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A meta-analytical view of non-technical skills for business and engineering students

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ABSTRACT

Academic programs often seek methods to integrate the technical skills and non-technical skills sought by employers. A literature review explores the diverse interpretations of non-technical skills in order to build a logical and comprehensive topology. The authors then test the topology using a robust dataset of online job advertisements.

KEYWORDS: Soft skills, curriculum, content analysis

INTRODUCTION

The increasingly complex global economy, with a greater reliance on technology, flexibility and adaptability, is forcing employers, as well as colleges and universities, to develop new approaches to ensure that college graduates are best positioned to excel.

Technical skills are necessary discipline-specific knowledge, cognitive ability, proficiency, and experience (Ling, 2002). But the growing demands being placed on workers is necessitating a wider array of skills to succeed in the workplace. This additional set of skills is often described collectively as non-technical skills. These skills, including communication, leadership and teamwork, presentation, project management, and adapting to change, are not easily taught in the traditional discipline focused classroom setting. In a study of performance drivers of logisticians, Myers et al. (2004) did not find a direct relationship between performance and experience or performance and education, suggesting the need for a blend of technical and non-technical skills that directly affect job performance.

Research indicates that hiring professionals are looking beyond the discipline specific technical knowledge of recent college graduates when making hiring decisions (Salleh et al. 2015). The need for non-technical skills is being promoted based on the challenge for newly hired employees to apply their technical knowledge in a dynamic global economy (Kovacs et al. 2012; Sallah et al., 2013). Researchers suggest that these non-technical skills are important because of their role as the connective tissue between the employee's discipline specific knowledge and the workplace environment (Bennett et al. 1999).

Non-technical skills have been approached from different perspectives as: core and generic skills (Keneley & Jackling 2011; Bennett et al. 1999), collaborative capacities (Lizzio et al. 2002), generic abilities (Barrie 2006; Jones 2009), soft skills (Salleh et al. 2015; Ling 2002),

professional skills (Reinig et al. 2011), personal skills and employability skills (Nunan et al. 2000) and interpersonal/managerial basic skills (Mangan & Christopher 2005). For the purposes of this study, we use the term *non-technical skills* as a generic moniker that does not understate their value in the workplace.

While it is recognized that college internship experiences can aid students in bridging the gap between academic knowledge and workplace application, universities are being called upon to provide curriculum that helps students develop non-technical skills as part of their academic program (Candy & Crebert 1991). Historically, students may have been able to focus on academic learning in college and then work out how to apply that knowledge during their early career years. But today's fast-paced and competitive work world has little time, resources or expertise to facilitate that learning process. Without workplace programs in place, newly hired graduates must self-develop or risk failure (Marsick 1988). Since universities already have learning processes in place, they are the logical place for both technical and non-technical skills to be developed.

With the wide array of perspectives on what encompasses non-technical skills, universities are left to identify their own subset to address. This study purports to provide a meta-analysis of extant empirical studies that results in a comprehensive topology of non-technical skills. A preliminary evaluation of these skills is provided using a robust dataset of online technical job advertisements.

BACKGROUND

Academic accreditation bodies, professional organizations, industry professionals, and academics all provide support for the critical role of non-technical skills. Organizational documentation and studies have drawn on these perspective from multiple disciplines to identify specific non-technical skills that new graduates should possess.

Accrediting Organizations

The Accreditation Board of Engineering and Technology (ABET) and The Institution of Engineering and Technology (IET) provide frameworks which academic engineering programs must meet in order to be accredited. The standards published by these organizations identify specific knowledge and skills that the academic programs must develop in their graduates. ABET accredits 3,600 programs at 700 colleges in 29 countries (ABET 2016). ABET's accreditation standard requires that academic programs provide traditional technical skills and integrate student outcomes related to teamwork, communication, ethics, diversity, and timeliness (ETAC 2014). By including these concepts in their accreditation standards, ABET holds accredited programs responsible for developing both technical and non-technical skills through their curriculum and ensuring that students achieve these learning outcomes. The Institution of Engineering and Technology (IET) also provides accreditation for academic programs with a focus on the UK. IET accredits bachelor- and master-level academic programs and currently accredits 1,300 undergraduate programs in the UK (IET 2016). The IET Accreditation of Higher Education Programmes (AHEP), third edition (AHEP 2014) requires academic programs to include non-technical areas such as working with information ambiguity, communication, innovation, project management, teamwork, and ethics.

