skills fails to adequately address actual employer hiring priorities, and therefore employee suppliers, such as institutions of higher learning, may not be providing the appropriate skills. For example, are employers more interested in academic degrees or certifications? Is an academic degree required to get an entry level position? How important is experience if you are looking for an entry level position?

This becomes increasingly important as the options for obtaining entry level technology skills increase. The failure of academic institutions to meet the labor needs of technology firms has resulted in the creation of alternative programs including but not limited to: for profit schools, coding academies, and online non-academic programs, just to name a few.

As the number of options for obtaining technology skill sets increases, it becomes necessary to understand how employers view these alternatives. That being said, few have ventured into this area of research. To address this gap in the literature, this research looks at how employers value the different methods for acquiring technology skills by identifying and analyzing three primary sources of high level skill categories: Academic Degrees, Certifications, and Work Experience. Further the authors posit that the value technology employers place on these higher-level skill categories does not align with perceived popular expectations.

The remainder of this paper consists of a literature review of entry-level career development and job skill literature in the IT field followed by the research methodology. An analysis of the results is then presented focusing on the individual entry-level skill categories of academic degrees, certifications, and work experience. The paper concludes with a comparison of the three categories as they relate to how employers value entry level skills, a summary of findings, and recommendations.

2. LITERATURE REVIEW

One of the most common complaints from those seeking entry level employment is, "How can I get the experience they require if they won't hire me to get the experience?!" By itself, this statement illustrates the desirability employers place on experience. However, the majority of employment literature, while exceptionally broad, fails to address this specific topic.

In general, the common areas of study are exhibited by literature such as Tesone and Ricci (2005), who studied the preferred entry-level attributes within the lodging and restaurant sectors; Hu (2003), who looked at the hiring practices of large firms as compared to small firms; Hansson (2009), who performed a comprehensive analysis on employers' perspectives on human capital development; and Hoffman et al. (2013), who looked at the employment compact between employers and employees.

The findings of these authors are interesting and applicable within their narrow application. However, their results focus at the granularity of individual skills, most often the skills associated with formalized learning within their respective corporate areas of focus. Additionally, in many cases, the results are not necessarily generalizable over time. As industries and technologies change, the types of jobs and how jobs are performed change; therefore, the associated skills for those jobs change. This results in a needed re-evaluation of the narrow level skill requirements on a regular basis, such as: Nelson (1991), Todd et al. (1995), Cappel (2001), Prabhakar et al. (2005), and Aasheim et al. (2012).

This circumstance applies even more to the ever-changing field of Information Technology (IT). A considerable body of knowledge has evolved since Cheney and Lyons (1980) first looked at IT skill requirements as defined by information system (IS) managers at 32 large organizations. Their study identified a ranked importance of 26 specified IT related skills including: Job Control Languages, Minicomputer Characteristics and Uses, Computer Scheduling, List Processing, and Sorting. Many of these 'skills' are foreign language to today's entry level IT candidate or are unstated, expected knowledge sets for today's employers.

Since that time, and recognizing the volatile and ever-expanding nature of the IT industry, researchers have continued to evaluate the constantly changing skill requirements of the IT industry. Some of the more noteworthy examples include: Nelson (1991), Todd et al. (1995), Cappel (2001), Prabhakar et al. (2005), and Aasheim et al. (2012). This literature primarily focuses on the unique and individual skill sets desired by employers, but does not address the source of those skills or how employers perceive the value of those sources.

3. METHOD

In 2012, an anonymous survey was electronically distributed to a sample of 33,863 businesses. The survey was targeted to the head of the company's IT department and/or the HR recruiting manager in charge of hiring IT personnel.

The survey sample was obtained using the Orbis database and consisted of all businesses that have a presence in North America and had provided an e-mail address.

As an enticement to complete the survey, three weekly drawings were conducted from the collective pool of participants having completed the survey thus far. In essence, the sooner they completed the survey, the probability of winning was higher. Each drawing awarded the winner a Visa Gift Card valued at $150.

A total of 540 responses were received of which 342 were usable. This resulted in a response rate of 1%. A low response rate was not unexpected. E-mail addresses that are made publicly available are subject to several issues. A majority of such e-mails are typically associated with sales or support contacts. The introduction to the survey attempted to address this issue by asking the reader, if they were not the intended recipient, to forward the request to the appropriate target. The survey also provided a contact number and e-mail address if they had any questions concerning the survey, resulting in numerous contacts being made to verify the nature of the survey.

Another issue associated with public e-mail addresses is the lifespan of its activation. While the data provided by the Orbis database is continuously updated, maintenance of the active e-mail addresses is subject to the willingness of companies to provide accurate data. While a specific count of the inactive accounts was not kept, a significant number of e-mail addresses in this survey were no longer active.

Finally, instances where companies are no longer in business or e-mail addresses are active, but no longer maintained, also exist. The number of these are impossible to determine as any e-mails submitted to these addresses are received but not responded to, much like active e-mails where the receiver chooses not to respond to the survey request.

Taking these issues into account, the 1% response rate under-represents the actual response rate, and the 342 responses rank this research as one of the largest sample bases for this type of research.

The survey instrument consisted of 11 questions and is provided in the Appendix.

Various methods were used to identify dependence among variables. Non-parametric methods (i.e., $\chi 2$ Test, Fisher Exact Test) were used to analyze categorical responses (i.e., size of the company and type of company). Correspondence analyses were used to identify the nature of the dependence among variables. Simple correspondence analysis is a method used to analyze frequencies formed by categorical data in two-way tables (Greenacre, 2017). Multiple correspondence analysis (MCA) is a generalization of simple correspondence analysis where the correspondence analysis is performed on frequency tables that are greater than two dimensions. This type of analysis can be thought of as the analysis of all two-way cross-tabulations among categorical variables (Camiz and Gomes, 2013; Greenacre, 1988, 2017).

To visualize the joint correspondence analysis (JCA), symmetric maps are used. A symmetric map is a low-dimensional display of a data matrix. In a symmetric map, both rows and columns are represented in the same space using the principal coordinates. These coordinates represent the row and column profiles (Greenacre, 2007).

4. ANALYSIS

4.1 Description of the Sample

The respondents were classified into five levels: top-level managers such as CIO, CTO, or Vice-President of IT; mid-level managers such as IT Director; area managers such as project managers or operations managers; non-managers such as programmers, administrators, or developers; and finally, human resources related positions.

Demographic data was captured to measure the position that the respondent holds within the company, the size of the company they represent, and the type of company.

The respondents to this survey were mostly top-level and mid-level managers, representing 36.84% and 35.67%, respectively. The human resources (HR) respondents represent 21.35% of the sample. The remaining 6.14% were low-level managers or non-managers. Therefore, most respondents were either senior level IT managers or from HR. This implies that the questionnaire reached the intended target respondent successfully. Additionally, over 75% of the respondents were directly associated with senior level IT department managers who have the direct knowledge associated with the focus of the survey.

External sources were consulted to define the organizational size classifications used. The US International Trade Commission (USITC) defines small and medium organizations as less than 500 employees (U.S. International Trade Commission (USITC, 2010). Size standards are also broken down by the North American Industry Classification System (NAICS) and are based on two things: size in millions of dollars and number of employees. For most industries, 500 employees are the maximum for the small business classification; although, there are industries where a business can have 1,000-1,500 employees and still be considered a "small business."

