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A Comprehensive Framework to Enhance the Effectiveness of the Recruiting Experience for Data Science Graduates

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Abstract:

The allure of the IS major depends on the successful placements of recent IS graduates in rewarding careers. The rise of the data science field provides an opportunity to rebrand and rebuild IS departments using the career-placement successes of IS graduates as a springboard. This paper describes a framework that IS departments can use to coordinate between the employer demand side and the graduate supply side of the data science job market. We developed the framework based on empirical evidence gained over several years in successfully placing IS graduates into IS consulting firms across the US. The framework contains four different perspectives: the university IS department, the organizations hiring IS graduates, the IS graduates themselves, and career-development professionals at the university and college level. IS departments seeking to place their graduates in the data science field can use this framework.

Keywords: Student Skill Sets, Data Science, Student-employer Engagement, Recruiting.

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1 Introduction

The data science field is growing immensely in information systems (IS) (Bughin, Chui, & Manyika, 2010; Chen, Chiang, & Storey, 2012; Davenport, Barth & Bean, 2013). Data science refers to extracting knowledge from data using descriptive, predictive, and prescriptive analysis (Dhar, 2013; Grus, 2015). Although this definition is vague, data science is arguably the umbrella term for such fields as big data, business analytics, and business intelligence. Businesses are looking to hire graduates who are familiar with basic data science techniques such as data cleaning, data warehousing, querying, statistical analysis, and predictive and prescriptive modeling. In addition, businesses are looking to hire graduates with skills such as domain knowledge and data visualization, which are just as important as those on the technical side of data science. IS programs across the globe are quickly adapting their programs to meet this changing demand.

However, compared to traditional IS, data science offerings are cross-disciplinary in nature. Students who want to pursue careers in this field must be skilled in statistics, computer science, and IS. This skill level must go beyond what the introduction to statistics or introduction to computer science courses that most IS majors take offer. As such, IS departments need to understand the field's changing skill sets.

To further complicate matters, IS majors are dwindling or remaining stagnant in number even though the demand for technology-oriented fields are growing (Burns, Gao, Sherman, Vengerov, & Klein, 2014). Previous research attributes this phenomenon to common myths about the IS field, including the increase in offshoring, lowering salaries, and an uninspiring perception of work responsibilities such as programming (Dick, Granger, Jacobson, & Van Slyke, 2007). The rise of the data science field provides an opportunity to rebrand and rebuild IS departments. Successful placement of graduating IS students in rewarding careers has an impact on how current and prospective students view the IS major (Koch, Van Slyke, Watson, Wells, & Wilson, 2010) and has a significant impact on the IS major's strength and vibrancy (Firth, Lawrence, & Looney, 2008). Koch et al. (2010, p. 488) describe the importance of working with external stakeholders, primarily employers, but they do not provide detail on how to achieve this collaboration. Without coordination between the demand side (organizations hiring graduates) and the supply side (universities supplying graduates), IS departments could misfire in their efforts. Without this coordination, the skills employers seek may mismatch with what IS departments deliver in the curriculum. Arguably, the skill sets are the same—they are just communicated in a different manner.

To address this potential mismatch, we describe a framework that IS departments can use to coordinate between the demand side and the supply side of the data science job market. Specifically, we design a process in which IS curriculum administrators/faculty members coordinate with organizations hiring (or potentially hiring) their graduates to increase the hiring of IS majors in the data science field. This process possibly requires adjusting classes and creating data science certificates or areas of concentration/specialty, tracks, or domain knowledge. We developed this framework to help University of Montana (UM) IS students compete in the highly competitive information systems consulting field, and it has shown promising results in consulting. In a typical year, more than 40 percent of UM's IS graduates obtain work at an IS consulting firm of their choice. In addition, UM provides one of the largest sources of talent for two global companies seeking IS graduates. UM is now taking that same framework and applying it to the data science field to provide IS students a chance to be a part of this high-growth employment opportunity.

