FROM ENROLLMENT TO EMPLOYMENT:
A DACUM APPROACH TO INFORMATION SYSTEMS AND INFORMATION SECURITY AND ASSURANCE CURRICULUM DESIGN

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ABSTRACT

Issues associated with information security are numerous and diverse. Since the majority of organizational actions rely greatly on information and communication technologies, Information Systems (IS) security is now a main concern for firms, governments, institutes, and society as a whole. As a result, a plethora of graduate programs have been created, covering nearly every aspect of IS security. The authors review the current state of the IS industry presented in the literature, and identify a panel of IS experts in which to explore current job skill needs using a "Developing a Curriculum," DACUM, process to support curriculum design for two graduate degrees in IS and Information Security and Assurance (ISA) through the eyes of a university that has a unique relationship with Microsoft and an active Industry Advisory Board (IAB).

Keywords: Information Systems, Information Security, Information Assurance, DACUM, Curriculum Development, Job Analysis

INTRODUCTION

Friedman (2006) highlighted how the world is flattening by technology and additional forces where almost all advanced complex occupations are in competition. Oxford researchers suggested that 45 percent of the jobs in the United States could be automatable with future technology (Rutkin, 2013). The latest report from the National Center on Education and the Economy (NCEE) entitled Commission on the Skills of the American Workforce (2010) reaffirmed this outlook and suggested audacious changes with regard to instructor employment, national standards and assessment, in addition to supporting adult lifelong education. It is projected that by 2018 more than 230,000 Science, Technology, Engineering, and Mathematics (STEM) jobs, requiring an advanced degree, will not be filled even if every U.S.-born STEM graduate is recruited (The Partnership for a New American Economy & the Partnership for New York City, 2012). In addition, there are concerns about the quantity of H1B visas being processed for foreign IT workers and whether U.S. universities can meet the demand of the workforce (Boyd, 2014).

With the rapid growth in the global Information Technology (IT) environment, increased levels of risks, threats, and vulnerabilities are seen. Organizations have started employing Information Security (IS) experts or specialists, such as Security Engineers, Security Analysts, and Security Architects, to safeguard accessibility, authenticity, privacy, and integrity by way of protecting the information throughout all phases from input, to process, and through output (Wilson & Hash, 2003). Moreover, organizations have established a collection of technical weapons to prevent computer security breaches. This arsenal is comprised of firewalls, encryption techniques, access control mechanisms, and intrusion detection systems. The federal government also has responded with the establishment of the Department of Homeland Security, which oversees cyber security and infrastructure protection, and is also building a national strategy to secure cyber space. Regrettably, to date these measures have had only limited success (Gordon, Loeb, & Lucyshyn, 2003).

The evidence of the cyber threat is growing. New vulnerabilities are found each day (Sharma & Sefchek, 2007). The level of sophistication and speed of development of the tools being used to create security breaches and attacks are growing exponentially (Loch, Carr, & Warkentin, 1991; Swartz, 2004). The Computer Security Resource Center (CSRC) is considered one of the most visited Web sites at the National Institute of Standards and Technology (NIST). CSRC promotes the sharing of information security tools and practices, offers a resource for information

security standards and guidelines, and hosts major security Web resources to assist industry and government users. There is no doubt that education is vitally central not only to the global economy, but also to the sole advantage of every learner.

In the past, the United States depended significantly on employers to identify specific job skills. Currently, employers are seeking job-ready applicants but the definition of job-ready seems elusive. Without strong industry-university partnerships, universities are left to make assumptions about curriculum inclusion or base curriculum and its structure upon prior job skill information which may be outdated. There is some agreement between educators and industry leaders that we should determine particular core skills, which should be instilled in the curriculum (Binkley et al., 2012). Therefore, higher education systems need to ensure that their curricula are relevant and contain enough flexibility to accommodate different learners and different social and economic needs (Husbands & Pearce, 2012), but must also support the needs of the employers who will be expected to hire these graduates

A leading-edge university system should offer students the skills for not only for jobs that currently exist, but also for those positions we cannot predict. This is especially true when speaking of skills in the ever-changing IT field. It is often assumed that the advent of digital technologies requires fundamental change to the curriculum and to the teaching and learning approaches used in schools and at universities around the world to prepare not only this generation of ''digital natives'' or the ''net generation,'' but also to accommodate other, older learners who are contemplating career changes. Therefore, we need to train and prepare students to quickly adapt to varying technologies along with organizational workforce expectancies; such as pace of work, workload, and soft-skills, such as critical thinking, decision making, and agility.