The Association to Advance Collegiate Business Schools (AACSB) provides accreditation to 755 business programs in 51 countries and territories (AACSB 2016). Within the AACSB standards, programs are required to address communication skills, ethics, interpersonal skills, and teamwork within their curriculum (AACSB 2016).

Professional Organizations

The American Society of Engineering Education (ASEE), the American Society of Mechanical Engineers (ASME) and the National Academy of Engineering (NAE) all support that graduates from engineering programs need both technical and non-technical skills, thus ensuring that colleges and universities integrate these skills in their programs (Dukhan & Hassif 2014).

Business oriented professional organizations provide similar support. The Institute of Supply Management (ISM 2016) with 50,000 members provides professional certification noting the importance of ethics. The Project Management Institute (PMI) includes project management as a technical skill in their discipline along with non-technical skills related to communication and ethics (PMI 2016). The Academy of Management (AOM) with 18,000 members across 100 countries endorses the importance of ethics (AOM 2016).

Bridging the academic and employment chasm, the National Association of Colleges and Employers' (NACE) annual survey shows employers' interest in non-traditional skills. "Leadership" and "the ability to work in a team structure" (each 77.8%) were the most important traits for prospective employees, eclipsing workers' "communication skills (written)" (73.4%) and "problem-solving skills" (70.9%), according to its 2014 survey of 260 employers (NACE 2014). The 2016 survey, polling 201 employers, found respondents seeking "leadership" (80.1%), "ability to work in a team" (78.9%), "communication skills (written)" (70.2%), "problem-solving skills" (70.2%) and "communication skills (verbal)" (68.9%) as most important for applicants (NACE 2016).

Academic Research

Previous research has attempted to define non-technical skills, although the components of this list vary greatly. Goleman included several non-technical skills in his book*, Working with Emotional Intelligence*. The skills he identified included self-control, conscientiousness, trustworthiness, social skills and leveraging diversity (Goleman 1998). This list could at best be considered primitive, suggesting basic skills for successful employment.

Empirical research on the skills of architects and architectural engineers has identified important non-technical skills. In a survey of architectural firms, respondents rated the importance and their satisfaction with recent graduate's non-technical competencies (Salleh et al. 2015). Non-technical skills included teamwork, communication, managing information, conflict management, meeting management, leadership, problem-solving, and decision making. In a survey of 51 design and build contractors, performance success was positively affected by non-technical skills (decision making, enthusiasm, speed) (Ling 2002). In comparison, traditional technical skills (task proficiency, job experience, and job knowledge) were not significant contributors to performance success (Ling 2002).

In a review of job advertisements for architects, non-technical skills encompass soft skills (communication, presentation, interpersonal, leadership, and time management) and personal attributes (work independently, teamwork, flexibility, responsible, positive attitude, creativity, maturity, self-motivated, and ability to work under pressure) (Salleh et al. 2013). These skills were distinct from traditional construction technical skills, including knowledge (project management, visualization techniques, and working with construction drawings, contracts, building materials, and building codes) and hard skills (design skills and software).

Evaluations of non-technical skills for logisticians and supply chain managers provided similar results. In a triangulated multi-method study of academics, students and professionals found common expectations for the development of non-technical skills (project management, leadership, analytical thinking, and change management) (Mangan & Christopher 2005).

Kovacs and Tatham (2010) test an enhanced version of Mangan & Christopher's (2005) model of technical and non-technical skills for humanitarian logisticians. Results show strong support for problem solving (information gathering/sharing and problem analysis/identification/solving) and interpersonal skills (communication, negotiation, leadership, meeting facilitation) to be more relevant than general management (finance, accounting, information technology, project management, marketing, relationship management) or technical skills. Specifically reviewing job advertisements for humanitarian logisticians, Kovacs et al. (2012) identified general management skills (project management, relationship management, and change management), interpersonal skills (communication, negotiation, and leadership), and problem solving skills beyond the functional logistics technical skills required for the job.

Surveys of accounting students reinforce the perceived value non-technical skills. Accounting students from diverse cultural backgrounds identified that their academic programs helped them develop generic skills (behavioral and cognitive) beyond the required technical skills (Keneley & Jackling 2004). In a study of teaching effectiveness, accounting students endorsed the value of team-based learning and the development of professional skills (teamwork and interpersonal skills) in their accounting curriculum (Reinig et al. 2011).

