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Abstract:

Job placement data is important for understanding where graduates get jobs. We present an empirical study of eight years of undergraduate and graduate IT placement data to explore IT jobs obtained within IT functions. Niederman, Ferratt, and Trauth (2016) propose clustering IT jobs into four macro-level categories based on knowledge, skills, and abilities (KSAs) required for these jobs: IT bridgers, technical specialists, application domain specialists, and IT managers. They argue an increased need for, and value placed on "bridgers" who can fill bridging jobs within IT. Bridgers within IT possess both technical and "soft skills" like communications/managerial and change/project management and work within the IT function but can liaise between IT and business units. Using a longitudinal sample of 1,980 IT graduates from one Information School, the data supports that IT bridgers are hired within IT, are hired earlier, and are largely hired in consulting, technology, and finance industry sectors. Contributions include exploring the utility of the macro-level categorization of NFT IT job categories to analyze job placement, the importance of tracking IT job placement in employer sectors, and the overall value of IT placement data for IT educators and administrators.

Keywords: Job Placement, IT Workforce, Bridgers, First Destination Jobs, IT Education, Co-evolution, IT Careers, IT Curriculum, Soft Skills.

[Department statements, if appropriate, will be added by the editors. Teaching cases and panel reports will have a statement, which is also added by the editors.]

[Note: this page has no footnotes.]

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1 Introduction

As organizations continue to leverage information technologies, the jobs of Information Technology (IT)[1] professionals have become more complex and challenging. This is especially the case as the COVID-19 pandemic has increased reliance on Information and Communication Technologies (ICTs) for a greater range of services within organizations and to support workers and students who telecommute.

Decades of experience support that it is critical and yet challenging for organizations to recruit, retain and motivate a diverse range of qualified people who will work efficiently with current and emerging information technologies (Tarafdar & Gordon, 2007; Guzman et al., 2008; Guzman & Stanton, 2009; Kappelman et al., 2022). The balance of technical and communication/managerial skills has been of particular interest, as studies have shown that IT alignment between business and IT strategy is heavily dependent on this shared knowledge (Bassellier & Benbasat, 2004). Shared business and IT knowledge increases communication, collaboration, and perceived value of IT when aligned with strategic business goals (Tarafdar & Gordon, 2007; Yu-Yin et al., 2016). Studies demonstrate that having IT skills among the business units improves IT innovation, adoption, and collaboration between IT and business units (Bassellier & Benbasat, 2004; Reich & Kaarst-Brown, 1999; Tarafdar & Gordon, 2007).

In the current technology era, we have seen increasing sophistication and tremendous evolution in IT and technologies that affect the user side of organizations even as it changes the skill requirements within IT. Emerging technologies have required new and advanced skills in areas such as cloud computing, “big data” analytics, edge computing and IoT, IT security, enterprise risk assessment, artificial intelligence (AI), and process automation. Niederman et al. (2016) argue that these advanced technologies have swung the pendulum back to where the end-user must rely on IT experts to help them. This means at least one category of IT workers need to be able to liaise or bridge with end-users, well beyond the old help desk function.

Despite the decades of attention paid to alignment of IT and business strategies, Niederman et al. (2016) argue that beyond shifting technical skills, the 21st century and current era of technology has an increased need for IT workers within the IT function who can serve in these bridging roles rather than relying on business workers with IT acumen outside of IT. They argue that there is a strong relationship between the evolution of technology through four distinct “eras” and the classification of IT jobs into four, broad macro-level IT job categories: (1) “technical specialists” who focus on support and operations, including maintaining infrastructure, (2) “application domain specialists” who focus on designing, building and extending information systems throughout the organization, (3) “IT bridgers” who liaise or bridge between IT and the business units, including project managers, business-technology analysts, and many IT consulting roles, and (4) IT managers at various levels within IT. Unlike other research that focus on business knowledge among senior IT leadership, their arguments and our research focuses on recent graduates’ “first destination jobs” as important indicators of Niederman et al.’s proposed shift in desirability of bridging KSA’s within IT, and the utility of the macro-level IT job categorization.

There is little published information on graduate placement (Gallagher, 2015) and even less about graduate placement in IS/IT jobs either practically or theoretically. This is surprising as accreditation bodies and State agencies in the United States monitor first jobs of graduates (see Laguilles, 2016; NACE[2], 2023; Sykes, 2011). Traditional career placement studies often report starting salaries, how long before or after graduation students obtain jobs, hiring employers/industries, and job titles. Job placement data, however, traditionally relies on those jobs titles rather than classifying them into a standard set of job categories. Some programs allow graduates to report their own job titles or roles rather than using any standard drop-down menu. Additionally, data collection systems may vary throughout the years as tools and administrators change. This further complicates an already complicated challenge of understanding IT job placement trends beyond limited analysis of employment offers received before or after graduation or

[1] Information Systems (IS) workers or Information Technology (IT) workers are terms that are often used interchangeably. We use the term IT professionals or IT workers here. We use Niederman et al (2016, pg. 29) definition of IT professionals to include all people working with information technology as "information systems (IS) personnel" to include the entire continuum of workers who design, build, and manage application systems, who introduce them and other related IT into organizational environments, who operate, maintain, extend, and manage the IT, and who provide training, documentation, and support for the organizational context in which these systems are embedded.” We use this definition to refer to the IT workers who pursue IT jobs within the IT function.
[2] National Association for Colleges and Employers (NACE).

starting salary. This also makes analysis of both the roles and emphasis of required KSA's harder to compare[3]. Despite these challenges, we felt understanding IT placement is an important gap to explore.

In this paper, we bring longitudinal placement data from one Information School to explore Niederman et al.'s (2016) arguments for the increasing importance of KSA's that support IT bridging jobs within IT. Their simple, yet comprehensive macro-level categorization of IT jobs into four IT job categories provides a concise way to organize and compare IT job placement across different IT degree programs based on the KSA's required. We turned to eight years of placement data on 1,980 IT graduates, of whom 1,755 obtained full-time IT jobs within IT. Our objective was to find insights into questions of whether we indeed see hiring into jobs that fall in the NFT IT job category of IT bridgers and which sectors are hiring them. As part of this, we consider two other explanations that might negate Niederman et al.'s speculations of a need for more IT bridgers within IT.

The following sections provide an overview of these competing arguments, and our propositions for each of these three perspectives. After presenting our findings, we discuss contributions to research and practice, limitations, and directions for future research.

2 Three Perspectives on Job Placement of IT Graduates

Our first set of propositions derive from Niederman et al.'s (2016) argument that there is a co-evolution of skill requirements that align with the evolution of technology, leading to the need for more graduates trained for IT "bridging" roles. We wanted to explore if IT placement data supports that IT functions are hiring IT bridgers and how this compares to hiring of the other three NFT IT job categories. This hiring of IT bridgers is potentially contradictory with recent studies that suggest concerns about the shortage of workers to fill highly technical IT jobs which do not mention soft or non-technical skills (e.g., cybersecurity, cloud, analytics) (Johnson et al., 2023). The second perspective is that demand for all IT jobs is increasing, and so would account for little or no difference in hiring of IT bridgers versus jobs in the other NFT IT job categories (domain, technical, and IT management). We assessed this argument by considering the timing (urgency) of placement for IT jobs overall (e.g., before or after graduation), versus for specific NFT IT job categories. A third perspective draws upon literature that looks at where graduates are hired. Research suggests that many schools target employers for their programs and region, which for IT programs would be those who employ many IT workers and offer higher salaries and other benefits such as internships, or sponsoring visas for international students (see also Binder et al., 2016, Laguilles, 2014, and Rivera, 2011). By controlling with a sample from a single school, we speculated little or no difference in hiring across the four NFT IT job categories by employers in different industry sectors. By using archived placement data to compare these three perspectives, we hope to gain additional insights into Niederman et al.'s (2016) argument of co-evolution of IT jobs and technology leading to hiring of IT bridgers within IT departments. We review the literature to support each of these perspectives and present our propositions.

The following sections provide an overview of these competing arguments, and our propositions for each of these three perspectives. After presenting our findings, we discuss contributions to research and practice, limitations, and directions for future research.

2.1 First Perspective Arguing for Increased Need for IT Bridging Roles Within IT

Niederman et al. (2016) argue that requisite KSA's and roles of IT workers within IT are shifting, even as the IT skills and roles of non-IT workers are evolving. They propose many potential implications of these co-evolutionary trends, but three issues are particularly relevant to placement of IT graduates. The first issue is "a steady expansion of the boundary that includes IT personnel" (pg. 36). Researchers have argued this point for many years, debating "who is the IT workforce" (Kaarst-Brown & Guzman, 2005), as many IT skills and IT trained graduates were employed outside of formal IT departments.

> *We are not suggesting that all social media users will become IS personnel; however, those who have KSAs that match new organizational goals and technologies have the potential to be selected as members of the IS personnel population.* (Niederman et al., 2016:36)

[3] A further challenge in relying on job titles is that the range of terminology has shifted over the decades, as noted in the Standard Occupational Codes (SOC's) used by the US Department of Labor/Employment and Training Administration (US BLS, 2018), the US Bureau of Labor Statistics (Jones, 2014), and academic studies (see for example Niederman, et al, 2016). NACE (2023) provides a template to collect data, but it includes broad job market categories, not just IT.

As such, where workers with both business and IT skills may have previously been housed outside of IT, they argue there has evolved an increasing need for people with business and technology skills within the IT function. Building on Hirschheim and Klein (2012, p.196), Niederman et al. (2016) further argue that the shift to what is referred to as the fourth era of technology, beginning in the late 1990's (and still ongoing) resulted in an increased need for "advanced and differentiated technical skills" that requires an increase in shielding of end-users from details of operationalizing technology, even with a growth in user application domain skills. This fourth era is characterized as the era of the internet age, ubiquitous computing (e.g., laptops, netbooks, tablets, smartphones), advanced search engines, and social media. They argue that this has led to an increase in the IT job category referred to as "bridgers," or those IT personnel able to liaise or "bridge" between aspects of information technology and business functional areas. Bridgers within IT are different from non-IT employees who simply use technology or IT workers who support the domain systems provided. The argument is made that organizations that have many "IT bridgers" who can liaise between IT and the business functional areas and provide translation of technical capabilities and opportunities "possess a foundation for innovation via IT that could enable them to compete effectively using IT" (pg. 40).