For purposes of this research, organization size is defined as "small" (<100 employees), "medium" (100-499 employees), and "large" (500+ employees). The distribution of respondent size in this sample is weighted toward medium sized businesses with 41.64%, followed by large businesses at 29.91% and small businesses at 28.45%.

In addition to respondent type and company size, type of industry was also requested. Specifically, the authors were interested in how the amount of technology associated with a business could influence the results. The use of industry standard industrial classification (SIC) codes does not identify technology-based organizations specifically. Single digit codes are often very broad and do not permit easy separation of technology companies from non-technology companies. As one increases the granularity of the SIC codes to four or five digits, the ability to identify unique technology-based companies improves; however, at a cost of diluting the sample size per industry.

To address these concerns, the authors chose to identify six different industry categories and allow the respondents to self-identify. They are presented with their associated representation in the sample: Private Non-Technology firms represent the majority of the firms with 35.67%, with Private Technology and Public Non-Technology equally represented at 17.54% each. Government has the smallest representation with just over 7.32% of the respondents.

4.2 Entry-Level Skills

This study considers three general categories for obtaining a skill: academic degrees, certifications, and experience. Academic degrees include any accredited degree granting institution and is most commonly associated with both two-year and four-year public and private colleges and universities. Certifications include non-accredited organizations that certify a person having achieved a specified level of competency for a specific skill or task as determined by the governing certifying body. Experience includes any means of obtaining a specific skill through participation and observation of the associated skill activities.

The survey instrument asked a series of questions covering each of the three skill categories. The survey analysis is organized below, first by individual category analysis and then by comparison of the three categories.

4.2.1 Academic degree requirements: The respondents were asked if, when hiring entry-level personnel for the IT department, their company requires the applicant to have an academic degree and, if so, what level of degree.

As illustrated in Figure 1, most of the respondents (53.22%) answered that their company does not require an academic degree for a person to be hired for an entry-level IT job. The remaining (46.78%) stated that their company does require some kind of academic degree – associate degree (19.3%), bachelor degree (23.68%), or other (3.8%). The most common types of degrees mentioned as required were: computer science, IT, or management information systems (MIS).

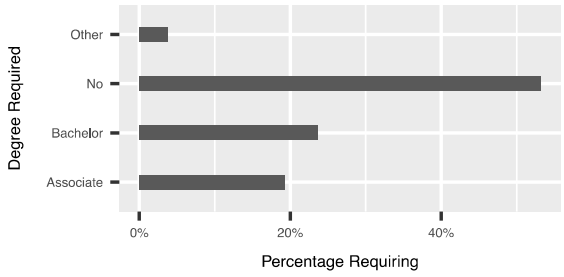

Figure 1. Degree Requirements

To complement questions on how employers value academic degrees, they were also asked about the actual percentage of employees that hold college degrees. The expectation being that there should be some kind of correlation between what is required and the actual composition of the IT work force. An analysis of the results found that 25.97% of the respondents answered that 100% of their employees have a college degree. And, 35.52% of respondents answered that 90% or more of their employees have a college degree. Further, 53.13% of the respondents indicated that 75% or more of their employees have a college degree.

Additional analysis on the demand for academic degrees was done against company size and type, in order to explore if these variables are related to the demand for skills. This type of analysis is lacking from the majority of the IT skills literature. Simon et al. (2007) and McMurtrey et al. (2008)

are notable exceptions. For purposes of this analysis, the academic degree types were aggregated into a single measure (degree: yes or no). This resulted in an overall distribution of (53.37%) requiring a degree and (46.63%) not requiring a degree.

When analyzing by size, the figures show that the proportion of respondents having no degree requirement fluctuates around 50% for all sizes (i.e., 0-99: 55%; 100-499: 57%; 500+: 47%). A statistical comparison indicates that industry size is independent from degree requirements (see Table 1, $\chi 2 = 2.4648$, df = 2, p-value = 0.2916). This result fails to corroborate the results of Simon et al. (2007).

	Degree: No	Degree: Yes	Total
Size: 0-99	15.54	12.90	28.45
Size: 100-499	23.75	17.89	41.64
Size: 500+	14.08	15.84	29.91
Total	53.37	46.63	100.00

Table 1. Percentage of Degree Requirements by Size of Company

An analysis of variance (type III) did not find a statistical difference between the mean proportions of employees holding an academic degree by company size. Therefore, the proportion of employees who hold an academic degree is independent from the size of the company (F = 0.374, df1 = 1, df2 = 2, p-value = 0.6881).

About half of the respondents indicated that 75% or more of their IT employees held a college degree, regardless of company size. Also, the percentage of IT employees having a college degree is similar across company size.

There is a noticeable discrepancy when comparing the composition of current employees having academic degrees to the expressed requirements for entry-level employees to have degrees (Table 1). Over 50% of respondents identified that no academic degree is required, and yet over 75%, on the average, of current employees have academic degrees. This dichotomy may exist because, while employers do not require academic degrees, they in fact value them. This issue will be explored further in the manuscript.

In addition to size, an analysis was also performed by industry type. Similar to the analysis by size, industry requirements show that most respondents for the majority of the industry segments also do not require academic degrees (Table 2). Also, similar to the analysis by size, a statistical comparison between the distributions of degree requirements did not reveal enough evidence of a relationship between the type of industry and degree requirements from entry level applicants (see Table 2, $\chi 2 = 3.5126$, df = 5, p-value = 0.6215).

	Degree: No	Degree: Yes	Total
Government	4.39	2.92	7.31
Private Technology	7.89	9.65	17.54
Private Non-Technology	19.59	16.08	35.67
Public Technology	3.80	4.39	8.19
Public Non-Technology	9.36	8.19	17.54
Other	8.19	5.56	13.74
Total	53.22	46.78	100.00

Table 2. Percentage of Degree Requirements by Type of Industry

The distribution of responses reveals the tendency for companies to have IT personnel who have academic degrees, as evidenced by all categories second quartile starting near 50%, with the exception of "Other" which starts at 35.75%.

The private technology sector distinguishes itself from the rest by having the least amount of variability in responses, and 51.67% of the private technology companies reported that at least 90% of their IT employees have academic degrees. Comparatively, with the exception of "Other" industries, the remaining categories all have comparable variability and median values. The larger variability in responses from "Other" is expected since this category agglomerates companies of diverse types.

An analysis of variance (type III) reveals that Private Technology companies' mean proportion of IT personnel holding academic degrees is statistically significantly different from the mean proportion in Public Non-technology companies (F = 2.502, df1 = 1, df2 = 5, p-value = 0.0305; Tukey HDS(PvtTech−PubNon-Tech) p-value = 0.0235). The mean proportion of employees holding academic degrees is larger for Private Technology companies.

When both factors, size of the company and type of industry, are considered together as they relate to the requirements for an academic degree for entry-level jobs, the evidence suggests that the size of the company, the type of industry, and the requirement for an IT degree at the entry-level are not independent from each other (Likelihood Ratio = 42.9212, df = 27, p-value = 0.0266).