Focusing on project managers, Cheng (2005) developed a 12 point behavioral competency model. Those qualities include achievement orientation, initiative, information seeking, focus on client's needs, impact and influence, directiveness, teamwork and cooperation, team leadership, analytical thinking, conceptual thinking, self-control, and flexibility. Seeking to quantify how managers' observations of their technical engineering project management professionals compared to test results for "soft skills quantification" (SSQ), another list of six areas of soft skills was developed. This list included results orientation, interpersonal skills, personal accountability, flexibility, problem-solving, and planning and organization (Petter et al. 2009). While these lists have some common elements, they also vary – both in the words they choose to identify specific skills and how broad the requirements of non-technical extend.

Aggregating the Breadth of Non-Technical Skills

As the NACE studies indicate, employers use their own language to specify the non-technical skill sets they are seeking in job applicants. For instance, one could easily argue that "ability to work in a team" denotes "teamwork," or vice versa. But one also could see how answering a prospective employer's request for information about when an applicant showed the "ability to work in a team" might lead to statements about the specific skills that make one able to work in a team. They might include listening, responding to different opinions, considering other points of view, communicating effectively with others, reaching a logical conclusion from all available information. Those skills could each be considered part of what makes someone skilled in non-technical areas.

Additionally, depending on the discipline, certain skills may be considered technical rather than non-technical. Skills such as project management and negotiation vary depending on discipline. Engineering and project management professionals often identify project management as a technical skill (e.g. Salleh et al. 2013; PMI 2016) and similarly, negotiation may be considered a technical skill for a supply chain manager (e.g. ISM 2016). To address this issue, this cross-disciplinary study includes skills as non-technical if they are identified as such by any discipline.

To bring greater clarity and consistency to the discussion of non-technical skills, the authors propose grouping non-technical skills into four categories (Table 1). These categories are designed to increase the specificity and clarity of those who seek to describe non-technical skills in both academic and workplace settings. These groupings also can ensure that synonyms

and words that are closely aligned convey the same general ideas. Through these groupings, similar words that people may use independently, but signify the same idea, become part of the whole, adding further weight to the overall non-technical skill moniker. Furthermore, these categories can make addressing these increasingly important job qualifications easier for both employers and academic institutions.

Table 1: Non-technical Skill Categories

Skill Category	DESCRIPTION
Group Interaction	Skills that foster group success
Character/Personal	Skills and traits unique to the individual that enable that person to achieve objectives
Interpersonal	Skills that an individual employs to have positive one-on-one interactions
Tactical	Skills that applying methods and procedures to achieve results

An aggregation of the non-technical skills identified in relevant literature provides a cross-disciplinary view of what encompasses non-technical skills (Table 2). Recall that these studies represent the perspectives of faculty, students, and the professional community from various disciplines with strong technical skill requirements for their employees.