This paper proceeds as follows. In Section 2, we review the literature. In Section 3, we discuss the skill set-based framework. In Sections 3.1 to 3.4, we explain each process from four different perspectives: the university IS department, the organizations hiring IS graduates, the IS students themselves, and the university and college/school career-development professionals. Each of these processes represents a set of tasks that one needs to complete in a certain order. Appendix A summarizes this framework with a flowchart. In Section 4, we discuss how to implement the framework, alternatives, and next steps. Finally, in Section 5, we conclude the paper.

2 Literature Review

The literature on fostering college graduates to make them more employable is well grounded and has a rich history in many fields of study. Birch, Allen, McDonald, and Tomaszczyk (2010) studied the considerable mismatch between student job expectations and experiences with what the business community expects. Gault, Leach, and Duey (2010) examined the differences between how much training

students believe they need versus what employers already expect from the students when hired. These sources definitely note a mismatch in expectations and skills.

Tanyel, Mitchell, and McAlum (1999), in surveying prospective employers and university faculty on their perceptions of the skills and abilities business school graduates should possess in to compete in industry, found that about half of the skills listed by each group differed. In other words, what faculty thought were the important skills versus what prospective employers actually sought did not match. This gap in skills demonstrates the importance of revising curricula and making other changes in business education (Tanyel et al., 1999).

Other research has addressed the need to change and adapt the university curricula to meet the needs of making students more employable. For example, Ehie (2002) discusses the importance of constantly updating IS programs to keep pace with rapid changes in the IS market. Ehie argues that the development of an undergraduate IS program should be grounded in the industry's expectations by reflecting on the perspectives from individuals that employ IS graduates. Wilton (2008) studied business graduates from 1999 and followed up with them four years after graduation to report on their experiences. He explores the relationship between skills developed in undergraduate programs and those used in employment. Wilton expresses the need for business schools to engage more with employers to determine employability strategies and practices to help graduates transition into the workforce. Wilton also discusses the balance of on-the-job training that employers should pay for versus what skills graduates should have coming out of their programs.

Along this theme, other research has examined a skills-based approach for students to make them more employable. Bridgstock (2009) discusses the increasing pressure for universities to produce employable graduates. She argues for optimal economic and social outcomes wherein graduates must proactively navigate and self-manage the career-building process. As a result, students gain discipline-specific skills and important generic skills. Andrews and Higson (2008) conducted a study in Europe on the importance of why universities must provide students skills that fit employers' needs. One finding from their study demonstrates the importance of a student gaining skills via work experience and internships. Rosenberg, Heimler, and Morote (2012) used a survey methodology to empirically examine the basic employability skills needed for job performance in business-related fields. They found that considerable differences in opinions among some of the different actors (recent graduates, faculty, and recruiters) with regards to the skills needed for job performance exist.

Bennis and O'Toole (2005) discuss how business schools, particularly MBA programs, face intense criticism for failing to provide useful skills, failing to prepare leaders, and failing to guide ethical behaviors that lead graduates to good corporate jobs. They argue that business schools have adopted a measurement of success by how their faculty members conduct scholarly research. Instead, they contend, business schools should balance this scholarly research with diverse faculty populated with professors who hold a variety of skills and interests in the business field.

Chiang, Goes, and Stohr (2012) present the challenges facing IS departments on adapting to delivering big data education. They discuss the knowledge and skills needed for graduates to navigate employment. They note that academic business analytics offerings should better align with the needs of employers. Wixom et al. (2014) call to universities to respond to emerging needs in business intelligence/business analytics (BI/BA). They encourage IS leaders to continuously refine curricula to keep pace with the marketplace.

After an extensive search of the literature, we found only a small number of skill set-based approaches to curriculum changes at the university level. Washer (2007) proposes a framework for key skills that one can use or adapt in any discipline at the university level. However, this framework does not adopt potential recruiters' guidance and is not specific to fast-changing fields such as information systems. In another example, Jones and Warnock (2014) create a competency framework for student work-based learning. In their framework, they consider ways to incorporate work-based learning into their curricula. However, this framework focuses on biosciences, and the skills presented are at a higher level. For example, some of the skills listed are teamwork, leadership, and communication skills. Although students need these skills, the framework does not provide an overall process on how to coordinate with employers to add the skills to the undergraduate curriculum.