The third issue raised by Niederman et al. (2016) and others (see Hirschheim and Newman, 2010, and Kaarst-Brown, 2010) is that traditional Business Schools, Computer Science Schools, or Information Schools offer different types and diversity of IT curriculum needed to meet evolving demand for requisite KSAs across the range of technical specialists, domain specialists, IT bridgers, or even IT management. The need for strong technology as well as "soft skills" creates pressures to expand educational offerings, however, sustaining the "entire continuum of IS and hybrid personnel will become increasingly difficult" (Niederman et al, p. 42). They state that while technical skills include "operating systems, programming languages, networks/communications, software development tools," the "non-technical skills include communication, interpersonal, leadership, organization, self-motivation, and creativity" (Gallivan, et al., 2004 as referenced in Niederman et al., p. 38). In this study, we refer to these soft skills as communication/managerial to encompass the full range of non-technical skills or soft skills. Niederman et al. argue that Information Schools may be better positioned to offer the broader blend of technical and non-technical curriculum needed to address this shift in technology. Information Schools that "house computer science, information systems and often additional programs like library science (p. 42)" can offer integrated technology and soft skills content and degree programs that can address the four NFT IT job categories with varying degrees of emphasis on technical versus non-technical skills.

> *IS educators face a policy and pragmatic question as to whether they should expand their programs to address IS personnel moving toward either the more technical or the more end-user orientations, whether they should focus on "bridgers," or whether they should include offerings for IS managers. They could concede education of the more technical topics to our colleagues in computer and information science programs.* (Niederman et al., 2016, pg. 44)

We are not debating the advantages of any type of school, however, IT graduates from Information Schools present as a good exploratory sample because their degree programs train future IT workers for all four of the NFT IT job categories. Information schools have a "strong reliance on the social and behavioral sciences, as well as computing, artificial intelligence, and linguistics… iSchools' topics include data science, human-computer interaction, information organization and access, bibliometrics, and information integrity" (ischools.org). While business schools provide breadth and depth in traditional business courses, and computer science schools provide strong technical training in many diverse areas, Information Schools often provide not only greater breadth and depth of IT technical KSA's, but also those soft skill courses such as project management, IT change management, and user focused subjects. When comparing across IT degree programs offered within a single school or across IT degree programs offered by diverse types of schools, we would expect to see differences in IT job placement based on this emphasis on communication/managerial skills in addition to strong technical emphasis of degree programs. In particular, Niederman et al. (2016) argue there are KSA's that IT bridgers must have that are different from technical specialists, IT domain specialists, or those already in some aspect of IT management.

This first perspective based on Niederman et al. (2016) raises two questions and resulting propositions.

Question 1: If we look at placement data of recent IT graduates in the fourth era, will we see evidence supporting Niederman et al.'s (2016) argument that they will be hired into bridging jobs within IT?

We propose that:

P1. We will observe placement of IT graduates into IT bridging roles reflecting evolving needs for KSA's emphasizing the management of technology, sheltering of users, and user-technology liaison and translation.

Question 2: Given the need for technical skills within IT, is there evidence that communication/managerial skills are becoming more valued among IT workers, as proposed by Niederman et al.? For example, will there be differences in the percentage of graduating students placing in IT bridging roles versus technical or domain roles based on KSA emphasis of degree programs?

As such, we propose that:

P2. Given the proposed high value of communication/managerial KSA's combined with IT KSA's, we expect that a larger percentage of IT bridgers would be hired into IT jobs from those IT degree programs that emphasize both types of these KSA's.

These questions and resulting propositions provide a basis for comparison across all four NFT IT job categories and KSA emphasis in different degrees.

2.2 Second Perspective Arguing for Growth in Demand for IT Workers

A counter argument to Niederman et al (2016) is that there is simply *an increase in demand for all types of IT workers*. There is an acknowledged shortage of IT workers in the US and globally (WEF, 2020) and according to the 2022 SIM IT Trends study, IT Talent/Skill Shortage/Retention remained among the top three CIO concerns from 2013 to 2022 (Johnson, et al. 2023). High demand jobs will likely be recruited early in the career placement cycle demonstrating an urgency for those types of skills. Knowing when students obtain their jobs, either before graduation or within certain periods after graduation, would serve as a surrogate for desirability of KSA's by hiring employers, with changes in timing of when jobs are obtained indicating changes in urgency on the part of employers recruiting from a school.

The growth/decline argument is different from the co-evolution argument which links trends in technology with changes in actual skills or roles that are needed or valued. For example, since 2001, we have seen an increase in general demand for IT network security workers (NFT IT Technical Specialist category) (Johnson et al., 2023). Finnie, Mueller, and Sweetman (2018) posit that macro-industry demand needs better metrics that consider curricular choices by students (e.g., to pursue IT related KSA's), changes in salaries, and shifts in demand by industry sector. They do not dispute high demand for IT workers but also consider the realities of lag between industries acknowledging the need for specific types of IT skills and the time it takes educational institutions to train graduates (see also Weaver and Osterman, 2016). The timing of job obtained as a surrogate for urgency in fulfilling jobs may also inform potential shifts in perceived needs of employers.

There are two questions and resulting propositions that emerge from this argument that any changes in urgency of job offers and resulting placement are purely driven by ongoing demand for IT graduates versus value within IT for a broader range of technical and soft skills.

Question 3: If general employer demand for all IT workers is driving timing of job offers for IT graduates, would we see some evidence of urgency in jobs obtained earlier in the recruiting process, for example three or more months prior to graduation?

P3. All IT graduates from IT focused degree programs will be hired with the same urgency regardless of KSA emphasis.

Question 4: If general employer demand for IT workers is driving timing of job offers for IT graduates, should not demand be consistent across all four NFT IT job category roles?

P4. All IT graduates will be hired with the same urgency for all four NFT IT job categories, with no difference for the IT bridgers category.

Support for these two propositions would challenge Niederman et al.'s (2016) arguments that the IT function needs and places value on those able to fill IT bridging roles.

2.3 Third Perspective Arguing for Funneling IT Graduates to Desirable Employers

The third counter perspective to Niederman et al. (2016) is about where IT graduates get jobs. Niederman et al. posit that IT departments now need IT bridgers with requisite technical skills but also communication/managerial skills, which would suggest that this would be uniform across industry sectors reliant on IT. It can also be argued that while some industry sectors hire more IT workers than others, making them potentially desirable first job destinations, they would likely need all four types of NFT IT workers.

It is common for schools to seek the most prestigious career paths for graduates from their types of degree programs (Crawford & Wang, 2019; Laguilles, 2016; Rivera, 2011; see also NACE, 2023). Binder et al. (2016) found that some Ivey league universities also experience a funneling of graduates to jobs in prestigious industry sectors, through combined efforts of aggressive campus recruiting by employers and "career prestige systems" that influence students view of desirable jobs (p.21). One would expect that technology schools, business schools, computer science, or other schools that offer IT degrees would seek to attract and exploit the benefits of placing graduates in IT jobs with organizations or industries they and their students consider offering desirable first-destination jobs. Similarly, one would expect organizations with higher IT spending and who hire many IT workers to be seeking IT graduates to fill technical and domain specialist roles within their IT departments, not just those who can fill IT bridging roles.

Question 5: Where placement data is available, would we see consistent hiring across all four NFT IT job categories (domain specialists, technical specialists, IT bridgers, and IT managers) due to need for all types of IT workers, or some distinctions for IT bridgers based on industry sectors? Based on the third perspective, we propose that:

P5. There will be no difference in graduates' placement in different industry sectors based on NFT IT job categories.

This perspective raises questions that could support or counter Niederman et al.'s (2016) argument of an increasing need for bridging roles within IT departments in general.

3 Methodology

Niederman et al. (2016) and Hirschheim and Klein (2012) posit that the fourth era of technology began in the late 1990's. Our longitudinal analysis began with data starting in 2010, over a decade into this fourth era. As such, any evidence supporting the importance of bridgers should be well established. We obtained eight years of placement data (2010 to 2017) across three different IT degree programs (one undergraduate and two graduate programs) from one iSchool that is part of a larger liberal arts university (Table 1). All three of these IT degree programs prepared students for IT jobs with both basic and advanced technical courses, however, differed in the emphasis on communication/managerial topics. For purposes of our study, this iSchool setting provided a sample of graduates who could be hired in any of the four NFT IT job categories. These graduates acquired both technical and soft skills, so could be studied at a degree level, without the need for a course level analysis of each individual graduate.

Using this private archival data, we created a database to track placement across one undergraduate IT program and two graduate IT programs. The curriculum for these three programs was very stable, with updating of courses but little change in program emphasis between 2010 and 2017. A strength of this data is that while students would have variations in some electives, the primary focus of the different technical degree programs was very uniform allowing reasonable comparison across the years.

The four-year Undergraduate in Information Technology & Management (UGITM) degree combined 50% liberal arts plus 50% iSchool curriculum. This program had both strong technical aspects of IT studies, such as programming and IT security, but also less technical aspects such as project management, and additional communications skills from the liberal arts component. The two graduate degree programs were each two-years of study. They differed in that the Masters in Information Technology Management (MITM) admitted most students from different technical disciplines but also some from less technical disciplines. This program also included additional elective courses focused on communications, data analytics, management, and user focused topics (e.g., project management, database administration, social media, IT strategy, risk management). Alternatively, the Masters in Information Technology (MIIT) degree was more heavily technically focused in both its core and elective topics (e.g., networks, IT security, IT

architecture), attracting students with strong technical backgrounds and interests, but the program also provided access to soft skills electives. (See Table 1.)

