A Skill Set Based Framework to Increase the Recruiting Efficacy for Data Science Graduates

Full Papers

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Abstract

Successful placement of IS students in rewarding careers has an impact on how the IS major is viewed by students. The rise of the data science field provides an opportunity to rebrand and rebuild IS departments off the career placement successes of IS graduates. 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. The framework was developed based on empirical evidence over several years in successfully placing IS graduates into IS consulting firms across the U.S. The framework contains three different perspectives: the university IS department, the organizations hiring IS graduates, and the IS graduates themselves. This framework can be used by IS departments seeking to place their graduates in the data science field.

Keywords

student skill sets; data science; student-employer engagement

Introduction

The field of data science\(^1\) is growing immensely in information systems (IS) and computer science (Bughin et al. 2010; Chen et al. 2012; Davenport et al. 2013). Businesses are looking to hire graduates who are familiar with basic data science techniques such as data warehousing, data querying, statistics, and data modeling. In addition, businesses are looking to hire graduates with skills such as business domain knowledge and business processes engineering – which skills 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.

To complicate matters, IS majors are dwindling or remaining stagnant (Benamati et al. 2010) at the undergraduate level across the U.S. Previous research has demonstrated this phenomenon is attributable to common myths about the IS field, including the increase in offshoring, lowering salaries, and an

\(^1\) We are referring to data science as the all-encompassing term of big data, data analytics, and business intelligence. Although there is disagreement as to their individual meanings, this paper treats this field as one large subfield of information systems.
Increasing Recruiting Efficacy for Data Science Graduates

uninspiring perception of work responsibilities such as programming (Dick et al. 2007). The rise of the data science field provides an opportunity to rebrand and rebuild IS departments. Successful placement of IS students in rewarding careers has an impact on how the IS major is viewed by students (Koch et al. 2010) and has a significant impact on the strength and vibrancy of the IS major (Firth et al. 2008). Koch et al. (2010) describes as a “Best Practice #1: Partnering with External Stakeholders” (pg. 488) 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, potentially exacerbating things.

This paper describes 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 requires possibly adjusting classes, creating data science certificates or areas of concentration/specialty, tracks, or domain knowledge. This framework was developed to help University of Montana (UM) IS students compete in the highly competitive information systems consulting field. The framework has shown promising results within consulting. In a typical year, more than 40% of UM’s IS graduates are now placed at an IS consulting firm of the student’s choice. UM is now taking that same framework and applying it to the data science field to provide IS students an opportunity to be a part of this high-growth employment opportunity.

In this paper, a brief literature review section is provided. Next, the framework is presented. Third, each process is explained from three different perspectives: the university IS department, the organizations hiring IS graduates, and the IS students themselves. Each of these processes represents a set of tasks that needs to be completed in a certain order. A flowchart summarizes the framework. Finally, we discuss how to implement the framework, alternatives, and next steps.

Literature Review

The literature on fostering college graduates to make them more employable is well grounded and has a rich history within many fields of study. Buckley et al. (1989) discuss the role of business schools in identifying and addressing the mismatch between student job expectations and experiences with that of what the business community expects. One of their findings was today’s (printed in 1989) students were not prepared to meet the verbal and written communication requirements and new employees are found to lack essential skills and want/need more individual guidance. Arguably, this resonates today. Buckley et al. (1989) also discusses the importance of broaden the curriculum to prepare students for a broader role in the business community.

There is other research that addresses 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.

Other research examines a skills-based approach for students in order 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. The outcome of this process is that students gain discipline-specific skills and important generic skills. Andrews and Higson (2008) conduct a study in Europe on the importance of why universities must provide students skills that fit the needs of employers. One finding from their study demonstrates the importance of a student gaining skills via work experience and internships. Rosenberg et al. (2012) use a survey methodology to empirically examine the basic employability skills needed for job performance in business related fields. Their study finds that there are considerable differences in opinions among the different actors (recent graduates, faculty, and HR recruiters) with regards to the skills needed for job performance.

Chaing et al. (2012) presents the challenges facing IS departments on adapting to delivering big data education. They discuss the knowledge and skills needed for graduates to navigate employment. Another
finding from their research is that academic business analytics offerings should better align with the needs of employers. Wixom et al. (2014) announced a call to action for universities regarding the need to respond to emerging needs in BI/BA (business intelligence/business analytics). They encouraged IS leaders to continuously refine curricula to keep pace with the marketplace.

Figure 1 above shows a high-level summary of the skill set based framework for student-employer engagement. This framework was created by synthesizing previous literature in the fields of university curricula, employable skill sets, and data science skill sets (see Andrews and Higson 2008; Bridgstock 2009; Buckley et al. 1989; Chiang et al. 2012; Cox and King 2006; Ehie 2002; Rosenberg et al. 2012; Wixom et al. 2014; Wixom et al. 2011). The IS department has 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 then clearly communicate those skill sets to the IS majors they are seeking to hire. Students need to clearly understand the skill sets they have, how they match those being sought by employers, and then clearly communicate their skill sets to employers. The next three sub-sections detail the processes and required actions of the IS department, the employers, and the students.