The theme of the relevant literature in the field addresses the importance of understanding the skills that employers need and the university's importance in filling this need. Given the IS's ever-changing nature, IS departments need to continuously adapt the skills that employers need. In Section 3, we present a

framework with which one can evaluate the skills that employers need and integrate them into the IS curriculum. We also discuss the framework, the actors, and the responsibility of each actor in the framework.

3 The Framework and Major Players

Figure 1. Summary of a Skill Set-based Framework for Student-employer Engagement

Figure 1 shows a high-level summary of the skill set based framework for student-employer engagement. We created this framework by synthesizing previous literature in the fields of university curricula, employable skill sets, and data science skill sets (see Andrews & Higson, 2008; Bridgstock, 2009; Chiang et al., 2012; Cox & King, 2006; Ehie, 2002; Rosenberg et al., 2012; Wixom et al., 2014; Wixom et al., 2011). IS departments need to understand the required skill sets for graduating IS majors and then teach those skill sets. Employers have to clearly understand what skill sets they need and clearly communicate those skill sets to the IS majors they seek to hire. Students need to clearly understand the skill sets they have, how they match those being sought by employers, and clearly communicate their skill sets to employers. University and college/school career-development professionals need to establish relationships with all three of the other players in the framework and help the students maximize their ability to secure quality careers and internships. For example, career-development professionals can offer resume, cover letter, and interviewing workshops for students. In Sections 3.1 to 3.4, we detail the processes and required actions of the IS department, the employers, the students, and the university and college/school career-development professionals.

We recognize that IS departments operate in many different configurations and are subject to many competing constraints as a result (King et al., 2014), but we believe that one can use the framework we present here in a wide variety of IS department configurations.

3.1 IS Department

The first task for the IS department is to understand which organizations are hiring its graduates. This task is the cornerstone of understanding the demand side of the equation. One can accomplish this task in many ways.

A simple procedure is to survey students in the IS capstone class prior to graduation. Although simple, this method is problematic in that it almost certainly will not capture the complete list of where students will go on graduation unless one deploys it after the end of class. At that point, the data's completeness will likely be severely hampered. In addition, many students often take some time after graduation to secure their first career placement, so the optimal time to deploy the survey is almost impossible to know.

Instead, using an IS tool such as LinkedIn (www.Linkedin.com, a business-oriented social networking service launched in 2003 with more than 330 million users as of January 2015) allows the IS department to more completely and accurately track graduates. At UM, we require students in the IS capstone class to add themselves to the UM IS major LinkedIn group. We also take this opportunity to coach students on the value of a professional networking tool such as LinkedIn, and we show them that most employers have a profile on LinkedIn and that most IS professionals at those organizations also have personal profiles on LinkedIn. We encourage our students to "follow" the organizations that they might be interested in joining. "Follow" is a feature on LinkedIn that pushes posts made on LinkedIn by the followee to the follower.

As a result, this process ensures that IS departments can do a search in LinkedIn to see where their IS majors find work after graduation. Figure 2 displays such a search that members of our IS faculty performed recently on LinkedIn. The LinkedIn search engine allows a host of options for refining the search. Figure 2 displays a general search that took less than 10 seconds to complete from the launch of the LinkedIn webpage. From our search, we determined that KPMG (KPMG US and KPMG are both the same firm) is the main employer for our IS students, followed by a local IS consulting firm (Advanced Technology Group), DirecTV, and Microsoft. We also were able to quickly determine to which locations our students go and what they do.