The distinctions between curriculum and stability of the programs at this school made them optimal for making comparisons, although we later found the MIIT program to have smaller numbers making comparisons more cautious. Given Niederman et al.'s (2016) emphasis on the differentiated KSA's, considering both undergraduate and graduate IT job placements from a single iSchool also provided a common context in which to analyze placement while controlling for curricular differences and recruiting efforts/employers.

Table 1. Blend of Technical Plus Communication/Managerial Focus of Three Degree Programs

Technical Degree with Least Communication/Managerial Emphasis	Technical Degree with Blended Liberal Arts/ Communication/Managerial Emphasis	Technical Degree with Higher Communication/Managerial Emphasis
Graduate Degree: Masters in Information Technology (MIIT)	Undergraduate Degree: Information Technology & Management (UGITM) (50% Liberal Arts component)	Graduate Degree: Masters in Information Technology Management (MITM)

3.1 Data Collection and Description

Table 2 provides a high-level overview of the raw data obtained for this study (before coding). This secondary data was not collected specifically for our purposes, and was anonymized prior to release to us, but is sufficiently detailed by individual graduation record that it was suitable for coding and analysis. All students who applied for graduation were prompted to complete a survey asking about their post-graduation choices. In most years, students were tracked to allow for targeted follow-up. This responsibility shifted over the years. In particular, the school shared that in 2011 there were changes in responsibility for collecting the data and procedures for follow-up with graduates. We believe this lack of follow-up resulted in a lower student response rate for 2011 as the economy was strong and employment steady.

Given that not all respondents completed all fields in the survey, but completed most of the relevant fields, the number of records used for analysis varies depending on the nature of the proposition. As mentioned earlier, for the purposes of this study, we were most interested in those *students who accepted jobs within IT* and could be coded into the NFT IT job categories. The data set includes graduation year, degree program, employer, industry, job title, job type, job function (department), location (country), and timing of job obtained. Table 2 provides a description of the raw data used in our analysis.

Table 2. Data Fields and Description – Uncoded Records

Data Fields	Data Description Before Normalization
Years of Graduation	8 years of data from 2010 to 2017
Program	Total N = 2642 (2010-2017)
UGITM – Undergraduate	1,244 graduates
MITM – Graduate	1,217 graduates
MIIT - Graduate	181 graduates
Employer	797 employers
Industry	Respondents typed or selected 72 industries
Job Title	Respondents typed or selected 1082 different job titles
Job Function	Respondents typed or selected 103 different job functions
Job Type	Respondents typed or selected 65 different job types
Job Obtained	Respondents selected among four options from 0-3 months before graduation to > 6 months after graduation

3.2 Data Coding and Analysis

We coded the data in two rounds. The first round normalized the data and identified the subset of IT graduates who accepted employment within IT. The second round of coding was based on propositions under the three perspectives.

3.2.1 First Round of Coding

In this first round, data was normalized to ensure that terms and coding were applied consistently and addressed variability in terminology used over the years or programs. We were able to account for the career choices of 75% of the graduating students. One quarter of graduating students elected not to complete the employment survey (non-response); however, we could see the anonymized incomplete records. We can only speculate why, for example, a graduate had no job at the time of the survey, was not willing to share, opted for alternative career choices such as furthering their education, or ignored follow-up reminders to complete survey.

In the initial coding for graduates hired into IT versus non-IT jobs, we used (Kaarst-Brown & Guzman, 2005) argument that *"Having graduated from a top IT program, those employed in IT jobs would have clearly defined roles easily distinguished as part of the IT profession (for example, programmer, project manager, analyst, and so forth)"*. We also explored the employer websites for the nature of firms doing the hiring and their job postings, job titles, and responsibilities. This allowed understanding of the initial pool of records for those graduates who reported full time employment within IT and the pool to be coded later with Niederman et al.'s four IT job categories.

As part of this process, we separated out those students who reported other options such as furthering their education, internships, employment outside of IT (e.g., Real Estate Agent), or military service. Some students did not complete enough fields to enable coding of the NFT IT job categories and so we marked these records as unclear. The 1,980 responses we used as our initial "N" were coded based on graduates' plans following graduation, such as "IT Job (69.2%)" versus "non-IT job (12.7%)", "Unclear/Incomplete (7.0%)", and 11.1% who did not accept jobs but pursued other options such as "Self-Employed (0.09%)", "Graduate School (5.6%%)," or "Part-time, Co-op or Internship (3.5%)". Table 3 shows the results of our initial classification of placement responses.

Table 3. Records Coded into Generic Post-Graduation Placement Categories

Classification of Placement Responses After Graduation	**2010**	**20114**	**2012**	**2013**	**2014**	**2015**	**2016**	**2017**	**Total**	
Total Records	210	285	295	303	329	377	410	433	2,642	
No Response	54	195	77	74	68	59	82	53	662	
Non-Response Rate	25.7%	68.4%	26.1%	24.4%	20.7%	15.6%	20%	12.2%	25.1%	
Usable Responses										% of 1,980 Usable Responses
IT Job (used to compare NFT IT job categories)	84	59	154	157	202	202	253	259	1,370	69.2%
Non-IT Job	21	16	43	50	23	36	31	32	252	12.7%
Self-Employed	2	1	2	4	1	4	2	2	18	11.1%
Graduate School w/o employment	13	1	12	4	26	28	27	20	131	
Part-time, Co-op or Internship	13	8	4	8	2	5	13	17	70	
Incomplete/Partial Data	23	5	3	6	7	43	2	50	139	7.0%
Usable Responses	156	90	218	229	261	318	328	380	1,980	100%
Response Rate	74.3%	31.6%	73.9%	75.6%	79.3%	84.4%	80.0%	87.8%	74.9%	

[4] Despite the low response rate in 2011, we included this data in the analysis both to see if 2011 recorded data was like other years, as well as in aggregated totals. We did not expect this small number would skew the findings.

3.2.2 Second Round of Coding

In the second round of coding, the authors independently coded one year of data using the four NFT IT job categories proposed by Niederman et al. (2016). We drew upon the explanations and definitions provided in Niederman et al. as noted earlier (examples are provided in Appendix A). Authors then compared and discussed results to develop a standard coding schema to increase inter-rater reliability. In addition, we coded the date when the job was obtained and employers' industry sectors.

- NFT IT Job Category - Niederman et al.'s (2016) four IT job categories (IT bridgers, domain specialists, IT managers, and technical specialists) To assess category of full time IT jobs.
- Date Job Obtained – (before graduation, within 3 months of graduation, 3-6 months after graduation, more than 6 months after graduation, or no response) Surrogate for urgency of employer demand for IT workers across all four NFT IT job categories.
- Employer Industry Classification - (industry sector, no response) To identify where IT graduates were hired based on records with both NFT IT job category and Industry Sector.

As noted earlier, we used different elements of the data to explore the three different perspectives, resulting in a different number of records associated with each perspective (see Table 4 below). Our coding of IT jobs to the NFT IT job categories was not just based on the IT job title as we also considered the job function, the job type, and industry fields. Before labeling a job as unclear and therefore uncodable, we also checked the employer website for job descriptions. Non-IT jobs were those clearly outside of IT such as real-estate sales, retail sales, or accountant. We do not report on non-IT job placement data here.

Since an existing field clearly defined timing of placement/date of "job obtained" as identified by respondent, we did not re-code this field other than to normalize responses or identify non-response records.

After verification, employers were re-coded from 72 industries into one of 19 industry sectors (or self-employed). Appendix B provides details on the industry sectors where 1,774 graduates were hired or indicated they were self-employed. The three top industries for all hires include Consulting, Technology, and Finance that we refer to as CTF moving forward. Again, if there was any question as to the emphasis of an organization's products of services or its industry sector, we reviewed their web sites for mission statement and NAICS codes[5]. Of these, 1,344 records were included as IT jobs codable by the NFT IT job categories and providing employer information (See Table 4 below and Appendix C).

Table 4. Records Analyzed by Year 2010-2017

Year	2010	2011	2012	2013	2014	2015	2016	2017	Total N
First Perspective Propositions Records									
Records Coded by NFT IT Job Category Across 3 Degree Programs	84	59	153	158	204	201	252	259	1,370 (100%)
Second Perspective Propositions Records									
Records Coded by NFT IT Job Category and Date Job Accepted	23	59	109	140	81	184	228	255	1,079 (78.8% of NFT coded records)
Third Perspective Propositions Records									
Records Coded by NFT IT Job Category and Employer's Industry Sector Classification	84	59	152	158	180	201	251	259	1,344 (97.8% of NFT coded records)

[5] The North American Industry Classification System (NAICS) is the standard used by Federal statistical agencies in classifying business establishments for the purpose of collecting, analyzing, and publishing statistical data related to the U.S. business economy. Accessed June 15, 2018, at https://www.census.gov/naics/ .

Once we were confident in our coding schema, we trained research assistants on coding protocols. After the research assistants completed coding of one year of data, the authors and research assistants discussed where there was disagreement or where data was unclear. The research assistants completed coding for the remaining years; however, authors and research assistants met weekly to review and discuss coding to ensure inter-coder reliability. If agreement could not be reached, the NFT IT job category field was re-coded as "unclear" to ensure that we were only analyzing data where there was 100% agreement on the NFT IT job category codes. Authors later reviewed every code category for every record to ensure consistency.

4 Findings

Findings are presented based on the propositions from three perspectives to explore if IT graduates were placing in IT bridging roles *within* the IT function, as proposed by Niederman et al. (2016).

4.1 Findings Related to the First Perspective Arguing for Increased Need for IT Bridging Roles Within IT

P1. We will observe placement of IT graduates into IT bridging roles reflecting evolving needs for KSA's emphasizing the management of technology, sheltering of users, and user-technology liaison and translation.

Given that we can account for career plans of 75% (1,980) of the graduating IT students, 69.2% (1,755) of whom accepted jobs within IT, our sample shows a larger number of accepted jobs within IT that involved bridging responsibilities. Table 5 reports on the 1,370 records coded under the four NFT IT job categories from 2010 to 2017. In raw numbers, more than double the number of IT students graduating during the eight years of our data accepted bridging jobs within IT over the other NFT IT job categories.