The symmetric map displayed in Figure 2, reveals the nature of the relationships among the three variables of: size of the organization (S), the industry classification (I), and requirements for an IT related degree for entry-level IT jobs (D).

According to the JCA, Private and Public Technology companies located in the bottom left quadrant, and Other companies, located in the top left quadrant, tend to be smaller as indicated by the closer angular positioning of their respective arrow vectors to that of the size (S:0-99) vector. Private and Public Technology companies, however, are more likely to require an academic degree and "Other" companies do not. This is evidenced by their vector positions relative to the requires-an-academic-degree (D:No) vector and the requires-an-academic-degree (D:Yes) vector.

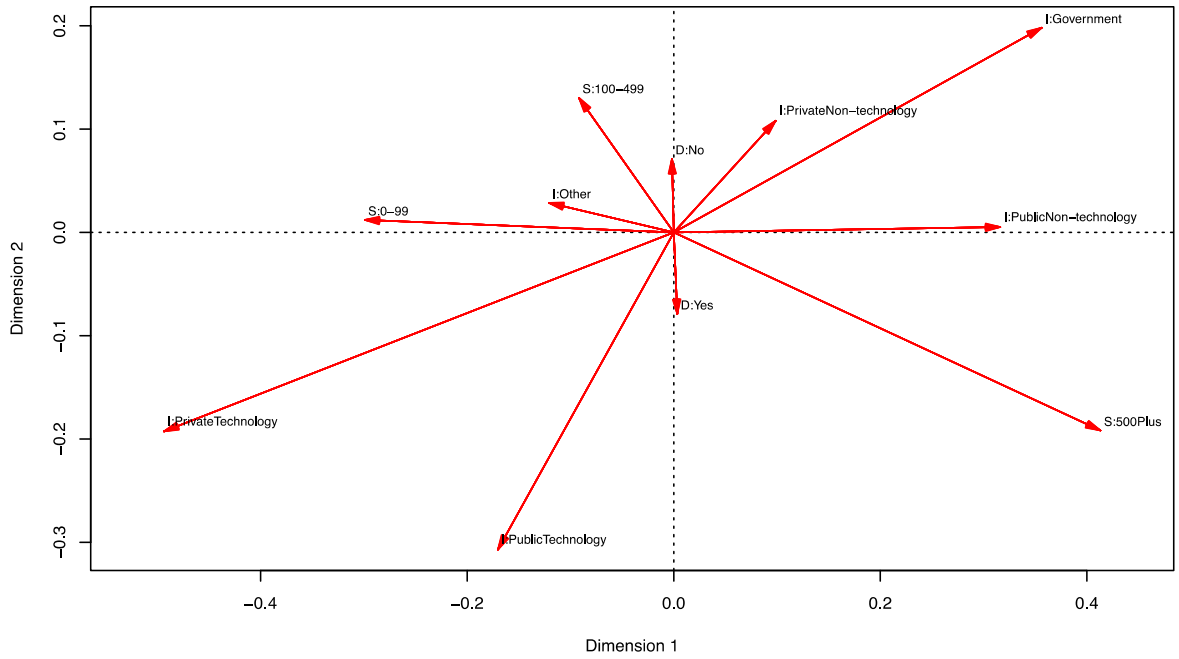

Figure 2. Relationship between Type of Industry, Requirement of an IT Degree, and Size of Company

Applying this analysis to the remainder of the relationships shows that Private Non-technology and Government institutions tend not to require academic degrees.

The evidence suggests that the value employers have for academic degrees is limited. Private and Public Technology firms, both identified as small in size, are the only firm types that tend to require academic degrees. The remaining company types, with the exception of Public Non-technology firms, small or large, do not require academic degrees when hiring an entry level IT position.

4.2.2 Certifications: Of the three skill sets identified in this research (i.e., academic degrees, certifications, and work experience), the literature on certifications is the deepest. As far back as 1981, Sopka (1981) promoted certification in the field of computing. He identified certifications specifically as an effective means of recognizing attainment of a level of excellence in knowledge in the IT field. In a non-scientific study, Gabelhouse (2001) asserts that, of respondents to a Certification Magazine survey, 53% received a raise in the first year of attaining their primary certification and the first-year ROI was 2.3 to 1 for the employees.

Cegielski (2004), in a technical opinion piece in *Communications of the ACM*, commented that certification value depends on who is doing the hiring. Hitchcock (2005) concluded that a certification is a valued credential that provides competent knowledge, attitude, and some skill that provides qualification for gaining experience. In their white paper, Anderson and McStravick (2006) determine that certification improves team skill, which increases team performance, which increases organizational performance. Finally, Wierschem et al. (2010) surveyed 144 university IT departments to determine the value of IT certifications. Their findings showed that, based on a willingness to fund certification activities, 69% of the IT departments in the sample valued certifications. However, only 45% required or expected employees to have certifications or to obtain them.

While academic degrees are widely viewed as the academic contribution to employment, in the technology field, certifications provide another acceptable means for formal training. Not as broad nor as time consuming, certifications provide targeted and focused, deep level understanding and knowledge of subjects. Often times, these subjects are product or company specific such as Cisco's series of network certifications or Microsoft's certifications. Others are more focused on targeted areas of expertise, for example Security+, Network+, or ICSSP for security.

To determine the employers' perspective of certifications on entry-level employees, respondents were asked a series of questions regarding certifications. They were asked if their firm requires certifications from their entry-level job applicants, what percentage of their current employees hold at least one certification, and if they expect employees to pursue certifications.

	Percentage
No	84.80%
Yes	15.20%
Total	100.00%

Table 3. Companies Requiring Applicants to have Certifications

When asked if employers require entry-level applicants to have certifications (Table 3), 84.80% of the respondents stated that their company does not require any IT certification for hiring at the entry level. Of the 15.20% that do require certifications, the most common types of certifications they look for were: A+, Cisco, and Microsoft.

They were then asked what percentage of their current employees held certifications. Analysis found that 25.5% of respondents indicate that 90% or more of their employees have certifications. This is 10% higher than the percentage of those that require entry level applicants to have certifications (15.20%). Additionally, 19.81% indicate that 100% of their employees have certifications. Further, 67.3% of the respondents indicated that 50% or more of their employees have a certification.

Respondents were also asked if there is an expectation that current employees should pursue certifications. The results are presented in Table 4. Of special note is that 42.69% of respondents expect employees to pursue certifications, but only 15.20% require them of applicants.

	Certification
Don't Know	5.85%
No	51.46%
Yes	42.69%
Total	100.00%

Table 4. Percentage of Respondents that Expect Employees to Pursue Certifications

As with academic degrees, certifications were also analyzed relative to size and industry category. The analysis by size did not reveal statistically significant dependence between certification requirements and the size of the company (Table 5: $\chi 2 = 1.082$, df = 2, p-value = 0.5822). As with the analysis by academic degree, the analysis of the proportion of IT employees who have at least one certification, by size (Figure 3), did not reveal a statistically significant difference among the company sizes (F = 0.46, df1 = 2, df2 = 314, p-value = 0.6294).