Figure 2. LinkedIn Group to Determine Where IS Majors are Employed on Graduation¹

Once one establishes top IS student recruiters, determining what skill sets employers most seek is more defined in scope. We first focused on our top five employers. We used LinkedIn to determine that our IS majors were going to particular areas in these employers. For example, KPMG is best known as a global accounting and auditing firm. However, most of our students are hired by KPMG's IT attestation practice (in the firm's advisory side). This information is incredibly useful to determine the skill sets that our students need.

Keeping the focus only on top five employers as a first iteration through the process, IS departments should determine the required skill sets these employers seek in their new IS employees. One can achieve this task relatively straightforwardly by reading the job description that the employers post on the university career services' job postings website. We have found that employers' human resource departments usually write the job descriptions and that the descriptions themselves contain ambiguous and/or vague statements such as "technical skills" or "attention to detail".

One can take several steps to glean more meaningful skill set data. First, one can again use LinkedIn. Drilling down on currently employed (former) students in KPMG's IT Attestation practice, for instance, we quickly built a coarse skill set profile by simply looking at the "skills" section of the individual employee's profile. Figure 3 below shows that "business analysis", "business intelligence", and "program management" are the top three skills for this particular former IS student. Running through this process

¹ To create this picture, use the search function in LinkedIn to find the university/school. Click the students and alumni link. Use the right arrow in the middle of the screen to the "what they studied" list and add all the relevant selections for the majors. Then click on each bar to refine the data.

just four or five times on different graduates quickly showed the most meaningful skill sets for our former IS students in KPMG's IT attestation practice.

Figure 3. Using a LinkedIn “Skills” Profile to Determine Required Skill Sets

With skills such as “IT strategy”, “business process”, “business intelligence”, and “integration”, LinkedIn clearly provides only a high-level assessment of the skill sets needed. As a next step to obtain more specific and useful skill sets, we approached several of our former students at our top five recruiting firms. Using the high-level skill sets provided by our LinkedIn searches to scope our questions, we drilled down on the five skill sets most meaningful to the employer and, therefore, which ones should be of critical importance during the recruiting process.

Next, one should map these “top five” meaningful skill sets to specific courses offered in IS departments, which requires working directly with the professors/instructors teaching the IS courses. We have found that one can frequently and simply map the skill sets to the course schedule or timeline for a class. If a course or a combination of courses already offers the skill set, then the IS department and the applicable professors/instructors needs only to ensure the knowledge stays relevant.

If the skill set(s) sought by the top employers is not currently taught in a course or a combination of courses, then one needs to investigate further. First, the IS department needs to determine if the missing skill set is simply for one specific organization or for a broader base of organizations. If the former, then the IS department needs to determine if the organization is a large enough recruiter to warrant adding the skills to an existing course or a new course. Second, the IS department needs to determine if the new skill is in line with the strategies of the university, college/school, and department. For example, if the strategy of the IS department is to concentrate on security or software development, then perhaps a new data science skill set is not in line with this strategy—in which case the department can decide with much more complete and useful data whether to add the skill to a course.

In our experience, one can map many data science skills to existing IS courses such as database and systems analysis and design. For example, one skill set that two top employers identified was the ability to manage cloud resources and, more specifically, familiarity with Amazon Web Services (AWS). We easily remedied these skills’ absence in our existing classes by placing all of the hands-on technical aspects of the database course on AWS. The students in the database course now create their own virtual Amazon Relational Database Service (RDS). Another example of a skill set that an employer required was the ability to use the statistical package R. Previously we used SPSS in our introduction to data analytics course, but none of our employers needed SPSS as a skill set. As such, we offered R instead of SPSS. Since R is open source and plenty of resources for it exist on the Internet, the learning curve was not too steep for our faculty members.

One may have to add more-specific data science skills, such as neural networking or cluster analysis, to existing courses in the IS major or one may have to establish a new class in the IS major. Given ongoing budgetary constraints, we recognize that new classes are difficult to bring to life, but the process

described here might also allow an IS department to look across other units on campus to see if students can garner the required skills outside the business college/school. For instance, cluster analysis is often taught in mathematics, computer science, or psychology. Armed with the knowledge that cluster analysis is an important skill and knowing where on campus that skill set is being taught, the IS department can now advise students more astutely in how to have a successful basket of classes on graduation and perhaps consider these cross-campus classes as electives.