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 the framework presented here can be used in a wide variety of IS department configurations.

**Actors in the Framework**

**IS Department**

The first task for the IS department is to understand which organizations are hiring their graduates. This task is the cornerstone of understanding the demand side of the equation. This first task can be accomplished 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 upon graduation unless it is deployed after the end of class. At that point, completeness of the data is likely to 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 interesting in joining. “Follow” is a feature on LinkedIn that pushes posts made on LinkedIn by the followee to the follower.

The primary outcome of this process of ensuring that IS seniors add the UM IS Major LinkedIn group to their LinkedIn profile is that we are then able to do a search within LinkedIn to see where our IS majors are employed after graduation. Figure 2 displays a quick search performed recently on LinkedIn for our students. 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 were able to determine 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.
Once the top recruiters of the IS students are established, the task of determining what skill sets are most sought after by employers is now much more defined in scope. We first focused on our top five employers. We were also able to use LinkedIn to determine that our IS majors were going to very particular areas within 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 (within the Advisory side of the firm). This information is incredibly useful in helping us to determine the skill sets that our students need.

Keeping the focus only on our top five employers as a first iteration through the process, the next task is to determine the required skill sets these employers seek in their new IS employees. This can be a relatively straightforward task that can be accomplished by reading the job description posted by the employers on the university career services’ job postings website. We have found that the job descriptions posted by the employers usually are written by their human resource departments and contain ambiguous and vague jargon such as “technical skills” or “attention to detail.”

Several steps can be taken to glean more meaningful skill set data. First, LinkedIn can again be used. Drilling down on currently employed (former) students within KPMG’s IT Attestation practice, for instance, we quickly were able to build a coarse skill set profile by simply looking at the “Skills” section of the individual employee’s profile. Figure 3 below shows that “software documentation,” “business
process,” and “customer service” are the top three skills for this particular former IS student. Running through this process just four or five times quickly showed the most meaningful skill sets for our former IS students within KPMG’s IT Attestation practice.

Figure 3: Using a LinkedIn “skills” profile to determine required skill sets

With skills such as “software documentation,” “business process,” “customer service,” and “internal audit,” it is clear that LinkedIn 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 were able to drill down on the five skill sets most meaningful to the employer and, therefore, which ones should be of critical importance during the recruiting process.

The next task for the IS department is to map these “top five” meaningful skill sets to specific courses offered within the IS department. This requires working directly with the professors/instructors teaching the IS courses, although we have also found that the skill sets can frequently be mapped quite simply to the course schedule or timeline for a class. If the skill set is already offered in a course or a combination of courses, then the only work needed by the IS department is 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 more investigation is needed. 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, most data science skills can be mapped to existing IS courses such as the database course and operations management. More specific data science skills, such as neural networking or cluster analysis, may have to be added to existing courses within the IS major or a new class may have to be established within 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 the IS department to look across other units on campus to see if required skill sets can be garnered by students outside the business college/school. For instance, cluster analysis is often taught in Mathematics 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 upon graduation and perhaps consider these cross-campus classes for inclusion in the IS major’s electives.

In summary, the IS department must identify the top data science recruiters. After establishing a relationship (explained in more detail below) 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 strategy and mission of the department, then departments should consider offering these skills in current courses, creating new courses, or determining where on campus these skills are being taught. Although these tasks are explained serially, this process is iterative. As soon as new skills are needed or requested by recruiters, IS departments must repeat this process. Once the relationship is established with top recruiters, future iterations of this process are easier and less time consuming.

**Organizations Hiring 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, it is our experience that 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 was actually meant, though, was “the ability to learn new software.” The original phrasing of this job description by the employer frightened many talented IS graduates away because they inferred that the recruiter was seeking computer science graduates rather than IS graduates. With modified phrasing that focused on the skill set possessed by IS students, many more IS graduates applied for the positions.

In another example, one recruiter listed the skill set of “data analytics experience.” Very few IS graduates would confidently list this skill on their resumes. After a conversation with the recruiter, our faculty members discovered that the recruiter actually meant that it was seeking 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, as well as if they had an interest in data analytics.

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 have established faculty-employer engagement teams with two faculty members per team and some overlap between teams. These teams are dedicated to working closely with a top employer or two. As a result of these relationships, it has been easy to 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 hiring IS graduates is that recruiting efforts inside and outside of the classroom are crucial in establishing a relationship between students and recruiters, as well as the IS department, and are best achieved 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 is being taught in those classes, and what is needed to succeed in an IS career.

These recent graduates should be used 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.
We have found that a simple and cost-effective gesture on the part of the college/school and IS department has immensely helped us to generate productive conversations among our faculty/instructors and the recruiters. We sponsor “brown bag” lunches when the recruiters are scheduled to be on campus interviewing, 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, through the faculty, and the recruiters’ team members who are interviewing our students.