Table 5. Records Analyzed based on Niederman et al. (2016) NFT IT Job Categories

NFT IT job categories	2010	2011	2012	2013	2014	2015	2016	2017	Grand Total	Grand Total %
BRIDGER	37	32	68	82	105	119	143	157	743	54.2%
DOMAIN	23	10	31	35	48	52	63	54	316	23.1%
TECHNICAL	13	12	42	30	40	24	28	34	223	16.3%
MANAGER	11	5	12	11	11	6	18	14	88	6.4%
TOTAL CATEGORIES	84	59	153	158	204	201	252	259	1,370	100%

Figure 1 shows the yearly percentage of graduates who reported accepting a job within IT that fell into the NFT bridging category, aggregated across all programs.

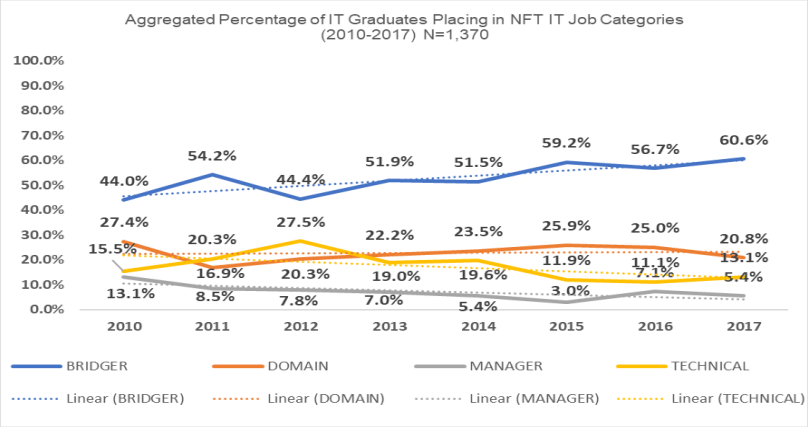

Figure 1. Aggregated Percentage of IT Graduates Placing in NFT IT Job Categories by Year (2010-2017)

Despite the variability over the eight years of data, we see a large number and higher percentage of IT students placing in IT bridging roles compared to roles coded for the other three IT job categories. Over the eight years, 743 or 54.2% of graduates placed in IT bridging roles, with 45.8% placing in the other three NFT IT job categories combined: domain, technical or managerial roles within IT. Even though this data includes only eight years of data from this second decade of the fourth era of technology evolution, the value of IT bridgers within IT seems well established. Niederman et al.'s argument that there will be a strong and even increasing demand for bridgers within IT is supported.

Proposition 2 looks more closely at breakdowns across the three-degree programs. As mentioned earlier, while all three programs provided traditional IT technical training, the UGITM program also emphasized liberal arts and the MITM degree included courses relevant to user focused interactions.

P2. Given the proposed high value of communication/managerial KSA's combined with IT KSA's, we expect that a larger percentage of IT bridgers would be hired into IT jobs from those IT degree programs that emphasize both types of these KSA's.

Figure 2 shows the placement of graduates into IT bridging roles across all three degree programs. The data supports proposition two, specifically in the two programs (UGITM and MITM) that emphasized a balanced focus on both information technology and soft skills with stronger evidence for the MITM master's program that is the most managerially focused of the three IT degree programs compared here. While the response rate in 2011 was very low (29.8%), among those who responded they accepted a full-time IT job, 47.6% found employment in an IT bridging role. The data suggests that the KSA's from these two degrees that emphasized blended technical plus communication/managerial KSA's were highly desired overall.

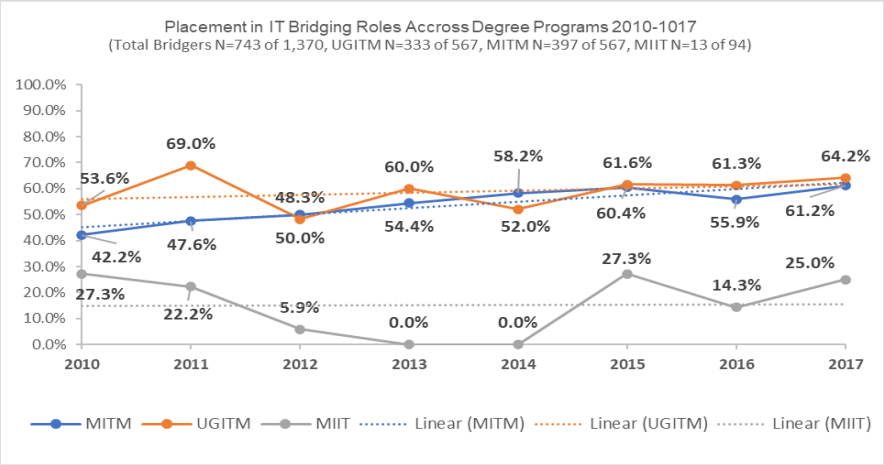

Figure 2. Placement in IT Bridging Roles Across Degree Programs 2010=2017

Figures 3, 4 and 5 show a breakdown by degree program, which further illuminates the importance of soft skill KSA's in addition to technical skills within IT.

4.1.1 UGITM Degree Placement

The total response rate for this group was 71.7%, with 567 (66.7%) of these undergraduates accepting IT jobs that were codable using the NFT IT job categories. The average placement in IT bridging roles for these 567 undergraduate students was 58.7%. Technical and domain specialist roles averaged equally at 19.0% and 19.8% respectively (38.8% total). IT manager roles averaged only 2.5%, likely because one would not expect the traditional undergraduate student to place directly into management. Undergraduates hired into IT bridging roles appear to have increased from 53.6% in 2010 to 64.2% by 2017, as did the number of IT undergraduates obtaining IT employment and reporting their jobs. This suggests some growth in the program overall, but also growth in value of those capable of serving in IT bridging roles.

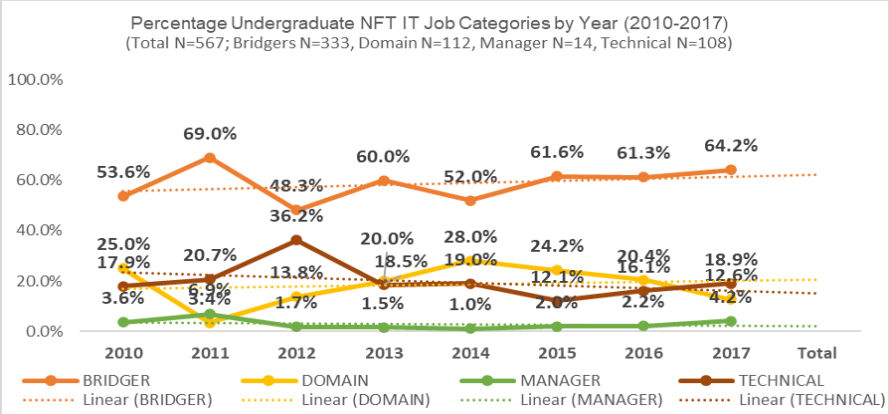

Figure 3. Percentage Undergraduate NFT IT Job Categories by Year (2010-2017)

4.1.2 MITM Degree Placement

The response rate for this group of IT graduates was 71.1%. Eighty-two percent of the MITM graduates (709 of 865) accepted IT jobs codable using the NFT IT job categories, as shown in Figure 4. The average of students placing in IT bridging roles in the MITM program across the eight years was 56%, with a low of 42.2% (2010) and a high of 61.2% (2017). An average of 24.8% placed in domain specialist roles and the average for those reporting their placement in technical specialist roles was only 9.6%. An average of 9.6% of MITM graduates reported placing in manager roles, a much higher rate than the undergraduate program, likely because they were currently employed or because of prior work experience.

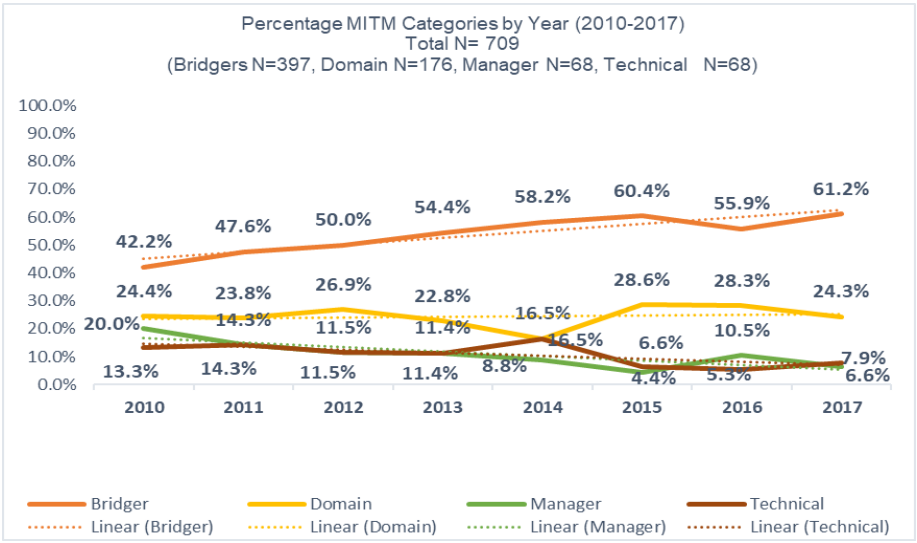

Figure 4. Percentage MITM Categories by Year (2010-2017)

4.1.3 MIIT Degree Placement

This most technical MIIT graduate program had lower overall enrollments and therefore correspondingly lower raw numbers reporting their IT placement. The response rate for this MIIT graduate program was also lower overall at 61.2 percent, with 94 of the 111 responding students accepting IT jobs codable with the NFT IT job categories (84.7%). The smaller size of the program was explained to us as due to a winding down in 2015 due to the popularity of the MITM graduate program, with the intent to sunset the MIIT program and reinvent it in 2018. This sunsetting of the accredited degree, however, kept all the technical courses available to all graduate students (with undergraduate versions also available), as noted by the number of students in the other degree programs who accepted technical specialist roles within IT. Figure 5 looks busy due to the small numbers; however, the graph allows us to see the relative distribution of IT job placement across the four NFT IT job categories with a clear emphasis on these IT graduates placing in the technical specialist jobs. While true comparisons of this degree program to the two larger

programs is less straight forward, we feel the results are still interesting and relevant to our explorations of this third IT program at this school.