In summary, the IS department must identify the top data science recruiters. After establishing a relationship (see Section 3.1) with these recruiters, the department must identify the skills needed for these positions. After a skills inventory, the department should map those skills to courses offered through the program. If the skills are missing and are in sync with the department's strategy and mission, then departments should consider offering these skills in current courses, creating new courses, or determining where on campus these skills are being taught. Although we explain these tasks serially, this process is iterative. As soon as recruiters need or request new skills, the IS department must repeat this process. Once the relationship is established with top recruiters, future iterations of this process are easier and less time consuming.

3.2 Organizations that Hire Graduates

Many of the employer-related tasks listed in this framework are already part of recruiters' existing hiring practices for students. For example, communicating the required skills needed for the position and interviewing students are well-established practices for an organization hiring graduates. However, in our experience, many organizations could do a better job of describing the skills they require of IS majors.

As an example, we have seen the phrase "high technical aptitude" listed by one top recruiter on its open position posting, and we also have heard it stated during an information session to an introduction to consulting class. What the top recruiter actually meant, though, was "the ability to learn new software". The original phrasing frightened away many talented IS graduates because they inferred that the recruiter was seeking computer science graduates rather than IS graduates. With modified phrasing that focused on the skill set that IS students possess, many more IS graduates applied for the job.

In another example, one recruiter listed the skill "data analytics experience". Few IS graduates would confidently list this skill on their resumes. After conversing with the recruiter, our faculty members discovered that the recruiter actually meant that it sought students with an interest in data analytics and the high-level ability to understand databases and SQL queries. Accordingly, IS graduates could confidently include on their resumes that they understood databases and SQL queries and if they had an interest in data analytics.

The fact that recruiters use vague and often ambiguous terms and descriptions for key components of the recruiting process has a direct impact on the recruiting outcome for data science graduates. The focus then becomes on how to help recruiters and, sometimes, even employees improve their descriptions and terms. We have found a two-step process to work well: IS departments need to 1) recognize and understand that recruiters often do not understand the implications of the terms and descriptions they are using in their recruiting efforts and the effects these terms have on their target audience, and 2) establish a good working relationship and open lines of communication with those who recruit its IS majors. With great working relationships in place, the IS department faculty can provide guidance to the recruiters on better ways to present what they are looking for in ways that resonate with the students who the recruiters target.

Our intervention with the recruiters presented in these examples illustrates a critical component of a skill set-based framework for student-employer engagement: the IS department needs to establish a good working relationship and open lines of communication with the top employers of its IS majors. To facilitate good working relationships, we established faculty-employer engagement teams with two faculty members per team and some overlap between teams. These teams work closely with a top employer or two. As a result of these relationships, we can easily have offline conversations about the skill set-based framework for student-employer engagement. During these conversations, we can raise issues regarding how the employer can improve the focus of the skill set description and other matters related to messaging.

Another important component for organizations that hire IS graduates is that recruiting efforts inside and outside of the classroom are crucial in establishing a relationship between students, recruiters, and the IS department; further, one can best achieve such efforts by involving recent IS graduates (Firth et al., 2008). Recent graduates have been in the same classrooms as the current students seeking employment, so

they understand the classes the students are taking, what those classes teach, and what one needs to succeed in an IS career.

IS departments and recruiters should use these recent graduates in recruiting efforts outside the classroom, including receptions, meet-and-greets, and evening presentations about the recruiter. These meetings can be formal or informal depending on the recruiter's culture. During these meetings, students can have one-on-one conversations with the recruiter's current employees regarding day-to-day life at the organization. Many of the students' questions can be addressed in this setting rather than in the formal interview, with the interview conversation then being able to have a sharp focus on the skill sets needed and possessed.