Information Security and Assurance (ISA) is a discipline dealing with the application, reinforcement, and support of security and control procedures to protect the availability, integrity, and privacy of electronically stored data very much beyond the confines of governmental protection. Many universities host Information Security (IS) programs at both the undergraduate and graduate levels. Despite the widely acknowledged importance of IS programs, the academic research in the area of IS security is almost non-existent. Given the current and future vulnerability of this industry due to innovations and threats, it is important to investigate the dynamics behind the evolution of the discipline, as well as investigate ways to bridge any gaps between academia and industry. The purpose of such programs are to moderate weaknesses in national information infrastructure through promoting higher education in IS and ISA programs, and to deliver a growing number of professionals with IS and ISA security skills (Bishop, 2000). However, universities alone cannot predict when disruptive technologies or radical change will require a rethinking of the curriculum. This lack of prediction supports the need to once again call upon industry leaders to help create supportive curriculum to meet current and future needs in a quickly changing industry, such as IS and ISA.

The purpose of this proposal is to document the findings for using a particularly inventive and extremely efficient technique of job skill analysis known as a DACUM, which stands for "developing a curriculum." A DACUM begins with an identification of an industry pool that is further reduced to an expert panel, culminating in a daylong workshop to identify new job skill statements and skill needs. Due to limited DACUM application within the IS and ISA fields of study, DACUM curriculum development milestones and outcomes experienced during the process will be shared to benefit future industry and academic collaborations with regard to curriculum development. Additionally, within the workshop process, the identification of job skill need versus curriculum assessment and activity inclusion is planned and will be documented to produce an end of process expert field survey that expects to support future IS and ISA course development to best support employment opportunities. Furthermore, a discussion of Embry-Riddle Aeronautical University and its unique relationship with Microsoft will also be included as a possible model for future university-industry partnerships.

LITERATURE REVIEW

Information Technology (IT) Industry Overview

The job market condition and forecasts remain one of the main reasons why learners think about enrolling in a graduate program in any field. Jobs in the technology sector, one of the quickest developing industries, are still valued and require a unique skill-set that includes both the theories and practices of Information Technology (IT).

Several big data breaches occurred in 2014 and 2015. It seemed that no industry went unscathed (Bieda & Halawi, 2015). The data breaches were broad and deep from the VTech Learning Lodge hack, to multiple breaches within the U.S. government Office of Personnel Management, Anthem and Premera, JPMorgan Chase & Co, and of course the high-profile breaches of Target, Home Depot, UPS, Dairy Queen, Kmart, Staples, USPS, Sony, and most important at the IRS (Greene, 2015). These eminent security breaches forced organizations to take additional measures to protect their technology infrastructure and databases against any possible inside and outside threats. The U.S. government, health care corporations, the financial sector among other industries and enterprises are growing more dependent on information security analysts to safeguard their information systems against any malicious attacks and cyberattacks (U.S. News & World Report., n.d.). This is good news for those looking for careers in information security and assurance or other high-tech fields.

According to the U.S. News and World Report as reported by Morgan (2015), Information Security Analyst ranked eighth on the 100 Best Jobs ranking. In addition, the profession is expected to grow at a rate of 36.5 percent through 2022 (Morgan, 2015). According to an analysis of the top-paying tech security jobs as reported by Dice (2015), the career hub for technology, salaries for specific technology professionals, such as lead Software Security Engineers, Directors of Security, and Security Consultants, significantly exceeded the standard average for tech-pro salaries (Dice, n.d.). Cybersecurity salary figures are in the six figures and according to Peninsula Press (a project of the Stanford University Journalism Program) as reported by Morgan (2015) and they project that the demand of IS professionals is expected to grow by 53% through 2018. In addition, the Bureau of Labor Statistics anticipates this career to thrive at a rate of 18 percent between 2014 and 2024; thus creating about 14,800 new vacancies for information security analysts (U.S. News & World Report., n.d.).