	Degree: No	Degree: Yes	Total
Size:0-99	24.93%	3.52%	28.45%
Size:100-499	35.19%	6.45%	41.64%
Size:500+	24.63%	5.28%	29.91%
Total	84.75%	15.25%	100.00%

Table 5. Percentage of Certification Requirements, by Size of Company

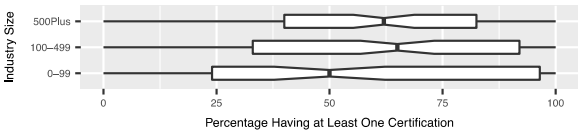

Figure 3. Percentage of Employees Holding at Least One Certification, by Size

However, it should be noted that the variability in the distribution of the percentages of employees having at least one certification decreases as the size of the company increases. Table 6 presents the breakdown of the expectation for employees to pursue certifications, by size.

	Don't Know	Pursue: No	Pursue: Yes	Total
Size:0-99	1.76%	15.54%	11.14%	28.45%
Size:100-499	1.17%	22.29%	18.18%	41.64%
Size:500+	2.93%	13.49%	13.49%	29.91%
Total	5.87%	51.32%	42.82%	100.00%

Table 6. Percentage of Employees Expected to Pursue Certification, by Size of Company

The analysis by size did not reveal a statistically significant dependence between certification expectation and the size of the company (Table 7: $\chi 2 = 1.082$, df = 2, p-value = 0.5822). Certification analysis by industry type gives similar results. Like the analysis by size, not enough evidence was found that the proportion of companies requiring IT certifications from their entry level IT personnel depends on the type of company (Table 7: $\chi 2 = 8.2052$, df = 5, p-value = 0.1453).

The analysis of the proportion of IT employees who have at least one certification by industry did not reveal a statistically significant difference among types of industry (F = 0.49, df1 = 5, df2 = 312, p-value = 0.7843).

	No	Yes	Sum
Government	5.85%	1.46%	7.31%
Other	10.53%	3.22%	13.74%
PrivateNon-technology	32.16%	3.51%	35.67%
PrivateTechnology	14.62%	2.92%	17.54%
PublicNon-technology	14.04%	3.51%	17.54%
PublicTechnology	7.60%	0.58%	8.19%
Total	84.80%	15.20%	100.00%

Table 7. Percentage of Certification Requirements, by Type of Company

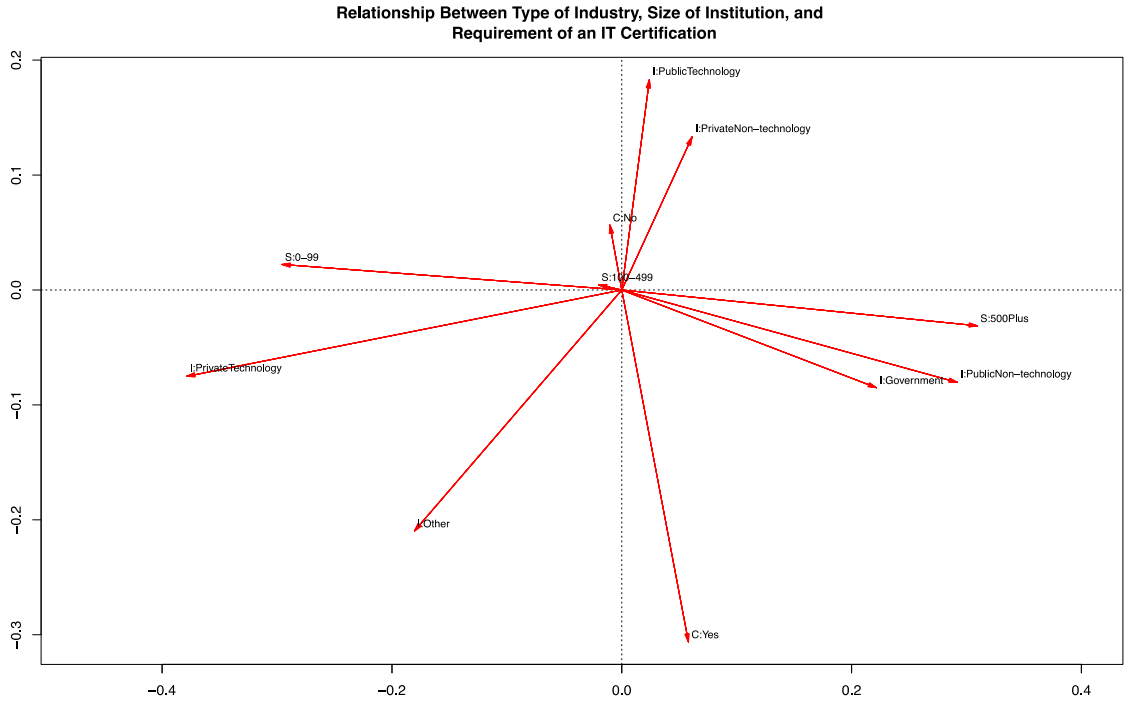

Figure 4. Relationship between Type of Industry, Requirement of an IT Certification, and Size of Company

	Pursue: No	Pursue: Yes	Don't Know	Total
Government	0.29%	3.51%	3.51%	7.31%
Other	1.46%	7.31%	4.97%	13.74%
PrivateNon-technology	2.34%	20.76%	12.57%	35.67%
PrivateTechnology	0.29%	7.60%	9.65%	17.54%
PublicNon-technology	0.58%	9.06%	7.89%	17.54%
PublicTechnology	0.88%	3.22%	4.09%	8.19%
Total	5.85%	51.46%	42.69%	100.00%

Table 8. Percentage of Expected to Pursue Certification, by Type of Company

Like the analysis by size, the analysis of the mean proportion of the expectation of employees pursuing IT certifications did not find a dependence among various types of companies (Table 8: $\chi 2 = 13.1821$, df = 10, p-value = 0.2137).

The possibility that the requirements for professional IT certifications for entry-level jobs could depend on both the size of the company as well as on the type of industry.

The evidence found suggests that, again similar to the analysis of academic degree, the relationship among the three variables is significant ($\chi 2 = 49.0709$, df = 27, p-value = 0.0058). The nature of the relationship found is illustrated in the symmetric map (Figure 4).

The symmetric map in Figure 4 illustrates that Public Technology and Private Non-technology firms tend not to require certifications as indicated by the close alignment of their arrows to that of the certification required (C:No) arrow. Conversely, Public Non-technology, Government, and Other tend to require professional IT certifications for entry-level jobs; however, the tendency is much less intense. Public Non-technology and Government also show a tendency to be large companies. Private Technology and Other are more closely aligned with small companies.

The possibility of an effect and interaction between the size of the company and the type of industry on the percentage of employees having a professional IT certification was then considered. An analysis of variance (type III) did not reveal any statistically significant relationship among the size of the company, type of industry, or the interaction between the two.