As we discuss above, in-classroom presentations are an important part of employers' recruiting effort. We typically schedule these presentations as 15-20 minute presentations toward the end of a class period followed by a question-and-answer session. These classroom presentations should be made in the "right" courses. Working with our two-person faculty-employer engagement teams, we identify (based on skill sets the employer requires) the classes in which the employer should make presentations. Where the skill set match is perfect, we often schedule an entire class period for the employer. However, we prohibit the employer from making a "sales pitch". We require a reasoned and tailored discussion to the class on how the skills in class are relevant to the students. After a recent class presentation, several students commented how they "had no idea that you could actually do what we cover in class as a career". As a result, our visiting employer saw a quick up-tick in the number and quality of students interested in open positions.

From our experience, we have also found that scheduling these full class presentations to end 15-20 minutes before the end of the class period allows for a mini meet-and-greet session during which interested students can chat informally with the visitors. Both the employers and the students value this time greatly.

Finally, having a visiting recruiter present in multiple IS courses is redundant; some students have shown disinterest in the visiting recruiter as a result of having to attend the same presentation repeatedly. To avoid this issue, we coordinate classroom visits by recruiters to core IS classes by student level. For example, a recruiter will visit only one 300 level class and one 400 level class per semester/year. Although we have not completely eliminated this issue, we have reduced it significantly.

3.3 Students

The third player in this framework is the IS students. Students can and should start engaging in the recruiting process early in their college careers with career development activities. A university or college/school career-development center can help students develop and refine networking and career-advancement skills in general. As we discuss in Section 3.4, career-development centers can provide more specialized assistance tailored to individual students and their strengths/challenges. Students should start these processes as soon as they are admitted into the IS major. In accordance with the "12-Step Program to Bring About Change in the Introductory IS Course" (Firth, Lawrence, & Looney, 2008), we have students set up a LinkedIn account profile early in their academic careers for two primary reasons. First, recruiters can use the information on LinkedIn to find potential candidates who fit their open positions. Second, nearly every employer will look at a student's LinkedIn profile to better understand the student and to learn how they have engaged in the professional networking space.

We introduce the students to why professional networking is important and emphasize that LinkedIn focuses on skills because employers focus on skills. We then Skype chat with an IS alumnus from one of our top IS employers to talk about the usefulness of LinkedIn and how skills from the IS major are useful in the business world.

An important task for the students is to provide skills on the resume that map to classes taken. For example, having "technical skills" on the resume provides no substantive information for potential employers. Instead, students should provide details such as NoSQL, R, or Python. In addition, students should include soft skills on the resume, such as "ability to design an OLAP structure". Students can take these skills directly from class syllabi or timelines/schedules of weekly topics covered. If a student's IS department has followed our suggested framework, professors/instructors have already added the skill sets covered in class to the syllabi. This information allows for a good match between skills the employer needs and skills the students possess.

Once the student is ready to apply for internships or full-time employment, the student starts seeking recruiters that are hiring. If the student is interested in a specific organization, we recommend that the student visit with their IS professors about the organization and/or position in the organization. The crucial part of this framework is for the students to visit with their professors and for these professors to understand the skill sets and culture of that particular recruiter. Because the IS department could have a relationship with this recruiter and certainly will have a relationship with the top hiring recruiters, such an approach could benefit the student and the recruiter by helping to ensure that the potential relationship is the right fit. Where there are faculty-employer engagement teams, those faculty have a particularly deep and rich understanding of the skill sets needed for those top employers and can help facilitate an even better process for IS students interested in those employers.

3.4 Career-development Professionals

Finally, a major player in this framework is university and college/school career-development professionals. These professionals at the university and college/school levels can provide much-needed assistance to students in specific career-development areas (especially if they work together in a coordinated and cohesive manner): resumes and cover letters, interviewing, etiquette and appearance/attire/hygiene, and networking.