It is not surprising that on average 50% of MIIT graduates who responded to the surveys placed in the NFT technical specialist category. Overall, 29.8% of MIIT graduating students placed in domain specialist roles within IT, about 5% more than those in the MITM program. Very few MIIT graduates placed in bridging roles (13.8% over entire eight-year period) and had lower results for IT management roles than the other master's program (6.4%).

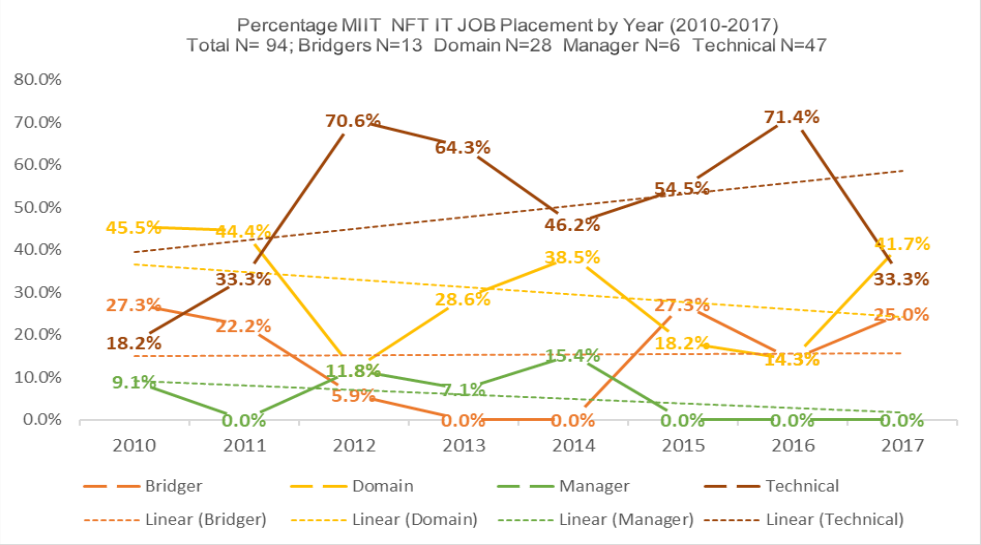

Figure 5. Percentage of MIIT NFT IT Job Placements by Year (2010-2017)

This second proposition that there will be differences on hiring into technical versus other roles based on distinct KSA's of degree programs is a logical expectation and is supported. While domain and technical specialist roles were filled by graduates from all three programs, IT bridgers were hired most from the UGIT and MITM programs that had heavier emphasis on communication/managerial KSA's. When analyzing each degree program in more detail, however, the data supports Niederman et al.'s argument that IT departments in this fourth era of technology value IT graduates able to serve in IT bridging roles, drawing upon curriculum that provides more balanced technical and communication/managerial KSA's.

4.2 Second Perspective Arguing for Growth in Demand for IT Workers

The first competing perspective is that the bridging roles are not, in fact, in any higher demand than other IT roles within IT. While percentages show more IT hires into these roles, this in itself does not suggest higher value so much as KSA fit. As stated in the literature and methods sections, we used timing of job obtained as a surrogate for urgency of employer demand for IT workers. The literature supports that general growth in demand for IT workers is driving placement of IT graduates. We did observe an increase in program size, with more graduates from all but the MIIT program. If general demand is driving urgency in hiring of IT workers, we would expect to see jobs obtained earlier, for example before or within three months of graduation.

P3. All IT graduates from IT focused degree programs will be hired with the same urgency regardless of KSA emphasis.

Table 6 below provides a summary of the total number of IT graduates in our coded sample based on when IT job obtained, along with the average percentage and range. This data is aggregated across programs and years. We were able to analyze 1,079 records based on IT graduates who reported *both the timing of their jobs and were codable into one of the four NFT IT job categories*.

Table 6. Summary of When IT Job Obtained for All NFT IT Job Categories for All Years for All Programs 2010-2017 (N=1,079)

	Before Graduation	0-3 months after graduation	3-6 months after graduation	6+ months after graduation
Total Number of Graduates Included	656	265	113	45
Average Percentage	60.8%	24.6%	10.4%	4.2%
Low-High Range from 2010-2017	52.17% (2010) – 74.58% (2011)	11.86% (2011) – 28-56% (2017)	7.41% (2014) – 21.74% (2010)	0% (2010) – 7.34% (2012)
Cluster Totals	85.4%		14.6%	

On average, about 61% of the undergraduate and master's program IT graduates were hired *before* graduation. Over 85% of IT graduates who reported employment (versus other career alternatives) obtained IT jobs within 3 months of graduation. Those who reported receiving their job offers six months after graduation averaged only 4.2%. These aggregated averages are useful in supporting what is already known about general labor demand for IT workers.

Like Table 6 above, Figure 6 below supports strong demand for IT workers across all eight years and is consistent with United States Bureau of Labor Statistics reports that IT jobs were among the top ten in demand (US BLS 2018).

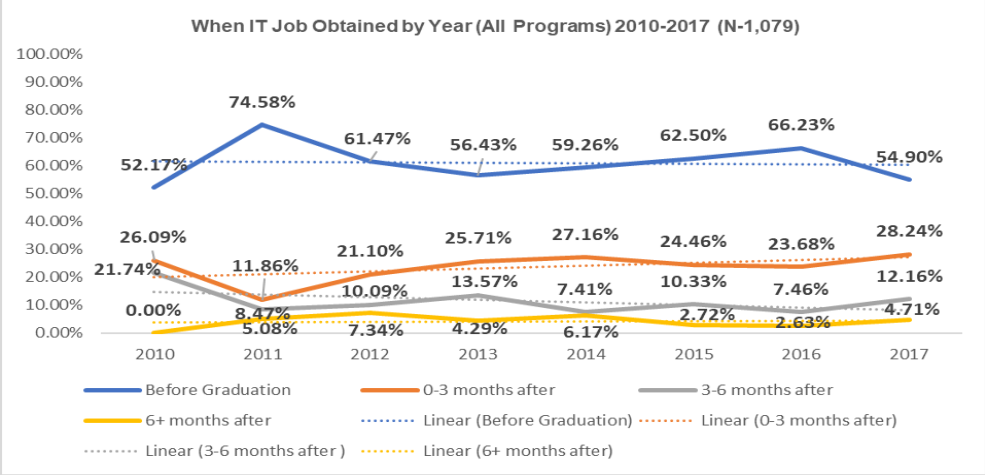

Figure 6. When IT Job Obtained by Year 2010-2017 (N=1,079)

Despite the growth in the raw number of IT graduates in our sample, when considering the percentage distribution of when graduates were hired, there is little shift in the data over the eight years (even accounting for the low response rate in 2011). An average of 85% of responding students from 2010 to 2017 obtained IT jobs before or within 3 months of graduation, aggregated across all programs and NFT IT job categories. As such, we further explored changes in employer urgency based on the three IT degree programs (Figure 7).

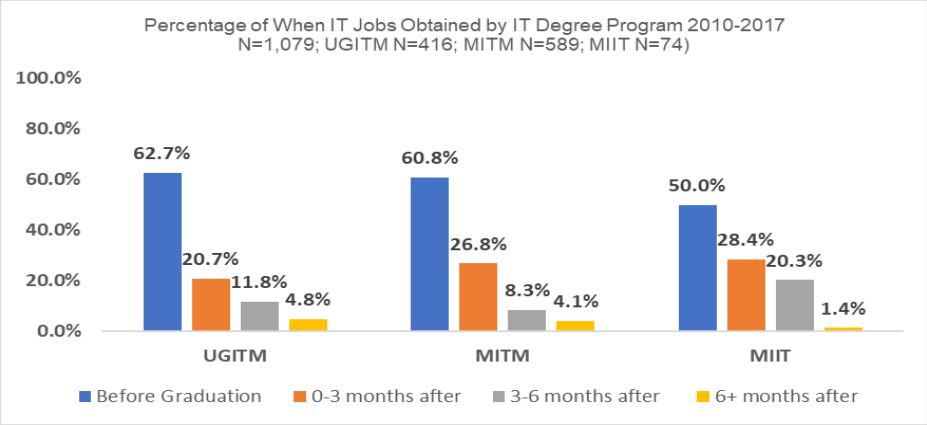

Figure 7. Percentage of When IT Jobs Obtained by Degree Program 2010-2017 (N=1,079)

When analyzing by IT degree program, we see distinct differences in employer urgency based on timing of IT jobs obtained. Figure 7 shows that there appears to be earlier offers from employers and acceptances by those graduates from the more managerially/communication focused degree programs (UGITM and MITM). A total of 87.6% of MITM graduates and 83.4% of UGITM graduates had jobs within three months of graduating. In comparison, 78.4% of the MIIT graduates had jobs within three months. In addition, 21.7% of the more technical MIIT graduates obtained jobs more than three months *after* graduation, in comparison to the 12.4% of graduates from the most managerially/communication focused MITM program.

The fourth proposition considers if IT jobs obtained by graduates are consistent across Niederman et al.'s four IT job categories or if there are further distinctions. If this general demand perspective applied, even with program differences, we would *not* expect to see differences in the urgency of jobs obtained based on whether IT graduates placed in IT bridging roles versus other roles (domain, technical, manager).

P4. All IT graduates will be hired with the same urgency for all four NFT IT job categories, with no difference for the IT bridgers category.

Analysis of each of the three programs showed minor differences in hiring patterns, but those differences are consistent with the aggregated percentage of graduates hired into IT jobs in the four NFT IT job categories. Figure 8 shows that across eight years of data, more of those hired into IT bridging roles were hired before graduation. Regardless of degree program, only 54.7% of those graduates who placed into technical roles and 50% of those who placed in domain roles were hired before graduation, compared with 66.6% for IT bridgers. We do not know if the more technical students had multiple offers, or if there are other explanations. We can also only speculate on the reason for the high percentage of managers with job offers before graduation (61.8%), such as many were returning to prior positions, or simply had more work experience so were a desirable group.