University Challenges - Information Systems (IS) Programs

Information Systems (IS) programs consistently encounter challenges that threaten the future of IS as a viable academic discipline. It is extremely important that IS academics acknowledge these challenges, their implications and thus implement some strategies to address them.

Enrollment is perhaps the chief challenge faced by IS programs. The market is somewhat saturated with trade-school or technical-school certificates that teach students the bits and bytes of IS but often lack the theoretical underpinning or a thorough understand of why we do what we do. In other words, a trade-school education is likely to teach "how to" vs. "think through." But, the prevalence of these schools and their alignment with industry has proven attractive to students wishing to enter certain fields. Most universities do not see themselves in competition with trade schools but IS has bridged the two teaching models, which can be confusing to students looking for an industry-relevant education. In addition, the university must now sell the student on the notion that while certificates are good and even industry aligned, a university education is better. This is not to suggest that certificates are bad, only that certificates combined with a university education create a more well-rounded and capable individual who understands more than the "what", but the "why."

Another challenge involves the shelf-life of courseware. A typical university course may have a shelf-life of a few years. However, this is not so for Information Technology (IT) courses. IT textbooks are rewritten often and concepts and applications in IT courses change frequently. While a course that is 2 years old may be "fresh and relevant" in a business program, it could be viewed as stale and dated in an IT program. While this accelerated curriculum lifecycle is often inconsistent with the normal pace of change at a university, it need not be viewed as a barrier with the proper controls in place to manage these lifecycle differences.

In today's society, computer literacy or some level of technical competence is commonly recognized as one of the keys to being successful in this global economy. Information Systems (IS) security programs aim to prepare students to obtain positions analyzing, maintaining, supporting, or securing information. With the rapid growth of information technology (IT) and employer needs for adequately skilled graduates, many universities offer IS security programs using slightly different titles, such as Information Sciences, Cyber Security and Information Assurance, Information Assurance, Computer Information Systems (CIS) with a concentration in security, Management Information Systems (MIS) with a concentration in information security, and Information Security (IS) (The Best Schools, n.d.). These titles reflect the lack of agreement in industry as to even basic terminology. This sentiment is also reflective in many curricular reviews between IS to that of other programs that suggests there is great overlap between programs with different names as well. If moving forward in this rapidly changing technological landscape, we must ask, how do we know what to prepare students for? Which program title(s) and curriculum makes the most sense for employability? In other words, how do we know what are the desired skills for IS and ISA security graduates wishing to become information security analysts, business analysts, or IS project managers?

RESEARCH METHODOLOGY

Research Questions
This proposal seeks to answer the following research questions throughout the overall DACUM process:

1. What can be done to bridge the gap between enrollment and employment for Information Systems (IS) security majors in a university setting?
2. What changes can be made to enhance program and course curriculum development in the IS security majors to better align with the findings of the DACUM job analysis to ready students for employment?

Sample

The aim of this research is to identify what constitutes IS security job skills to better align, improve, and fortify course content to support future employment of graduate students. Therefore, to prepare to host a DACUM event, we will seek experts from organizations with an established IS security management function and IS security consultants through snowball sampling beginning with Microsoft. The subjects of our research will be selected from a pool of professionals with significant experience in the field, whether identified through conference attendance, academic memberships, and through current literature findings with regard to current IS and curriculum research projects. The authors plan to also secure experts from independent, nonprofit, and globally identified associations that engage in the development, adoption, and use of globally accepted, industry-leading knowledge and practices for information systems.

For the initial expert identification, the authors plan to conduct Face-to-Face (F2F) interviews (some using teleconference technology such as Skype) with IT professionals, including Systems Analysts, IT Consultants, IT Project Managers, and senior IT Security Managers from various companies, while attending the 2016 International Association for Computer Information Systems (IACIS) and Information Systems Audit and Control Association (ISACA) conferences. IACIS is a not-for-profit society devoted to the development and enhancement of IS and IS education and that of information systems professionals. On the other hand, ISACA is an independent, nonprofit, global association that engages in the development, adoption, and use of globally accepted, industry-leading knowledge and practices for information systems.