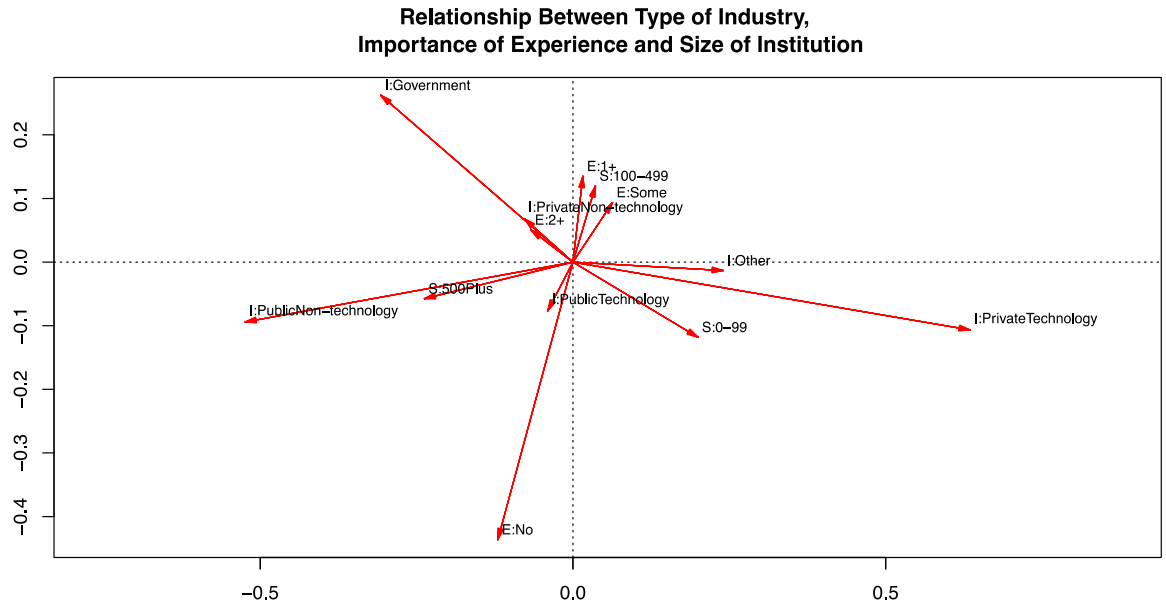

Figure 5. Relationship between Type of Industry, Importance of Experience, and Size of Company

	Experience
1+	20.41%
2+	16.04%
No	17.78%
Some	45.77%
Total	100.00%

Table 9. Percentage of Firms Requiring Applicants to have some Level of Experience

	None	Some	Year: 1+	Year: 2+	Total
Size:0-99	6.16	12.61	4.40	5.28	28.45
Size:100-499	4.69	20.23	10.26	6.45	41.64
Size:500+	7.04	13.20	5.87	3.81	29.91
Total	17.89	46.04	20.53	15.54	100.00

Table 10. Amount of Experience Required, by Size of Company

4.2.3 IT work experience requirements: The respondents were asked if their company requires entry-level job applicants to have work experience in the IT field. As illustrated in Table 9, most of the respondents, 45.77%, required "some" experience, which in this study is defined as IT work experience of less than a year. Likewise, 16.04% of the respondents stated that their company requires two or more years of work experience in the IT field.

Those respondents who require absolutely no experience were 17.78%. Therefore, an overwhelming proportion of the respondents, 82.22%, acknowledged that work experience in the IT field is required from their entry-level jobs applicants, ranging from some experience to more than two years.

Next, the possible differences in work experience requirements due to company size were considered (Table 10). A statistical comparison between the distributions of work experience requirements across companies of different sizes did not show significant statistical evidence, indicating that company size is dependent on experience requirements ($\chi 2 = 9.9142$, df = 6, p-value = 0.1283).

Of special note is that, while all companies identify some experience as the majority, the small and large companies identify no experience ("None") as their second highest. Medium sized firms identify 1+ (i.e., one year or more, but less than two) years of experience as their second highest. A similar analysis was performed considering the possible differences in work experience requirements by the type of industry. Again, not enough statistical evidence of a dependence between type of industry and IT work experience requirement was found ($\chi 2 = 21.0368$, df = 15, p-value = 0.1357). Of all the industries, only two, Private Technology and Public Non-technology, rank no experience second to some experience. The others, with the exception of Government, rank 1+ years of experience next. Government ranks 2+ years of experience second.

If we consider the requirements for entry level IT applicants to have IT work experience, together with the size of the organization and the type of industry, similar to academic degree and certifications, there is evidence of dependence (Likelihood Ratio = 113.4072, df = 61, p-value < 0.0001).

The symmetric map presented is the result of a JCA for the variables: organization size, industry classification, and requirements for IT experience for entry-level IT jobs (Figure 5).

The symmetric map reveals that mid-size companies (S:100-499) are strongly correlated to require at least up to 1 year of experience as indicated by the close alignment of the respective arrows. Government and Private Non-technology are strongly correlated to require two or more years of IT work experience for entry-level jobs as indicated by the close alignment of their respective arrows. Public Technology companies are strongly correlated with no experience requirements. Private Technology and Other companies tend to require some experience for IT entry-level jobs, but at a very low intensity as indicated by the degree of non-alignment of the respective arrows. Additionally, small companies are likely to have no experience requirements but also at very low intensity levels.

4.2.4 Importance of academic degree, certifications, and experience: The relative overall importance of having an academic degree, certifications, and work experience for an entry-level job are now compared together. This study considers the existence of an ordering of importance for experience, academic degrees, and professional certifications for entry-level job considerations. Respondents were asked to weight the relative value of each of the categories by assigning a relative percentage with the total of all three adding up to 100%. For example, a typical response could be: Experience 50%, Academic Degree 30%, and Certification 20%; thus, denoting work experience as more important than academic degree and academic degree as more important than certifications.

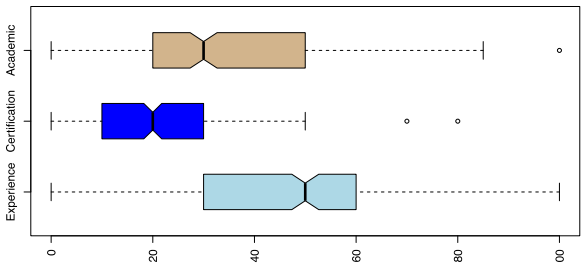

Figure 6. Relative Importance of Academic Degree, Certifications, and Work Experience

In general, experience was identified to be the most important criterion for an entry-level job selection (Figure 6). A statistical comparison of the median (Kruskal-Wallis Test) relative importance score reveals that there are statistically significant differences among all three scores. Work experience is considered to be relatively more important than academic degrees and professional certifications (KW $\chi 2 = 262.84$, df = 2, p-value < 0.0001). Likewise, the mean (and median) percentages for academic degrees are statistically significantly larger than the ones for certifications, and the ordering is evident: certifications < academic degrees < work experience.

While Figure 7 illustrates the higher value that employers place on experience over both academic degrees and certifications, it is interesting to note that academic degrees are skewed upward toward increased value, and experience is skewed downward toward a decreased value.

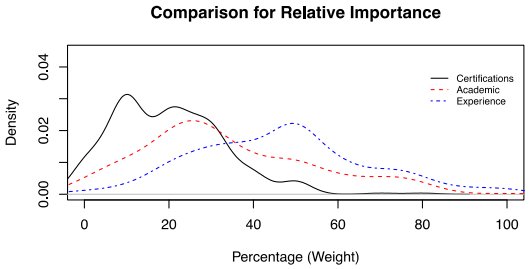

Figure 7. Relative Importance of Academic Degree, Certifications, and Work Experience

Valuation of certifications on the other hand is less diverse and on the lower percentages. This may indicate a broader relative valuation between academic degrees and experience directly or a dependency on other factors.