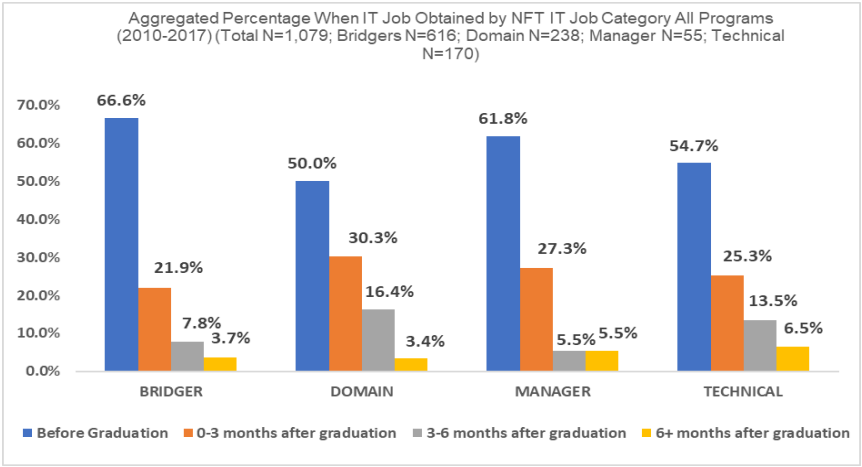

Figure 8. Aggregated Percentage When IT Job Obtained by NFT IT Job Category All Programs (2010-2017)

Within three months of graduation, 88.7% of IT bridgers obtained IT jobs, with 80.3% of domain and 80% of technical IT graduates at this school similarly placed. Overall, the data supports stable demand for all four categories of NFT IT workers, but does not contradict the arguments of Niederman et al. (2016) that IT graduates who can bridge between IT and business units are indeed highly valued within IT.

4.3 Findings Related to Third Perspective Arguing for Funneling IT Graduates to Desirable Employers

The third counter perspective to Niederman et al. (2016) is about where IT graduates get jobs. It is reasonable to expect that some industries hire more IT workers than others, making them potentially desirable first job destinations, however, it is logical to expect that industries need all types of IT workers, not just IT bridgers. Before reporting findings for proposition 5, table 7 summarizes the aggregate placement by industry sectors.

Looking only at all available employer/industry data for this school from 2010 to 2017, Table 7 below shows that 70.8 % of the IT graduates who indicated *where* they were hired were in fact hired into consulting, technology, or finance industry sectors. Proximity to many major cities and large consulting, technology, and financial institutions may explain this. Longitudinally, this placement data shows that these industry sectors formed the major hiring base for IT graduates from this particular school and have done so throughout the eight years of our sample.

Table 7. Aggregate Number and Percentage of Placements Reported by Year All Programs (2010-2017)

Years	Consulting, Technology, or Finance N=1243		Other N=513		Totals by Year (N=1,756)	
2010	89	65.0%	48	35.0%	137	100.00%
2011	58	66.7%	29	33.3%	87	100.00%
2012	150	73.9%	53	26.1%	203	100.00%
2013	158	71.5%	63	28.5%	221	100.00%
2014	154	76.6%	47	23.4%	201	100.00%
2015	209	73.3%	76	26.7%	285	100.00%
2016	213	71.5%	85	28.5%	298	100.00%
2017	212	65.4%	112	34.6%	324	100.00%
8 Year Avg		70.8%		29.2%		

We do not see a marked shift in the percentage of placements to these two industry groupings, despite small shifts from year-to-year. The trend lines in Figure 9 are relatively flat. The findings support larger percentages of placement with employers in consulting, technology, or finance industry sectors but no real increase.

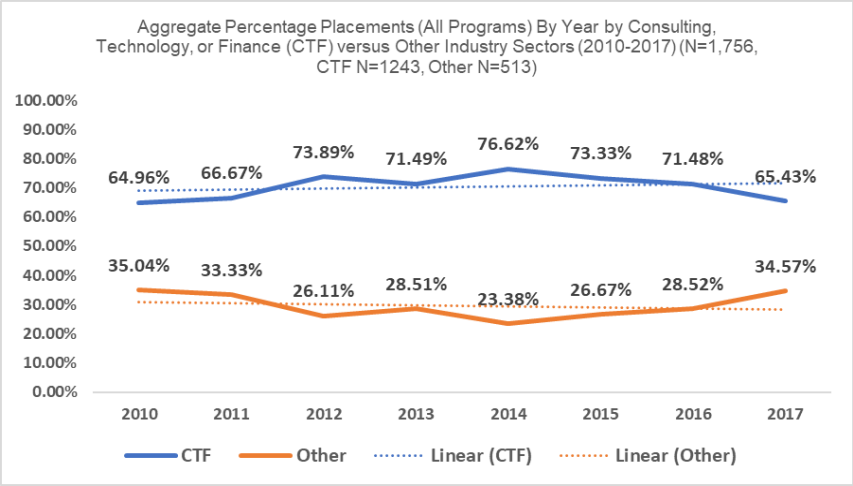

Figure 9. Aggregate Percentage Placements (All Programs) by Consulting, Technology, or Finance (CTF) versus Other Industry Sectors (2010-2017)

The question remains of whether industry sectors differentiate based on placements into IT bridging roles or the other NFT IT job categories? Based on the third perspective, we proposed that:

P5. There will be no difference in graduates' placement in different industry sectors based on NFT IT job categories.

Taking into consideration only those records with employer data that we could code by the NFT IT job categories, we had 1,344 total records across the three programs and eight years of data – 1,029 (76.6%) IT graduates reporting as hired by consulting, technology, or finance industry sector employers and 315 (23.4%) graduates hired by other industry sector employers (Table 8).

Table 8. Aggregated CTF versus Other Placemenet by NFT IT Job Categories (2010-2017) (N=1,344)

	Totals	Bridgers	Domain	Managers	Technical
Totals Across All Employers	1,344 (100%)	737 (54.7%)	307 (22.8%)	86 (6.5%)	214 (15.9%)
Consulting, Technology, or Finance (76.6%)	1,029 (100%)	673 (65.4%)	193 (18.7%)	43 (4.2%)	120 (11.7%)
All Others (23.4%)	315 (100%)	64 (20.3%)	114 (36.2%)	43 (13.7%)	94 (29.8%)

By raw numbers, Table 8 shows that more than half of those hired were employed in IT bridging roles (54.7%), but two thirds (65.4%) of these IT bridgers were hired by CTF industry sectors. Other industry sectors hired only 20.3% (64 of 315) IT bridgers. Remembering that large employers in the CTF industry sectors have heavy percentage of revenues spent on IT investments (Johnson et al, 2023; Kappelman et al., 2020), it is not surprising that they hire IT graduates from an Information School, but there are clearly differences in KSA's they were seeking from this school. The inverse is also true that other industry sectors turned to this iSchool equally for domain and technical specialists – 36.2% and 29.8% respectively for a total of 66.0% of their hires.

Figure 10 compares total placement of graduates into CFT industry sector jobs, aggregating all three-degree programs over eight years. The data shows an apparent upward trend in placement into IT bridging roles across the eight years, suggesting IT bridgers were valued by these sector employers.

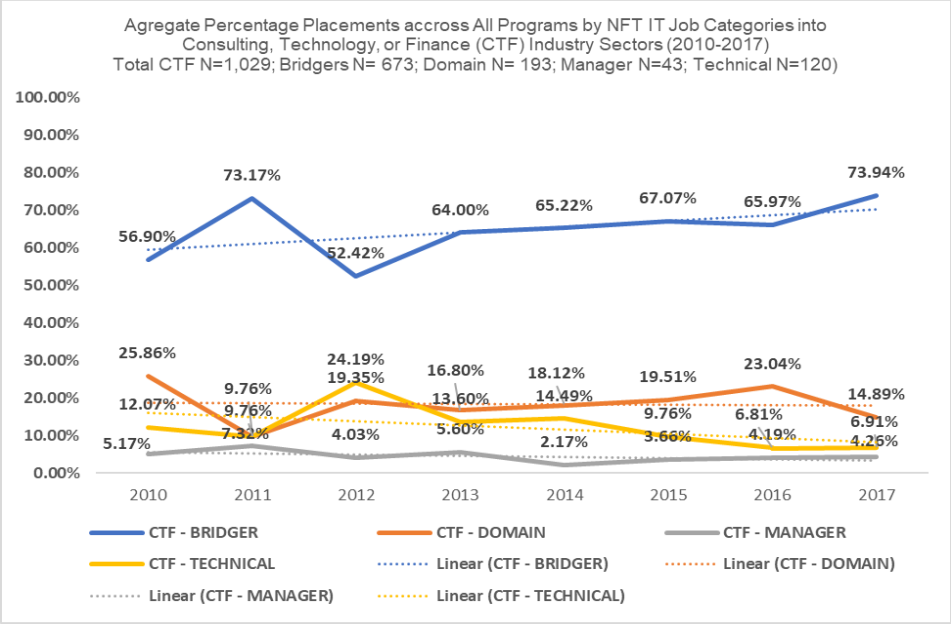

Figure 10. Aggregate Percentage Placements Across All Programs by NFT IT Job Categories into Consulting, Technology, or Finance Industry Sectors (2010-2017)

Figure 11 below explores IT bridgers hired by CTF industry sectors in comparison to other industry sectors over the eight years, regardless of degree program. Consulting, technology, and finance industry sectors seem to be desirable first destination IT jobs as they hired on average 92% of all IT bridgers. Again, this data supports that IT graduates who can fill bridging roles within IT were valued by CTF employers hiring at this school.