First, for resumes and cover letters preparation, our career services and internship services offices have professional staff members who are experienced and certified to assist our students with preparing effective resumes and cover letters. We have found that, because of their knowledge base and ongoing training, these professional staff members can provide a level of assistance to our students that our faculty members generally cannot. For example, these professionals provide counsel on matters of form (e.g., advising students to use identical fonts for the cover letter, resume, and “references” document and to use a professional email address and remove the hyperlink from this address) and not simply matters of substance. Through our school’s career-development program, we ensure that these professionals and the business professionals from human resource departments in the area receive maximum exposure to our students, and we have received many compliments from employers on the professionalism and polish of our students’ resumes and cover letters.

Second, interviewing skills are crucial to gain employment. In our experience, helping students prepare for the interview process is another area in which university and college/school career-development professionals can provide “value-added” services for students at levels higher than what most of our faculty members can provide. Our school’s career-development program hosts employer representatives (individually and collectively as part of panel presentations) who conduct “mock” interviews of students and relay constructive criticism on how the students can improve their opportunities to have successful interviews as they seek quality career and internship opportunities. Again, the professionals at our career services and internship services offices, combined with business professionals arranged to visit with our students by our school’s career-development program, provide “best-practice” information to our students on matters of both form and substance.

Third, the career-development program covers etiquette and appearance. We invite representatives of local recruiters to visit with our students at various forums. At these sessions, students receive advice about professional behavior during the interview process. Students also receive advice on the rules of business culture that may not necessarily be straightforward to a student who has yet to enter the workforce. For example, students learn the importance of sending “thank you” notes to interviewers and standing when shaking hands. In another example, the sessions address definitions of “professional business” attire and “business casual” attire. We have found that some of the most enriched “learning” often occurs in the question-and-answer sessions that typically follow presentations.

Finally, networking is another key area we have focused on. Networking encompasses presentations that our school’s career-development program has sponsored relating to networking and building relationships. Our guest speakers for these sessions have included professionals from the business world and administrators at the university and school levels. We have found this skill to be a critical one for our students, and, through our career-development program, we have noticed a visible change in the student culture as far as the students’ abilities to develop rapport with a recruiter, “carry the conversation”, and gracefully exit from the conversation.

In addition, a simple and cost-effective gesture on the part of the career-development professionals of the college/school and IS department has significantly helped us to generate productive conversations among

our faculty/instructors and the recruiters. We sponsor lunches when the recruiters are scheduled to interview on campus, and we send one or more of our faculty members to the university interview rooms to gather the recruiters and escort them to our facility for lunch with our faculty. The informal and relaxed setting has led to insightful observations from both stakeholder groups and resulted in procedural and substantive improvements for all stakeholder groups. We have found that the casual and relaxed setting has created camaraderie and goodwill among our IS department faculty and the recruiters' team members who interview our students².

4 Framework Implementation

In this paper, we describe the four components of the skill set-based framework for student-employer engagement: the IS department, employers hiring graduates, students, and university and college/school career-development professionals. Figure A1 in the appendix provides a flowchart of the steps in each component. It shows who does what, and it shows the decision points in the framework.

An important question that we only partly address above is who is responsible for completing the tasks associated with the IS department in our framework. Referring to the IS department section of Figure A1 ("Determine organizations hiring students"), we can see that the IS department needs to first set up a university IS department group on LinkedIn. Doing so is a relatively quick administrative task and need not even necessarily be done by the IS department. Next, the professor/instructor of the capstone course must require students to join the university IS department group on LinkedIn. Whoever runs the IS department's LinkedIn account can confirm the students have joined the group and, if necessary, assign a grade for doing so (to encourage the students to sign up). One then need only search LinkedIn to determine which recruiters are hiring students.

The professors/instructors responsible (or the two-person faculty-employer engagement teams) will need to review and map the skill sets the top companies need to the relevant classes. To ensure consistency, the person responsible for recruiting and student placement in the IS department should oversee this process. These same individuals will be responsible for highlighting which skills are missing; whether the skills missing fit the mission of the university, college/school, and department; and whether these skill sets should be added to classes (and, if so, which ones).