Figure 8 presents a more detailed inspection of the profiles of relative importance analyzed by company size. Each plot is a density plot where the horizontal axis represents the percentage reported by respondents and the vertical axis is the density.

As illustrated, there is minimal difference between the weighting distributions of relative importance based on company size. That is, the general ordering (certification < academic degree < work experience) seems the same for all company sizes. This fails to support the results found by Simon et al. (2007). Each frame illustrates that certifications peak lower than academic degrees, and both academic degrees and certifications peak below than work experience. The higher the peak the more concentrated the number of responses for that value. With the exception of medium sized companies, academic degrees peak slightly higher than experience.

Additionally, the certification distribution is much more concentrated at the lower range. This implies that respondents were in more agreement as to the valuation of certifications relative to academic degrees and experience, while academic degrees and experience have a broader spread as compared to certifications. This indicates a much more diverse valuation of experience relative to certification and academic degree. However, work experience peaks at approximately the 50% mark for all company sizes.

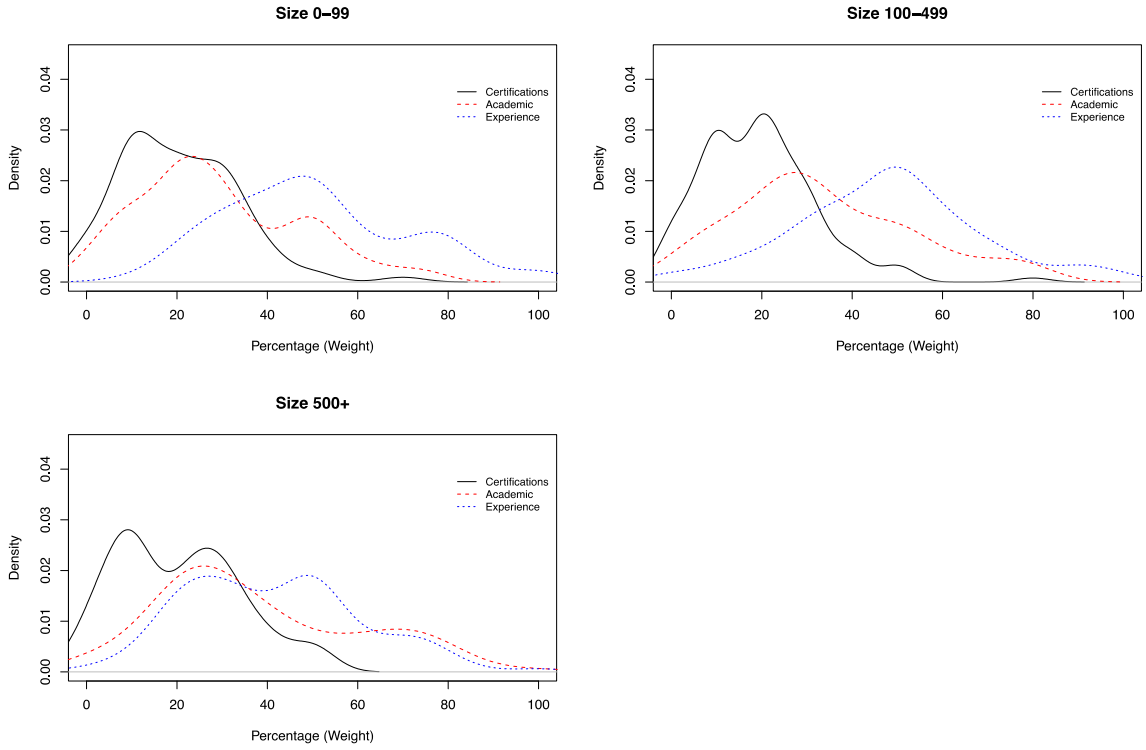

Figure 8. Relative Importance of Academic Degree, Certifications, and Work Experience, by Size

Figure 9 presents a more detailed inspection of the profiles of relative importance analyzed by type.

Unlike for company size, there are some unique characteristics for industry type. Certifications peak at a lower value (i.e., respondent relative importance) than academic degrees and experience in every industry, except Public Non-technology where certifications peak at the same level as academic degrees. Certifications also have the highest peaks (i.e., highest concentrations) in every industry except for Public Technology. Public Technology companies demonstrate a concentrated relative importance of experience above both certifications and academic degrees.

Public Technology has a strong valuation of experience at 40% (mode) with certifications and academic degree distributions much more broadly dispersed. This implies that, on average, Public Technology respondents have a much stronger valuation toward experience and see academic degrees and certifications as more interchangeable. Still, they value academic degrees higher than certifications as the academic degree distribution peaks at a level higher than certifications.

Of the three categories, academic degrees show the most consistent structure. With the exception of the "Other" companies, academic degree peaks between 25% and 35%, and it is skewed to the right. Experience consistently peaks to the right of both certifications and academic degrees indicating, as with size, its higher valuation by the respondents.

Government have the least concentrated (lowest peak) distribution for all three categories. This could indicate a higher acceptance of substitution between the three categories.

Other companies have the most distinct separation for the value of academic degree as compared to experience with experience much higher. Private and Public Non-technology firms are similar, and both have distinct peaks for academic degree and experience value with experience more valued than academic degrees.

4.2.5 Supported acquisition of formal education: Up to this point, employer valuation has been studied based upon survey respondent perceptions. A more concrete method to determine how companies value formal education is to measure their financial contribution to obtaining such education after they have been employed. To that end, questions were asked regarding if the companies provided financial support for the acquisition of academic degrees and/or certifications.