In summary, we did not find evidence to support that CTF versus other industry sectors hired equally across all four NFT IT job categories, nor hired IT bridgers equally. Proposition five that all NFT IT job roles are equally valued by all industry sectors hiring at this school is not supported. The hiring of IT bridgers within IT functions by CTF Industry sectors has been high and consistent across the years of our study suggesting early recognition of IT bridgers ability to add value within IT, supporting Niederman et al.'s (2016) argument. The fact that other industry sectors did not hire as many bridgers does not, in itself, contradict their arguments, but it does raise new questions about differentiated KSAs based on industry sectors, and differences in aggressiveness of recruiting (see Binder et al. 2016).

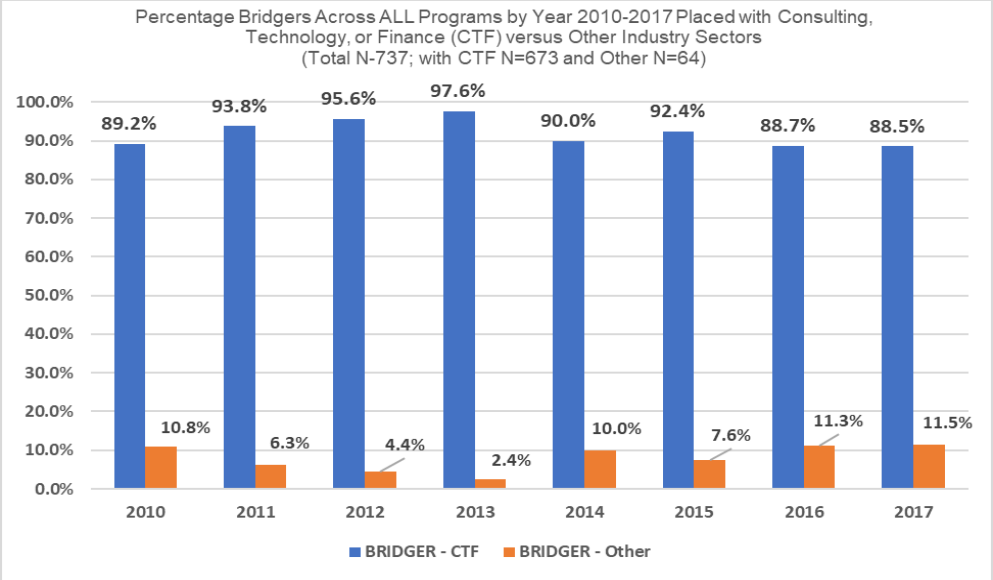

Figure 11. Percentage Bridgers Across ALL Programs by Year 2010-2017 Placed with Consulting, Technology, or Finance (CTF) versus Other Industry Sectors

5 Discussion

We chose to explore if there might be data to support Niederman et al.'s suppositions, but also considered alternative and potentially competing explanations. Our findings support Niederman et al.'s (2016) argument for increased need for the KSA's required for bridging roles *within IT*, rather than simply having IT skills within business units. This is especially the case in some sectors such as consulting, technology, or finance. The findings that these three industry sectors hired over 90% of graduates placing in IT bridging roles (Proposition 5) does not negate Niederman et al. In fact, these findings support the value placed on those able to serve in IT bridging roles among sectors with higher IT spending in relation to overall revenues.

Among the respondents in our study, we found that these IT graduates, in general, were hired before or within three months after graduation. We observed, however, that those graduates who placed in IT bridger roles frequently obtained their jobs before graduation, and a larger percentage obtained jobs before those hired as domain or technical specialists.

Our analysis found other differences by program and employers, for example, CTF industry sector employers were well established at this school in hiring IT bridgers within their IT areas. Employers in other industry sectors hired substantially fewer IT bridgers from this school than their CTF counterparts and proportionally more domain and technical specialists. The more balanced communication/managerial, technical, and liberal arts undergraduate IT program (UGITM) prepared graduates for the full range of Niederman et al.'s IT job categories, with almost forty percent of undergraduate students placing in the domain or technical specialist roles. The MITM program's emphasis on managerial/communication KSA's,

in addition to technical KSA's, also prepared graduates well to serve in IT bridging roles. We can speculate that the value placed on graduate level maturity or experience may also have weighed in these IT graduates favor, despite other potential challenges of VISA requirements for international students or expectations of higher salaries for master's degree holders.

Table 9 provides a summary of our findings for each proposition showing support or lack of support based on our placement data.

Table 9. Summary of Findings

Propositions	Findings
P1. We will observe placement of IT graduates into IT bridging roles reflecting evolving needs for KSA's emphasizing the management of technology, sheltering of users, and user-technology liaison and translation.	Supported: We see proportionally high numbers and percentages of IT graduates placing in IT bridging roles compared to the other three NFT IT job categories.
P2. Given the proposed high value of communication/managerial KSA's combined with IT KSA's, we expect that a larger percentage of IT bridgers would be hired into IT jobs from those IT degree programs that emphasize both types of these KSA's.	Supported. A larger percentage of IT graduates placed in IT bridging roles came from degree programs that have higher emphasis on communication and managerial KSAs in addition to strong technical KSA's.
P3. All IT graduates from IT focused degree programs will be hired with the same urgency regardless of KSA emphasis.	Not Supported. Over the eight years, we observed differences in the urgency of hiring IT graduates from the three different programs.
P4. All IT graduates will be hired with the same urgency for all four NFT IT job categories, with no difference for the IT bridgers category.	Not Supported. Up to 15% more IT bridgers were hired earlier (before or within three months of graduation) than those in other three NFT IT job categories.
P5. There will be no difference in graduates' placement in different industry sectors based on NFT IT job categories.	Not Supported. Across eight years of data, we observed that among consulting, technology, or finance industry sector hires, 65.4% were IT bridgers, more than twice as many as the total of the other NFT IT categories combined. Conversely, the other industry sector hired only 20.3% IT bridgers, hiring predominantly the other three NFT IT job categories from this school.

6 Contributions, Limitations and Future Research

We present our contributions to research and practice, followed by limitations and opportunities for future research.

Our findings support contributions to research and practice in four areas: understanding value of non-technical KSA's combined with technical skills within IT, the utility of a simplified categorization of IT job categories to analyze job placement, the importance of tracking employers and industry sectors hiring IT graduates, and the overall value of IT placement data to support strategic decision making about curriculum.

6.1 Understanding Value of Non-Technical KSA's Within IT

Niederman, Ferratt and Trauth (2016) raise many interesting arguments about how shifts in technology eras have resulted in different needs for distinctive groupings of KSA's and a shift in KSA's required within the IT function over time. Our findings demonstrate that the two-degree programs that provided a balance of managerial, communication, and technical KSA's placed much larger percentages of graduates in IT bridging roles within IT. This is consistent with the conceptual predictions of Niederman et al. Our findings are consistent over the eight years of placement data. In addition to supporting the value of IT bridging roles that include a blend of strong technical skills plus non-technical KSA's, our data supports that IT bridging jobs were obtained earlier (prior to graduation or shortly after) in comparison to the more technical or domain roles. This is potentially inconsistent with explanations of generic demand for all types of IT workers, but an alternative explanation is that those employers seeking IT bridgers have identified these degree programs as providing high quality candidates.

A practical contribution and implication of this study is that it reinforces the need for a diversity of degree programs or specializations within academic programs that prepare future IT workers, regardless of the type of school providing them. More research in this area with a broader range of schools and IT programs would benefit our understanding of evolving KSA's within IT, including soft skills.

6.2 Utility of NFT's Four IT Job Categories

Niederman et al. argue for a macro-level clustering of very diverse IT jobs into only four IT job categories – technical specialists, domain specialists, IT bridgers and IT managers. Our study provides early empirical data to evaluate the efficacy of these four NFT IT job categories. Our exploratory study is the first to apply NFT's four IT job categories as an alternative and more easily comparable approach to understanding placement of IT graduates into diversely titled IT jobs. Our findings support that there is value in using this clustering of diverse job titles into the four NFT IT job categories based on the KSA's required. Information technology jobs have become increasingly differentiated and the NFT IT job categories provide a new and simpler way to understand the relationships between degree KSA's and a new way to code IT jobs.

In practice, academic organizations could use this clustering approach to assess the primary focus, strengths, and potential opportunities of existing or future IT degree programs or specializations. During recruitment efforts, adopting this more condensed classification into the four NFT IT job categories may be useful in discussions of IT programs. The easily discerned distinctions between categories may help attract more people to the IT discipline by illustrating that not all IT jobs are purely technical. Future research might consider if the concern by employers that academic IT programs are failing to prepare students for their jobs can be explained more easily by the program or school emphasis on one or more of NFT's four IT job categories and their general KSA's rather than on specific job titles or simple lag in training versus employer needs.

6.3 Tracking Employers and Industry Sectors Hiring IT Graduates

Consulting, technology, or finance industry sector employers hired higher numbers of IT graduates who had both technical and communication/managerial skills. Other industry sector employers in our sample hired more technical specialist and domain specialist IT workers. We do not know from our data if at a micro level these other employers have smaller IT functions and therefore staff the critical IT roles or if there are other explanations (such as unable to fund visas, lower salaries, higher IT skills in their non-IT areas, or not seeing the need for IT bridgers). Despite this, our study provides new insights into the importance of knowing which employers and which industries are dominant for one's school or programs, and how it may inform career paths for IT graduates, or skilling for particular NFT IT job categories and related KSA's. At a practice level, it is important to track who is hiring our graduates and if there are any dominant industry sectors. There are opportunities for replication by others seeking to understand placement of IT graduates from iSchools, Business schools, or Computer Science schools.

The data, however, also raises the age-old question of what came first – the chicken or the egg. Did the co-evolutionary demand for IT bridgers within IT drive employers from these CTF industries to this iSchool's IT programs that provided graduates with the requisite bridging KSA's or did providing graduates with IT bridging skills attract employers who needed them? One might ask if this matters, but in terms of curricular design and goals to place students well and promptly, it is an important question still to be addressed. If one's degree programs suddenly shift to KSA's that emphasize data analytics, IT security, cloud or AI which prepare IT graduates for the other IT job category roles (technical or domain), then one might inadvertently result in disenfranchising previous hiring organizations who can no longer obtain graduates from a highly desired NFT IT job category. As an example, if this iSchool's programs stopped training IT graduates able to serve as liaisons between IT and business ("bridgers") within the IT function, employers could seek alternative recruiting options. The reverse is true in that failure to track current and target employers could result in continuing to emphasize KSA's out of sync with evolving employer needs.