Table 2: Non-technical Skills Grouped by Category

Non-technical Skill Category	Term(s) from literature	Source
Group Interaction	Meeting facilitation, Meeting (conducting/partnering)	Kovacs & Tatham, 2010; Kovacs et al. 2012; Sallah et al. 2015
	People management	Kovacs & Tatham 2010; Kovacs et al. 2012
	Leadership, leading change	Kovacs & Tatham 2010; Salleh et al. 2013; Sallah et al. 2015; Mangan & Christopher 2005; Kovacs et al. 2012; Goleman 1995
	Change management	Mangan & Christopher 2005
Character/Personal	Analytic, Analytical	Mangan & Christopher 2005; Lizzeo et al. 2002; Sallah et al. 2015
	Persuasiveness	Goleman 1995
	Question accepted wisdom	Keneley & Jackling 2011
	Think and reason logically	Keneley & Jackling 2011
	Understand ethical implications of decisions	Keneley & Jackling 2011
	Written communication, written presentation, written skills	Kovacs & Tatham 2010, Kovacs et al. 2012, Lizzio et al. 2002; Sallah et al. 2013, Sallah et al. 2015
	Stress management	Kovacs et al. 2012; Kovacs & Tatham 2010
	Listening	Kovacs et al. 2012; Kovacs & Tatham 2010; Salleh et al. 2015
	Innovativeness	Ling 2002
	Enthusiasm in tackling a difficult assignment	Ling 2002
	Loyalty to designer/builder	Ling 2002
	Offering suggestions to improve design	Ling 2002
	Persistenct in overcoming obstacles	Ling 2002
	Respect for designer/builder as team leader	Ling 2002
	Confidence tackling unfamiliar problems	Lizzio et al. 2002
	Decision making skills, make decisions	Sallah et al. 2015; Keneley & Jackling 2011
	Able to work independently	Salleh et al. 2013
	Able to work under pressure	Salleh et al. 2013
	Matured	Salleh et al. 2013
	Proactive	Salleh et al. 2013
	Self-motivated	Salleh et al. 2013
	Willing to learn	Salleh et al. 2013
	Responsible, make and take responsibility	Salleh et al. 2013; Keneley & Jackling 2011
	Creative, think creatively, creativity	Salleh et al. 2013; Ling 2002; Keneley & Jackling 2011
	Positive attitude	Sallah et al. 2013
Interpersonal	Interpersonal	Mangan & Christopher 2005; Ling 2002; Salleh et al. 2013; Salleh et al. 2015
	Resolving conflicts	Sallah et al. 2015
	Communication, Ability to communicate at multiple levels, communication skills, oral communication	Salleh et al. 2013; Ling 2002, Kovacs et al. 2012; Kovacs & Tatham 2010; Sallah et al. 2015
	Team member, team player, teamwork, work in a team, building and leading teams, past team size	Lizzio et al. 2002; Salleh et al. 2013; Sallah et al. 2015; Keneley & Jackling 2011; Goleman 1995
Tactical	Adapt knowledge to new situations	Keneley & Jackling 2011
	Open to new possibilities	Keneley & Jackling 2011
	Work with minimum supervision	Keneley & Jackling 2011
	Human resource management	Kovacs & Tatham 2010
	Negotiation	Kovacs & Tatham 2010; Kovacs et al. 2012; Sallah et al. 2015
	Information gathering, locating information; information sharing, organizing information	Kovacs et al. 2012, Kovacs & Tatham 2010; Sallah et al. 2015
	Problem solving, problem solving skills, problem-solving, solve problems, problem identification, problem analysis	Kovacs et al. 2012; Kovacs & Tatham 2010; Salleh et al. 2015; Lizzio et al. 2002; Ling 2002; Keneley & Jackling 2011
	Attention to design and construction details	Ling 2002
	Compliance with designer/builder's instructions and orders	Ling 2002
	Preparedness to revise design to achieve higher constructability and cost and/or time savings	Ling 2002
	Speed in obtaining statutory approvals, speed in producing design drawings, speed of response to the request and instructions of the designer/builder	Ling 2002
	Project approach, project management	Ling 2002, Managan & Christopher 2005
	Planning own work	Lizzio et al. 2002
	Critical Thinking	Sallah et al. 2015
	Time management, time management skills	Salleh et al. 2013; Sallah et al. 2015
	Presentation	Salleh et al. 2013

RESEARCH DESIGN

To validate the aggregated list of non-technical skills provided in Table 2, this study applies content analysis to online job advertisements. Terms identified in the literature are matched to and abilities sought by employers as provided in the job advertisement.

Prior studies have used job advertisements to assess recruitment effectiveness (Gibson & Cook 2001), architect skills (Salleh et. al. 2013), logistician skills (Kovacs et al. 2012), as well as to identify gaps between skills needed on the job and skills advertised (Matthews & Redman 2001).

Content analysis is a range of qualitative and quantitative research methods based on the review of text or symbol-based source documents (Duriau et al. 2007). Studies also have used content analysis to explore transcripts of recorded interviews (Porterfield et al. 2012). Beyond the identification of specific terms, content analysis includes the patterns or co-occurrences of terms similar to the traditional qualitative analysis technique of correlation (Krippendorff, 2004; Weber 1990). This study proposed to use both a qualitative and quantitative content analysis.

Using content analysis for qualitative and quantitative analysis requires the development of a robust framework of appropriate terms. Existing literature provides a framework of knowledge, skills, and abilities associated with non-technical skills. The aggregated list of terms is provided in Table 2.

Data

Job advertisements were sampled from the INDEED online job database (www.indeed.com). The online service includes nearly one million job advertisements across disciplines and geography. Advertisements were sampled for a 30-day period (1FEB2016 through 1MAR2016) for jobs within 50 miles of Chicago, IL. Chicago was chosen as a sample geography based on its central location in the US. The initial sample focused on engineering jobs. Engineering job advertisements were selected based on the job title of “Engineer”. In order to avoid temporary and part-time positions the query required a job type of “Full time”. The engineering query was further filtered to avoid job title terms associated with short term positions, computer programming, building maintenance, and other positions that did not require a traditional engineering degree (temporary, application server, ember, java, python, linux, data, hardware, controls, developer, network, support, systems, software, service, sales, office, field, operation).