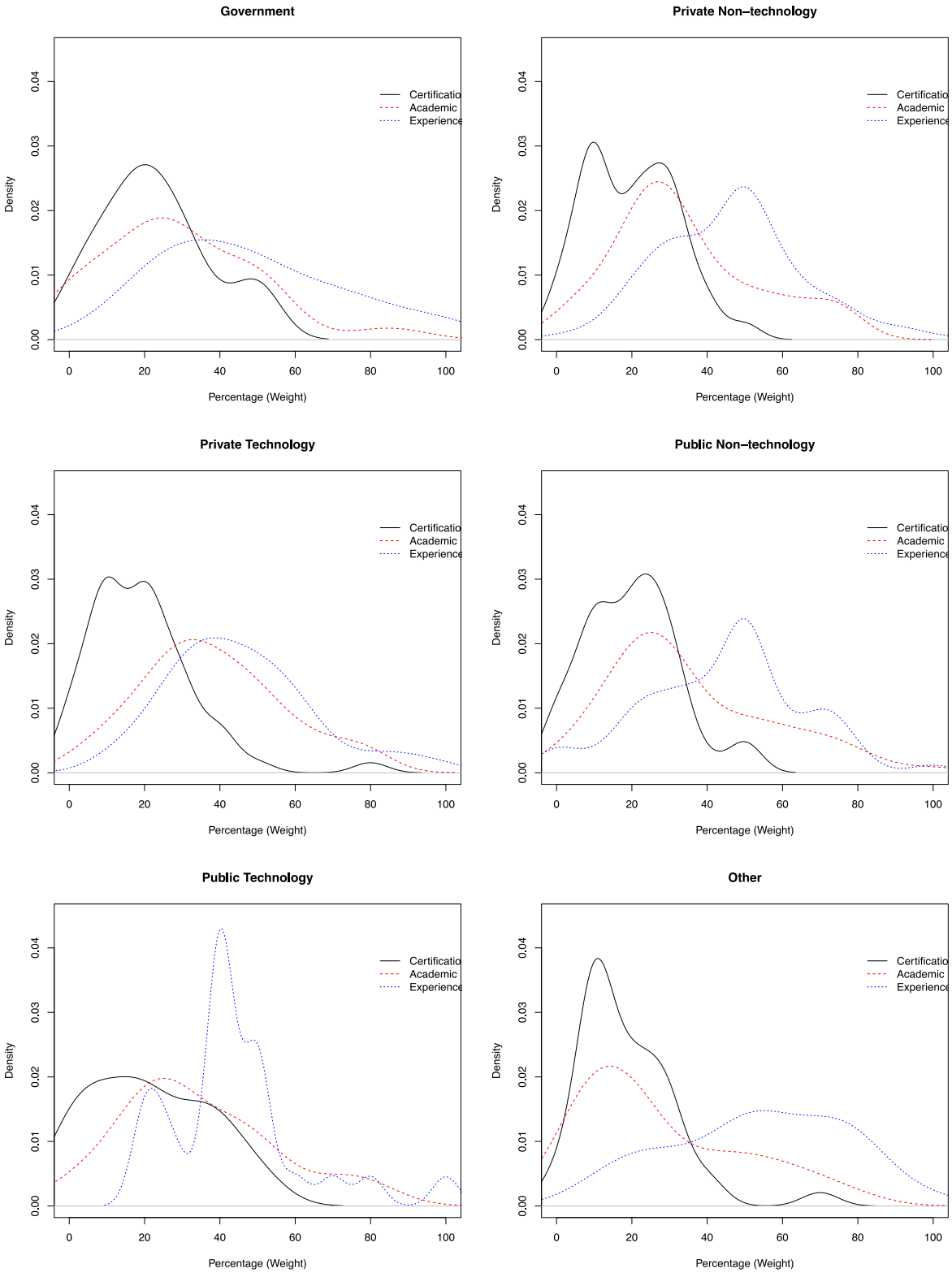

Figure 9. Relative Importance of Academic Degree, Certifications, and Work Experience, by Type

		Cert.: No	Cert: Yes	Total
Acad. Deg.:	No	20.65%	29.68%	50.32%
Acad. Deg.:	Yes	4.19%	45.48%	49.68%
Total		24.84%	75.16%	100.00%

Table 11. Proportion of Employers Offering Formal Education Support

As shown in Table 11, it was found that 45.48% of the companies provide support for both academic degrees and certifications. Just over 75% provide some type of support to their employees to obtain certifications, and approximately 50% support their employees in getting an academic degree.

Category	Degree Support	Cert Support
Academic Degree Req.	21.87%	31.49%
No Academic Degree Req.	23.32%	37.61%
Certification Req.	11.66%	18.95%
No Certification Req.	32.94%	48.98%
Experience Req.	37.32%	56.56%
No Experience Req.	7.87%	12.54%

Table 12. Percent of Respondents that Provide the Associated Type of Support

An analysis of company hiring requirements for entry-level IT positions and the support that they offer to obtain continued formal education, Table 12, reveals that companies that require academic degrees and/or certifications are less likely to pay for them while on the job. However, companies that require experience, and do not require academic degrees and certifications, are much more likely to support their acquisition after employment. Additionally, regardless of the category, employers are more likely to compensate employees for obtaining certifications as opposed to academic degrees.

Table 13 shows the types of support provided for continued employee formal education. This data illustrates that employers prefer to reimburse employees for successful efforts, and certifications are supported to a higher degree than academic degrees.

Support	Academic Degree	Certification
Tuition	20.99%	
Books	13.70%	
Reimburse Tuition	30.90%	
Paid Time Off	6.71%	38.48%
Lodging		29.45%
Prep Course		24.49%
Reimburse Prep Course		26.53%
Testing		29.45%
Reimburse Testing		37.03%
Other	5.25%	4.66%

Table 13. Percent of Respondents that Provide the Associated Type of Support

This is most likely due to the shorter time frame and holistically cheaper cost. That is, the cost for prep courses, lodging, and testing is significantly less than that for obtaining an academic degree. This also includes covering the cost of paid time off.

Finally, Figure 10 represents the relationship between employers that require experience, those that require a degree, and those that already have a degree.

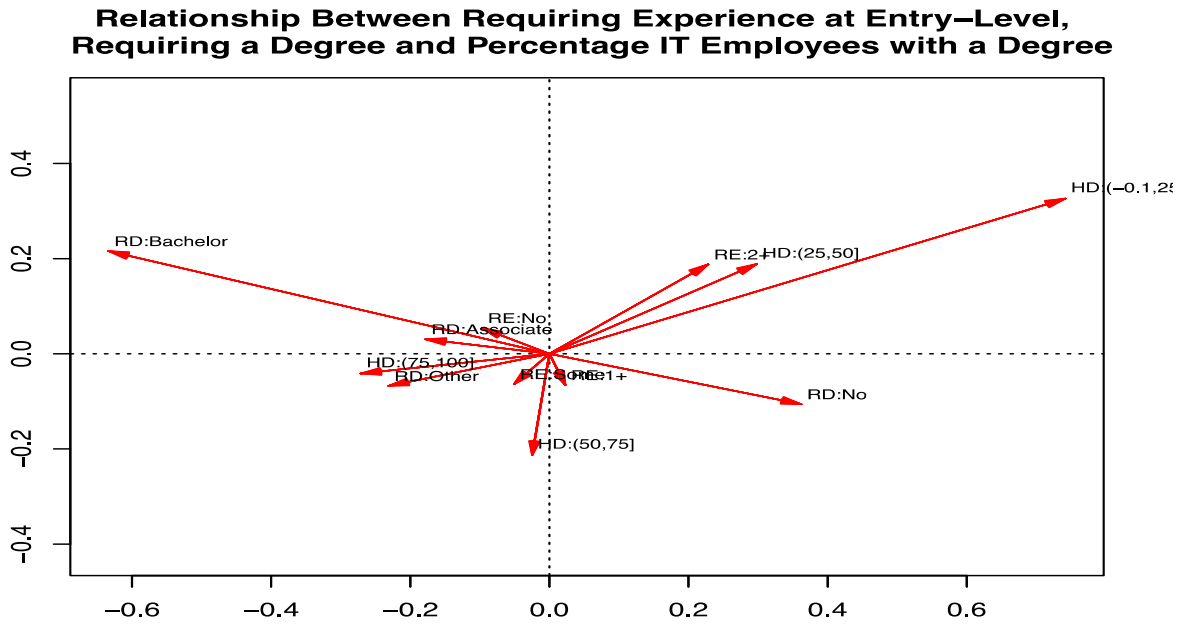

Figure 10. Relationship between Requiring Experience at Entry-Level, Requiring a Degree, and Percentage IT Employees with a Degree

The JCA shows that companies that do not require applicants to have an academic degree are associated with employees not having academic degrees (HD: -0.1,25 and HD: 25,50) and, not surprisingly, require 2+ years of experience. Employers that require a Bachelors or Associate degree (RD: Bachelors and RD: Associate) are associated with not requiring any experience (RE: No) and, also not surprisingly, most of their employees currently hold academic degrees (HD: 75,100). Figure 10 also shows that companies requiring one year (RE: 1+) or some (RE: Some) experience are associated with companies that report that 50% to 75% of their employees already have an academic degree (HD: 50,75).