Alternatives to this framework undoubtedly exist. Indeed, many organizations will have pieces of this framework in place or have ad hoc processes to deal with the issues we raise here. The skill set-based framework for student-employer engagement we present here formalizes and brings together these processes.

We have been successful in applying this framework in the IS department at our university. With it, we have been able to use our resources and time sensibly and make sound decisions. As we note in Section 1, in a typical year, more than 40 percent of our IS graduates find work at an IS consulting firm of their choice. In addition, despite factors that we can describe as generally working against us (such as our relatively rural setting, the lack of large businesses located in close proximity, and our comparatively small size), we are one of the primary sources of talent for two global companies seeking IS graduates. This framework has been successful enough that we can now: 1) increase our focus on local and regional employers that may hire only one or two of our students a year, 2) begin to focus on helping the IS students in our program who are struggling to find an IS career for whatever reason, and 3) know exactly how we need to engage data science employers seeking talent.

We are confident that we will be able to continue to translate this framework successfully from our proven ability to place students with IS consulting firms to a model that successfully places students with recruiters having big data needs. Although we have not tested our theory, we believe that this framework would be equally useful for healthcare informatics, cybersecurity, e-government, and other IS specialties.

² Although discussing the implications of violating federal privacy laws when working with recruiters of IS students is beyond our scope here, note that laws such as the Family Educational and Privacy Rights Act (FERPA) protect students' rights. FERPA and other laws generally prohibit university employees from disclosing a student's academic record to persons outside the university without the student's prior consent. For example, FERPA prohibits a faculty member in the IS department from "prescreening" candidates for a recruiter and from blurting out at a faculty-employer lunch which student earned the highest score on a particular IS project. Of course, ethical issues also are presumably raised if a faculty member promotes one student over others based on the instructor-student relationship. As a result, we work with our university and school career-development personnel to ensure compliance with applicable laws and the university's ethical guidelines.

The framework we describe does not come without its issues. We have encountered two main barriers implementing it. The first and most salient barrier is the time that IS faculty require to assist in the recruitment process. With the demands of research, teaching, and service, it is hard for faculty to find time to assist in the recruiting process for students. We have been able to resolve this challenge by dividing up the list of recruiters among our faculty. As we mention previously, we divide up the top recruiters into faculty-employer engagement teams. As such, we can glean and clarify the skill sets that the employers request in an efficient way. The second barrier is finding the top five data-science recruiters. Because the field is fairly new, organizations are still defining the recruiting process for these graduates. For example, a popular recruiter of our students for system implementation consultants has started hiring our data science students. This company is still not clear on what it needs, so it is difficult for it to communicate its needs to us. Since we have a previous relationship with this company, we can help its recruiters define these skills. However, this solution does not help us for companies with which we do not have a relationship. The framework was built for this issue, but it may take a few years to define the top five recruiters.

5 Conclusion

We provide a skill set-based framework for student-employer engagement in the data science field. With this framework, one can build an IS program that helps its graduates find jobs in the data science field. Over time, we believe that this framework will help our graduates find successful careers in this field much like our consulting graduates have done.

This framework engages four main stakeholder groups: the IS department, employers, IS students, and university and college/school career-development professionals. By working together in detailed coordinated activities, we have been able to successfully use this framework in the IS consulting field and have now begun to employ this framework in the rapidly growing big data field (Bughin et al., 2010; Chen et al., 2012; Davenport et al., 2013).

This research provides contributions both to practice and to literature. In practice, IS departments, university career services and internship services, graduates, and potential employers of data science graduates can use our framework. Ultimately, the framework helps graduates find careers in data science, and the framework can guide many different actors. This research also adds to the growing literature of redefining the IS curricula to meet the needs of recruiters in the data science field. As we state previously, we lack studies on skill-based frameworks that incorporate recruiters and address changing fields. This framework can help fill that void. Specifically, this research answers the call to action from Wixom et al. (2014) to respond to the emerging market needs of data science.

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Appendix A

Figure A1. Flowchart

About the Authors

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