As already discussed, in-classroom presentations are an important part of the recruiting effort by employers. We typically schedule these as 15 – 20 minute presentations by the employer toward the end of a class period, followed by a question-and-answer session for the students. It is critical that these classroom presentations are made to the “right” courses. Working with our two-person faculty-employer engagement teams, we identify (based on skill sets required by the employer) 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.” 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. Both the employers and the students value this time greatly.

Finally, having a visiting recruiter present in multiple IS courses causes redundancy for the students; some students have shown disinterest in the visiting recruiter as a result of having to attend the same presentation repeatedly. A counter-productive outcome fails to meet the needs of any of the stakeholder groups.

Although discussing the implications of violating federal privacy laws when working with recruiters of IS students is beyond the scope of this paper, it is important to note that laws such as the Family Educational and Privacy Rights Act (FERPA) protect the rights of students. 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 “pre-screening” candidates for a recruiter, as well as blurring 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.

**Students**

The last actor in this framework are the IS students. Students can and should start this process early in their college careers with career development activities. A university or college career development center can help students build resumes, cover letters, and interview skills; demonstrate appropriate dress, hygiene, and etiquette; and develop and refine networking and career-advancement skills. Students should start these processes as soon as they are admitted into the IS department. In accordance with the 12–Step Program to Bring About Change in the Introductory IS Course (Firth et al. 2008), we have students set up a LinkedIn account profile early in their academic careers for two primary reasons. First, recruiters can use this information to find potential candidates who fit their open positions, which can be accomplished through social connections or through skills listed directly on a student’s profile page. 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 in an IS alumnus from one of our top
Increasing Recruiting Efficacy for Data Science Graduates

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 SQL Server, SAS Enterprise Miner, or SPSS Data Analytics. In addition, students should include soft skills on the resume, such as “ability to design an OLAP structure.” These skills can be taken directly from class syllabi or timelines/schedules of weekly topics covered. If our suggested framework has been followed, professors/instructors have already added the skill sets covered in class to the syllabi. This information allows for a good match between skills needed by the employer and skills possessed by the students.

Once the student is “on the market” for internships or full-time employment, the student starts seeking recruiters that are hiring. If the student is interested in a specific organization, then it is recommended that the student visits with his or her IS professors about the position. 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, this 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.

**Implementing the Framework**

We have described here the three components of the skill set based framework for student-employer engagement: the IS department, employers hiring graduates, and students. Figure 4, below, provides a flowchart of the steps within each component. It shows who does what, and it shows the decision points within the framework.
Increasing Recruiting Efficacy for Data Science Graduates

Figure 4: A flowchart describing how to engage IS departments, recruiters, and graduates.

An important question only partly addressed above is who is responsible for completing the tasks associated with the IS department in the framework presented. Referring to the IS department section of Figure 4 above, “Determine Recruiters Hiring Students,” requires the IS department to set up a university IS department group on LinkedIn first. This 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. This can be confirmed within the LinkedIn account as an administrative task, with any attendant grade being entered in the student’s gradebook. It then becomes a simple administrative task to do a search within LinkedIn to determine which recruiters are hiring students.

The skill sets needed for positions for which the top companies are hiring will need to be reviewed and mapped to classes by the professors/instructors responsible for those classes or the two-person faculty-employer engagement teams. To ensure consistency, this process will need to be overseen by the person responsible for recruiting and student placement within the IS department. 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 raised here. The skill set based framework for student-employer engagement presented here formalizes and brings together these processes.

We have been very successful in applying this framework in the IS department at our university. It has allowed us to use our resources and time sensibly and provided us a means by which to make decisions. As noted earlier, in a typical year, more than 40% of our IS graduates are placed at an IS consulting firm of their choice. This framework has been successful enough that we are now able to do three things: 1) increase our focus on local and regional employers, who may hire only one or two of our students a year, 2) begin to place an emphasis on helping the IS students within 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. Our confidence results, in part, from the general-purpose nature of the framework and its flexibility in being broadly and nimbly applied. Although we have not tested our
theory, we believe that this framework would be equally useful for healthcare informatics, cybersecurity, eGovernment, and other upcoming IS specialties.

**Conclusion**

We have provided a skill set based framework for student – employer engagement within the field of data science. The goal of this framework is to build an IS program that helps its graduates find successful careers within the data science field. This framework engages three main stakeholder groups – the IS department, employers, and IS students. By working together in detailed coordinated activities, we have been able to successfully use this framework within the field of IS consulting and have now begun to employ this framework within the field of big data, an immensely growing field (Bughin et al. 2010; Chen et al. 2012; Davenport et al. 2013). This research provides contributions both to practice and to literature. First, this framework can be used by IS departments, university career services, graduates, and potential employers of data science graduates, with the ultimate goal of the framework to help graduates find careers within data science, the framework can guide many different actors. Second, this research contributes to the literature in providing skills to make students more employable. Finally, this research answers the call to action from Wixom et al. (2014) to respond to the emerging market needs of data science.

**REFERENCES**