5. SUMMARY/CONCLUSIONS

The majority of IT employment literature, as discussed previously, is focused on academic degrees and certification. Little, if any, has looked at the big picture of relative employer valuation of academic degrees, certifications, and work experience. To address this gap, this research focuses on the employer's relative valuation of academic degrees, certifications, and work experience.

A survey of 342 IT Managers and HR and IT workers was conducted, making this one of the largest samples undertaken in this type of study. In addition to quantifying overall responses, cross sectional analysis was also performed on the sample by company size and company type.

From the analysis it can be concluded that IT employers value work experience significantly higher than either academic degrees or certifications. IT work experience had an average weight of 50% followed by academic degrees with 30% and certifications with 20%. This is noteworthy in light of the amount of literature focused on academic degrees and certifications.

When comparing employer entry level requirements to their actual current employee qualifications, this study finds an interesting contradiction. Approximately 50% of employers require applicants to have an academic degree and only 15% require certifications. However, 50% of the employers indicate that at least 75% of their current employees have academic degrees, with 25% saying that 100% have degrees. As for certifications, 67% of the employers indicate that at least 50% of their current employees have certifications, and 43% of employers expect current employees to pursue certifications.

This peculiarity begs the question, "If employers value academic degrees and certifications to the level they do, why do they not require them from their entry level applicants?"

Further analysis across company size and company type indicates that these do not individually influence the category valuation. However, as presented in the analysis, when both are considered there is an impact on employer requirements. The analysis shows us that private and public technology companies tend to be smaller and require academic degrees from entry level employees, but private non-technology and government companies tend to be large and not require academic degrees. Public non-technology and government companies tend to be large and require certifications from entry level employees; whereas, private and public technology firms tend to be small and not require certifications. Public and private technology, mostly public technology, do not require experience for entry level positions, but government and private non-technology require at least two years of experience.

Combining the individual analyses, a pattern can be observed in which private and public technology firms are small and value academic degrees but not certifications or experience. That is, for these companies, academic degrees are used in lieu of experience. Private non-technology companies are small and do not value academic degrees or certifications but strongly value work experience. Public non-technology companies, as evidenced from the analysis, are typically large, slightly value degrees but not certifications, and slightly value experience. Government does not value academic degrees but does value certifications and, like private non-technology companies, strongly values experience.

Further, it was identified that about 50% of the companies offer financial support for current employees to obtain academic degrees, while 75% offer financial support for certifications.

Overall, with the exception of private and public technology companies, the majority prefer experience for entry level applicants to be hired, and then provide the opportunity to increase their formal education. Uniquely, it also supports the observation that employers value academic degrees and certifications more than their entry level requirements identify. But it begs the question, "Why do employers support so much more formal education after they have been hired as compared to before?" This research was not designed to address this question but it highlights how academic institutions and their curriculum offerings might not be meeting industry needs. If they were meeting the marketplace needs, wouldn't the requirement for academic degrees and certifications be higher?

The authors believe this research calls into question many of the assumptions made by today's academic institutions offering technology degrees and certifications. A significant amount of research has been done to identify the specific curriculum content that should be offered based on perceived desirability of employers. However, this research has failed to acknowledge the curriculum that employers are most (50%) interested in: experience.

To address this mismatch, academic technology programs should refocus their curriculum designs in three specific ways:

1) Increase opportunities for experiential-based learning by increasing the program/company partnerships to provide real world projects within capstone or other targeted classes.
2) Increase the focus on company internships, with obtaining and successfully completing an internship being a required component for graduation.
3) Establish, listen to, and better involve advisory boards.

Many programs offer some degree of one or all of these. But in most cases, because of their costs in time and the difficulty in implementation, assessment, and coordination,

they do not have the emphasis they should. As presented in this research, employers value academic degrees only 30% as compared to 50% for experience. Therefore, it is imperative for academia to increase the value of academic degrees and better integrate experiential learning with targeted curriculum for meeting today's employer's expectations. Advisory boards are a tremendous means for faculty to interact with those that hire their students. Unfortunately, too few advisory boards support faculty/industry interaction. Faculty are often hesitant to take curriculum advice from outside their own ranks, yet with the increasing development of coding camps, certification programs, and other non-traditional technology based formal education efforts, it is increasingly important for them to work together.

Companies also need to take a more active role. Companies need to work more closely with academic degree granting institutions. Opportunities include:

1) Active involvement in advisory boards, such as attending meetings and participating in discussions
2) Work with designated faculty to provide opportunities for real-world, content-applied projects including project mentorship
3) Work with programs to identify and support paid internships for students that provide hands on experience with appropriate oversight and training.

Companies that fail to communicate and actively work with academic degree granting institutions will suffer hiring ill prepared employees resulting in increased training costs and delaying the time they become effective contributors.

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APPENDIX – Survey Questions

Which title best describes your current position?
How large is your organization?
Which industry classification best describes your organization?
Approximately what percentage of your IT employees have a college degree?
Approximately what percentage of your IT employees have at least one certification?
To your knowledge are full time IT employees expected to pursue certifications?
Do you require entry level IT applicants to have an IT related degree?
If you require specific academic degrees for some positions, please list the major/area below.
Do you require entry level IT applicants to have IT work experience?
Do you require entry level IT applicants to have certifications?
    If yes, please identify which certification(s) you require.
How do you weight the relative value of academic degrees, certifications and work experience when considering an entry level new hire? The percentage total should add up to 100%
        % Academic Degree
        % Certification
        % Work Experience
Do you require non-entry level IT department hires to have IT related degrees?
If you require specific academic degrees for some positions, please list the major/area below.
Do you require non-entry level IT applicants to have IT work experience?
Do you require your non-entry level IT department hires to have IT related certifications?
    If yes, please identify which certifications you require:
How do you weight the relative value of academic degrees, certifications and work experience when considering a non-entry level new hire? The percentage total should add up to 100%
        % Academic Degree
        % Certification
        % Work Experience
Does your company offer financial support for current IT employees to obtain academic degrees?
    If yes, which forms of support are provided? (Check all that apply)
        We pay for tuition
        We pay for books
        We reimburse tuition fees based on the grade received
        We provide paid time off to attend classes
        Other
Does your company offer support for current IT employees to obtain certifications?
    If yes, which forms of support are provided? (Check all that apply)
        We provide paid time off to attend classes
        We pay travel and lodging to attend classes
        We pay for prep courses
        We reimburse for prep courses
        We pay for testing
        We reimburse for testing if successful
        Other

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