To efficiently extract the relevant job advertisements, the authors developed an application programming interface (API) that extracted the data as a comma delimited text file.

Rather than manually coding the job advertisements using multiple coders, advanced features of computer assisted qualitative data analysis software (CAQDAS) were used to identify the relevant terms in the job advertisements. Atlas.ti software provided tools to auto-code, count, and evaluate co-occurrences of the previously identified terms (see Friese 2014).

RESULTS

Descriptive Results

The API extracted 83 engineering job advertisements. Advertisements covered a range of engineering sub-disciplines (Table 3). The INDEED website requires that the organization posting the job opening select an “engineering type”.

Table 3: Engineering Disciplines

	Count	Percent
Industrial/Manufacturing	20	24%
Other	18	22%
Mechanical	11	13%
Quality	10	12%
Electrical	6	7%
Civil	5	6%
Mechanical or Electrical	3	4%
Architectural or Mechanical	2	2%
Mechanical or Chemical or Electrical	2	2%
Product	2	2%
Production	2	2%
Environmental	1	1%
Mechanical or BioMed	1	1%

In the job description, the organization posting the job opening can specify any degree requirements. Forty-one percent of the jobs in the sample specify a college degree of bachelor's or higher (Table 4).

Table 4: Degrees Specified

	Count	Percent
Bachelor's	27	33%
Master's	2	2%
Either Bachelor's or Master's	5	6%
Neither Specified	49	59%

In the job description, the employer can specify whether experience is required. Eighty-eight percent of the jobs in the sample required either general experience, specific work experience, or specific experience using software tools or engineering practices (Table 5).

Table 5: Experience Requested

	Count	Percent
Experience noted	73	88%
Experience not noted	10	12%

Content Analysis

To test the non-technical skills identified from the literature, the dataset was scanned for appropriate search terms related to each skill. Preliminary results for the *interpersonal* category are provided.

Forty-eight percent of the job advertisements noted at least one of the skills identified in the *interpersonal* category (Table 6). Of the interpersonal skills, team related skills were requested most (67%), followed by communication skills (40%) and interpersonal skills (23%).

Table 6: Interpersonal Skill Category Results

	Count	Percent
interpersonal	19	23%
communicat*	33	40%
team*	56	67%

While nearly half of the job advertisements include an interpersonal skill, 14% include two of the interpersonal skills and 2% include all three (Table 7).

Table 7: Skill Concentration

	Count	Percent
Noted one interpersonal skill	26	31%
Noted two interpersonal skills	12	14%
Noted all three interpersonal skills	2	2%

Co-occurence of terms can be evaluated using a binary correlation for cases where each term is present. The correlation analysis shows a moderate positive pair-wise relationship between communication and each of the other two interpersonal skills (Table 8).

Table 8: Skill Co-occurence

	interpersonal	*communicat**	*team**
interpersonal	1		
communicat*	0.28	1	
team*	0.16	0.26	1

DISCUSSION

These results offer a new lens with which the overall preparedness of job applicants in the engineering field can be explored. Academic institutions attempt to provide employers with prospective employees whose skill sets match what those employers need. Employers, based on who they hire and interactions with academic institutions, provide feedback on the effectiveness of academic efforts to prepare these students. The results of this sampling suggest that employers in the engineering field are actively seeking workers who possess these non-technical skills, and their stating of these skills in their advertisements suggest the acute nature of this need. The sampling shows that the interest of engineering employers in non-technical skills spans a wide range of engineering disciplines. This broad appeal of job applicants with non-technical skills seems to support growing weight placed on non-technical skills by academic accrediting bodies, professional organizations, industry professionals and academics.

The Language of Non-technical Skills

All new concepts are developed through reliance on existing concepts. The effort to find a universal definition of what encompasses non-technical skills is no different. From the literature review above, it is evident that various researchers, professional associations, and industries have applied the words and characteristics they believe comprises their specific definition of non-technical skills. While literature on non-technical skills dates back several decades, this research supports the idea that definitive and universally accepted language is not established.

For instance, in looking at the literature, “non-technical skills,” “behavioral skills” and “soft skills” are frequently used interchangeably, or as separate components of the first one. (For many, Goleman’s use of the phrase “soft skills” carries particular weight, even though it receives passing attention in his book.) The lack of consistent language at the foundation of this area of study suggests its infancy.