6.4 Value of Placement Data to Understand Changes in the IT Workforce

Our study modeled one way to analyze IT placement. It is important to remember that many schools or universities do not collect placement data or do so piecemeal or segregated from those who might use it. Others collect it primarily to support the perceived value and marketability of their educational programs or accreditation. Reports often highlight starting salaries, percentage of students placed, those furthering their education, or pursuing military service. Our study demonstrates the value of placement data for

research and practice, showing the importance of consistently collecting and tracking this data with a strategic view, rather than focusing on job titles and starting salaries (see also NACE, 2023).

We found different emphasis on desired KSA's based on retrospective data. If placement data is analyzed in a timely manner, there may be valuable insights available near-real-time to catch evolving competitive strengths or weaknesses. Tracking and understanding the role of shifting KSA's and evolving IT job category placement can provide important insights into curriculum issues in relation to perceived "hot demand areas." This may allow a more strategic geographic positioning of programs in relation to *desired or available* employers in the local, national, and international economy.

6.5 Limitations and Directions for Future Research

We used data from a single information school, which had advantages of consistency and comparability, however, it also is a limitation in that we did not have data on job placement of IT graduates from other types of schools' IT programs. Future studies are needed to explore if there are comparable results for IT graduates of other schools that prepare IT workers and to tease out the subtleties of technical versus non-technical KSA's.

Our use of secondary data presented opportunities in that we were able to capture eight years of longitudinal data very quickly. It also created some limitations in that we had no control over the data fields, different systems were used to capture it, and data was collected under the administration of different people. Despite this, we were careful and rigorous in our curation, normalization, and criteria for what were usable records for purposes of our study. It took far more effort than we had anticipated. There are opportunities for future research that starts now or can go back to capture a more extensive longitudinal sample.

The size of the three degree programs used in this study were very different with two larger degree populations (UGIT and MITM) and one smaller program (MIIT). This made comparisons between programs more difficult. While percentages were used for comparison, in some cases we were comparing vastly different numbers, for example when comparing when job obtained, the number of MITM graduate obtaining their IT jobs before graduation, we had 358 of 589 (62.7%) compared to 37 of 54 (50%) of MIIT graduates. The differences are real, however, in terms of true comparisons and interpretations, the results need to be understood in this context and in some cases taken with caution.

Another limitation of our study is that to our knowledge, it is the first of its kind that looks at NFT's four IT job categories as an alternative and more easily comparable approach to understanding placement of graduates into diversely titled IT jobs. We used Niederman et al. (2016) descriptions to craft the NFT IT job category constructs and inductively used the data to help determine the boundaries in coding. More studies are needed to explore the utility of the NFT IT job category macro-level classification.

We used when IT jobs were obtained (as reported by graduate) as a surrogate for the employer urgency in hiring, however, we do not know if students delayed accepting jobs or if some employers are traditionally early on offers (e.g., many of the larger consulting companies traditionally try to line up hires before graduation). This surrogate measure is also not a measure of true demand for IT workers, nor does it reflect demand for KSA's offered by other IT programs not studied here. Using when IT jobs were obtained as a surrogate of urgency does help us see if there are distinctions based on various IT jobs. This can inform curricular decisions and employer relation initiatives.

The clustering of industry sectors into CTF versus "other" is a very high level grouping, and specific to this data set and the dominant hires at this school. While studies show CFT are higher IT spend sectors, there are other industries that may offer high paying IT jobs and may be viewed as desirable first destination employers for IT graduates depending on program KSAs, geographical location, or targeted employer relationship management. A desirable employer or industry for one type of IT job or within one region may not be a desirable employer for another IT job or even feasible in certain geographical regions. More studies are needed to evaluate the value of industry sector data for all IT programs across the variety of schools providing IT education.

7 Conclusion

The emphasis on having both business and technical knowledge on the business side of organizations has been studied for decades. The study presented here is an exploratory study to see if arguments by Niederman et al. (2016) that the pendulum had swung and that IT functions are increasingly valuing IT

workers who can bring communications, managerial, and other soft skills to their IT roles. Our study highlights that there are opportunities to explore how the IT function has embraced this and is hiring those IT workers who can bridge from their side. Despite the limitations, our exploratory study begins to fill a gap in understanding shifts in KSA's value within IT that go beyond purely technical skills. As noted by Niederman et al., schools that train the IT workforce are facing curricular challenges related to breadth and depth. These strategic decisions may be informed through analysis of placement data for their IT graduates.

We hope others will take up the challenge and continue to explore this important topic. We also hope that practice will embrace the need for more and better data on where IT graduates place.

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Appendix A: Coding Examples For Niederman et al. (2016) Four NFT IT Job Categories

NFT IT Job Category	Definition	Examples of Job Titles
Technical Specialist	Those who work with and are directly concerned with the operation of new and evolving technology, characterized by infrastructure, and computing architectures, including security architectures, password and access controls, and other IT security technologies.	Network Engineer Software Testing Analyst Infrastructure Solutions Analyst Infrastructure Engineer Technology Services
Application Domain Specialist	Those who do more than use IT to effectuate predefined tasks but help to evolve technologies to a larger range of tasks and more effective operations.	Data Analyst/Engineer Software/Application Engineer/Developer Business Intelligence Analyst/Developer Web Developer Datamining analyst
Manager	Those at various levels within and across the three previous categories who are responsible for IS managerial functions. Any role listed as manager, regardless of whether they are technical, domain, or bridging.	IT Director VP Global Technology Telecom Services Manager, Manager IT Infrastructure Associate CIO
IT Bridger	IT personnel who extensively provide linkage or liaison between IT and the business domain. These are roles that clearly imply working with business units and IT.	Systems Integration Analyst/Consultant Business Technology/Systems Analyst Technology Solutions Analyst IT/Technology Consultant Technical Implementation Consultant
Note: The coding of NFT IT job category was not just based on the IT job title, we also considered the job function, the job type, and the industry. For example, IT Security could be a manager role, a domain role (e.g., risk and compliance; auditing), a technical role (security architecture), or bridging role (e.g., IT security awareness training). We coded accordingly. For more details on the coding please contact the Author.		

Appendix B: Placement Records by Industry Sector Classification[6]

Industry Classification	2010	2011	2012	2013	2014	2015	2016	2017	Grand Total
Consulting	23	12	67	71	69	78	80	86	**486 (27.7%)**
Technology	31	24	38	50	38	70	77	83	**411 (23.4%)**
Finance	30	20	44	36	46	59	51	39	**325 (18.5%)**
Education	10	7	10	13	8	15	17	19	99 (5.6%)
Government	13	3	11	10	11	12	7	10	77 (4.4%)
Retail	5	2	5	7	7	11	13	18	68 (3.9%)
Publishing, Media & Comm.	7	1	9	10	1	9	12	13	62 (3.5%)
Healthcare	1	7	11	8	3	8	8	13	59 (3.4%)
Manufacturing	5	4	3	4	5	3	4	7	35 (2.0%)
Marketing	1	1	1	5	4	6	6	8	32 (1.8%)
Arts, Entertainment & Recreation	2			3	3	3	6	6	23 (1.3%)
Aerospace	5	2	1	1	1	2	5	4	21 (1.2%)
Transportation				1		5	2	3	11 (0.6%)
Services		1	1	1	4		1	2	10 (0.6%)
Food and Beverage	1	1	2				3	3	10 (0.6%)
Energy and Utilities	2	1		1		1	1	3	9 (0.5%)
Logistics and Supply Chain	1	1			1			4	7 (0.4%)
Real Estate/ Construction	1					1	2	3	6 (0.3%)
Law						2	3		5 (0.3%)
Sub Total	137	87	203	221	201	285	298	324	1,756 (100%)
Self-Employed	2	1	2	4	1	4	2	2	18
Grand Total	139	88	205	225	202	289	300	326	1,774

[6] Industries coded as finance sector include insurance, banking, investment, mortgage, and credit cards. Industries coded as consulting sector include general management and IT consulting. Industries coded as technology sector include software and hardware services, technology goods, telecommunication, utilities, and aerospace as these fit the fit BLS criteria (Wolf and Terrell, 2016).

Appendix C: NFT IT Job Categories Hired by Industry Sector (2010-2017) (N=1,344[7])

Consulting, Technology and Finance Sectors						Other Sectors					
Year	**Bridgers**	**Domain**	**Manager**	**Technical**	**Total**	**Bridgers**	**Domain**	**Manager**	**Technical**	**Total**	**Grand Totals**
2010	33	15	3	7	58	4	8	8	6	26	84
2011	30	4	3	4	41	2	6	2	8	18	59
2012	65	24	5	30	124	3	7	7	11	28	152
2013	80	21	7	17	125	2	14	4	13	33	158
2014	90	25	3	20	138	10	14	6	12	42	180
2015	110	32	6	16	164	9	20	0	8	37	201
2016	126	44	8	13	191	16	19	10	15	60	251
2017	139	28	8	13	188	18	26	6	21	71	259
Grand Total	**673 (65.4%)**	**193 (18.8%)**	**43 (4.2%)**	**120 (11.7%)**	**1,029 (100%)**	**64 (20.3%)**	**114 (36.2%)**	**43 (13.7%)**	**94 (29.8%)**	**315 (100%)**	**1,344**

[7] Consulting, technology, or finance industry sectors also hired 122 into non-IT roles, and other industry sectors also hired 117 into non-IT roles. Only 10.6 % of IT graduates placed into consulting, technology, or finance industry sectors were hired into non-IT jobs, as compared to 27.7% of IT graduates placed into non-IT jobs in other industry sectors. This Non-IT job data was not analyzed further due to the focus on NFT IT job categories.

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