The authors plan to additionally recruit participants from the university's existing pool of IS faculty to collect data about their perceptions of the effectiveness of existing university IS programs. Initial expert interviews will conducted during said conferences, preferably Face-To-Face (F2F) as time or interviewee allow and where possible and applicable; thus, this method supports a more personable, comfortable, and effective communication method to best support the overall DACUM process. During the initial interview, participants will often provide only surface level information. However, by continuing to conduct additional interviews with more participants, and send follow-up questions to initial interviewees, there will be a point where the information from a number of participants

provides no new data and thus saturation is achieved and experts can be identified. The authors will interpret what each participant shared and then share the transcript with additional field experts in form of a survey for validation of DACUM findings

Theoretical Framework – A DACUM Structure

Once experts are identified from the literature and through conference and established working relationships, the DACUM event will be conducted in synchronous format using Adobe Connect. The DACUM process is a brainstorming, yet structured technique for job skill identification and comparison. The process consists of a panel of five to nine expert workers in the occupation/industry under examination, a competent and trained DACUM facilitator, and a recorder (Norton, 1997). During this process, panel experts create and verify professional job skills and proficiencies that employees should possess depending on job skill category**.** In order for the DACUM to succeed, panel members are expected to be eloquent, outstanding workers in their occupation, with highly-developed technical knowledge and skills. A facilitator should be particularly trained in the DACUM process for valid and practical outcomes. The facilitator should draw upon particular task statements, deal with conflict between experts, and moderate the debate to reach consensus of job skill identification (Eastern Kentucky University, n.d.). The findings are then compiled and presented in survey format to a larger group of experts to validate job descriptions. Curriculum is then developed keeping required skills in mind to ensure assessment and activities align to industry required skills.

Qualitative Methodology

To better understand the changes seen in the IS and ISA fields, and to identify a panel of six to eight experts representing each field, panelists will be invited to a half-day synchronous DACUM workshop using Adobe Connect. The authors will implement a two-part project consisting of: (a) expert identification, and (b) outcome reporting and validation from the DACUM itself.

Initially, a qualitative research methodology will be utilized in order to better understand and explain expert knowledge and their understanding of the depth and breadth of available employment options within the IS and ISA fields. According to Denzin and Lincoln (2011), qualitative research is a set activity that uncovers the witness in the world. Qualitative research is also interpretive and realistic in its approach (Denzin & Lincoln, 2011). Denzin (2009; 2012) suggest data triangulation for correlating people, time, and space; investigator triangulation for correlating the findings from multiple researchers in a study; theory triangulation for using and correlating multiple theoretical strategies; and methodological triangulation for correlating data from multiple data collection methods. Triangulation among the documents, and interviews will be used to validate the information and to prevent bias thus providing valid information for the research.

There is no one-size-fits-all method to reach data saturation when identifying an expert pool. This is because study designs are not universal. One cannot assume data saturation has been reached just because one has exhausted the resources. Data saturation is not about the numbers *or sample size*, but about the depth of the data. However, by continuing to conduct additional interviews with more participants, and sending follow-up questions to initial interviewees, there will be a point where the information from a number of participants provides no new data; thus, saturation is achieved and experts can be identified. Therefore, researchers expect to achieve saturation as multiple, yet the same, experts are referred to by those who were interviewed.

Participants (Sample*)*

To prepare to host a DACUM event, experts will be sought from organizations with an established IS security management function and IS security consultants through snowball sampling. The subjects of our research will be selected from a pool of professionals with significant experience in the field, whether identified through conference attendance, academic memberships, or through current literature findings with regard to current IS and ISA curriculum research projects. Additionally, for diversity, the authors plan to secure experts from independent, nonprofit, and globally identified associations that engage in the development, adoption, and use of globally accepted, industry-leading knowledge and practices for the topic of IS as an entire curriculum.

For a DACUM to succeed, this project requires two expert groupings: (a) the expert DACUM panel, and (b) the extended expert survey group, who are expected to validate the DACUM workshop findings. For initial expert pool identification, the authors plan to conduct Face-to-Face (F2F) interviews with IT professionals, including Systems Analysts, IT Consultants, IT Project Managers, and senior IT Security Managers from various companies. This identification period will be conducted while attending the 2016 International Association for Computer Information Systems (IACIS) conference and Information Systems Audit and Control Association (ISACA) conferences. The initial expert panel will be comprised of members who have been recognized by their peers as leaders within the field as identified during the interview process. IACIS is a not-for-profit society devoted to the development and enhancement of the IS field, IS education, and that of IS professionals globally; whereas, ISACA is an independent, nonprofit, global association that engages in the development, adoption and use of globally accepted, industry-leading knowledge and practices for IS.