This paper attempts to refine the language through its use of broader categories, giving employers, job seekers and academic institutions clearer categories under which they can group smaller components of the overall non-technical skill area. This approach could help eliminate potential confusion and redundancy in the language describing components of non-technical skills.

Driving Toward Clarity

Over time, a clearer definition of non-technical skills may emerge. At present, academic institutions, their graduates and employers also may be confronting a language barrier of sorts. This lack of clarity could be making it more complicated for employers and academic institutions to talk with each other and to properly assess the non-technical skills of job applicants. One can easily reason that “work independently” and “work with minimal supervision” are both attempting to convey the same idea. However, the difference in wording could lead to differences in how a job applicant might address a question and how a prospective employer might evaluate a response. An applicant for an engineering job might discussion in an interview a situation where she worked alone to develop a process to resolve a production problem, putting stress on the working alone aspects of the project. Asked to discuss a situation involving minimal supervision, the same applicant might discuss how once she was trained in a process, she managed the staff completing the process with weekly check-ins by her supervisor. Both answers might satisfy an employer, but at the same time, each answer might hurt the applicant’s chances for that job, depending on what the employer is looking for and how he refers to it. Similar situations involving a potential lack of clarity because of differences in how the words are used can be easily identified when looking at the varied list of words used to describe non-technical skills and its components in prior literature.

The Bigger Picture

When aggregated under the broader categories this paper suggests, trends become more visible. For instance, 48 percent of job advertisements in the sampling addressed the “interpersonal” category. Recognizing the similarities of “team-related skills,” the most requested among the sampling with 67 percent, followed by communication skills (40%) and the actual words themselves (23%), a more comprehensive and accurate picture of employers’ needs and areas that academic institutions should focus attention becomes clearer. That 14% of the sample include two of the interpersonal skills and 2% include all three terms could suggest the need for even greater importance to be placed on the interpersonal category of non-technical skills.

Academia Needs to Dig Deeper

The results also suggest that academic institutions have more work to do. Job advertisements are a cost that employers incur to obtain qualified workers. However, employers know that the more qualifications they seek in a job posting, the word count will increase and the more it will cost. Moreover, the more qualifications they seek, the narrower the pool of applicants is likely to be. Therefore, it can be argued that because employers are taking valuable and costly space in

job postings to specify the non-technical skills they seek in applicants could suggest that the applicants they are interviewing do not demonstrate these skills. The absence of the sought-after non-technical skills in graduates could suggest that academic institutions have not yet found the best ways to integrate these skills into their curriculum effectively. It also may mean that these non-technical skills, which by their own nature are not concrete, are difficult to teach in a group setting like a college classroom because each student comes to the classroom with his own strengths and weaknesses in this area, making it difficult to create a common curriculum to address identification and areas of improvement. This research does not address whether the validity of these claims, but future research should explore these areas.

Demonstration Issues

Job applicants who may have honed these non-technical skills in academic institutions may not be developing the ability to demonstrate these skills in ways that resonate with potential employers. Through examples, activities focused on real-world scenarios, internships and other efforts, academic institutions may be helping students cultivate these skills. However, students may not be as adept at describing these skills in response to employers' questions. As a result, employers may not be finding the words that applicants use or the experiences they describe matching exactly what they are looking for, thus the problem may not be in the instruction, but rather in the communication of these non-technical skills. Additional research should explore this area.

The employment advertisement pool collected for this research may not reflect the overall industry since its focus was on Chicago. Future research could use this methodology to explore employers' stated needs in their job advertisements in different geographic areas. Additional research also could focus on comparing employment advertisements among different industries to explore if the articulation of non-technical skills in these postings varies by industry.

CONCLUSION

An initial analysis of the aggregated non-technical skills list using online job advertisements for engineering positions reveals yet greater insight into how academic institutions and employers are addressing these important skills.

Developing broad categories under which the expansive list of words used to describe non-technical skills can be divided helps to improve the acceptance, clarity and usefulness of this increasingly important area of job preparation. Initial testing of one category suggest that further testing of all four categories against actual job postings yields new information on the interest employers have in finding graduates who have the appropriate non-technical skills they seek.

Armed with four important areas to address, colleges and universities can build programs more easily and efficiently. These groupings also allow employers to more effectively explore candidates and choose applicants for jobs that have the important mix of technical and non-technical skills.

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