The authors plan to additionally recruit and survey participants from the university's existing pool of IS faculty to collect data about their perceptions of the effectiveness of existing university programs. Initial expert interviews will conducted during said conference, preferably Face-To-Face (F2F) as time allows or interviewee availability where possible; thus, this method supports a more personable, comfortable, and effective communication method to best support the overall initial DACUM process. During the initial interview, participants will often provide only surface level information, which is useful in asking yes or no questions with regard to who they believe is an expert in the field. The authors will interpret what each participant shared and then share the transcript with additional field experts in form of a survey for validation of DACUM findings

Apparatus/Materials/Instrument

The researchers plan to create an initial survey instrument to support the interview process to identify the overall expert pool. Within the DACUM workshop, the researchers will follow the normal DACUM workshop process of brainstorming, categorization and summarization of job skills per job category, and document findings through the creation of Job Descriptions for each of the positions identified by the panel during the event. Lastly, a secondary survey will be created to support the DACUM validation process.

Design

Purpose of this two-part project aims to conduct a DACUM event that involves expert identification and a DACUM workshop. A DACUM is a well-organized workshop that is held to analyze job skill tasks associated with a given employment position or job description (Reid, 2003). The event operates under the advisement of a skilled DACUM facilitator with the assumptions that the selected panel members:

> (1) can better describe their job than anyone else, (2) any job can be effectively described in terms of the competencies or tasks that successful workers in that occupation perform, and (3) the specific knowledge, skills, attitudes and tools required by workers in order to correctly perform their tasks can also be described (Reid, 2003, p. 1)

Part one of this project seeks to identify an expert pool and narrow down this pool to a six to nine member panelist, which is a unique sample size to the overall DACUM process as indicated within the literature (Reid, 2003). Others from the overall expert pool that are not identified as the expert panelists will be used to validate DACUM workshop results. The objectives of the overall DACUM process is to identify job skill need versus curriculum assessment and activity inclusion. Therefore, part two of this project seeks to document the results of the initial DACUM workshop and survey the extended expert pool to validate DACUM findings and convert findings into usable results within the curriculum development process. Findings will then be analyzed to generate supportive curricular assessment and activity alignment to support future IS and ISA course development that bests support after graduation employment opportunities.

Procedure

As mentioned above, the procedure used is a DACUM framework. The DACUM utilizes an expert panel, and semi-to daylong workshop approach, and a validation event.

The researchers will seek out an expert pool to identify an initial expert panel. This panel will meet synchronously using Adobe Connect to host a half-day to daylong DACUM workshop to identify job skills for IS and ISA persons. The outcomes from this event will be surveyed by the remaining expert pool for validation, then analyzed for inclusion within the degree program curriculum development process in terms of course assessment and activity tasks.

CONCLUSION

Finding out what attracts learners into a particular IS or ISA program is a question companies and university administrators have been trying to answer for years. With the increased pressure of state and federal accountability systems, an effective, viable, and aligned curriculum is critical to student success and subsequent employability. This research expects to expand the knowledge of (a) data use in curriculum design, (b) how DACUM data can be used to signal changes needed in the curriculum development and course design processes, and (c) triggers can be created to indicates industry needs have shifted in which curriculum changes are needed to match employment skills. The overall research project will conclude with recommendations on how to build a strong model for university-industry partnerships, which will help students navigate a sea of similar degree titles and identify programs that are industry aligned. This will serve to maintain a strong base of students in aligned IS and ISA programs and identify where faculty with certain discipline expertise are needed. Lastly, it is expected that research findings will showcase collaboration between industry and academia measures that can best shape a discipline while generating new knowledge to better shape a discipline. The goal of this project is to help bridge the gap between enrollment and employment and create a strong and focused curriculum, conceived using the DACUM method that is industry-driven and supported.

This is a multi-part research project in progress that was initiated in May of 2016. The identification and interview phases are expected to be conducted while attending the IACIS 2016 conference, and while attending the ISACA conference. The synchronous DACUM workshop is tentatively scheduled for June 2017. Final report and DACUM findings are intended to be reported by end of June 2017.

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