Research Article

Characterizing Disciplinarity and Conventions in Engineering Resume Profiles

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***Abstract*—Background:** *Resume preparation is a common activity within technical writing classes, but the advent and increased use of resume profile and job-hunting sites, such as Indeed.com, require instructors and researchers to re-think common practices in the teaching of resume writing, particularly for writing instructors with limited disciplinary experience. Prior research for conventional resumes has quantified the disciplinarity of resumes as a function of resume quality using metrics of disciplinary discourse density, which may be useful in analyzing online resumes profiles.* **Research questions:** *1. How do online engineering resume profiles demonstrate disciplinarity? 2. What formatting and stylistic conventions are observed within engineering resume profiles? 3. How do rhetorical disciplinarity and conventions vary with resume profile quality?* **Literature review:** *Although past efforts have examined the resume as a critical genre for entering a professional setting, few researchers have sought to interpret the relationships between discursive and stylistic expectations and quality in online resume profiles, while also accounting for aspects of disciplinarity.* **Methodology:** *This study compares engineering (all disciplines) resume profiles from Indeed.com with a corpus of conventional engineering resumes through qualitative genre analysis and quantitative methods for calculating disciplinary discourse density. We also characterize stylistic and rhetorical conventions for resume profiles, and statistically compare these facets as a function of resume quality.* **Results and conclusion:** *Results determined that discursive strategies were significantly different between strong, moderate, and weak engineering resume profiles. Qualitative analysis captured differences in style and form that were also statistically linked with quality. Based on our results, we call for further investigation into resume profiles and reconsideration of current pedagogical approaches.*

Index Terms*—Communication, disciplinary discourse, engineering resumes, professional development, resume profiles.*

There has been a substantial shift in hiring practices over the past decade toward electronic job search, recruitment, and application tools. Adding one's resume to individual employer sites and jobs sites, such as Indeed.com and Monster.com, is becoming an increasingly common, if not standard, practice. While some online networking and job search sites enable candidates to upload a conventional resume in Word or PDF format, other sites, such as Indeed.com and LinkedIn, ask applicants to submit their qualifications through prebuilt forms. Despite this shift, the conventional print resume holds the focus of most technical writing textbooks and web resources aimed at job documents, leaving instructors with few resources on preparing students for the modern job application process.

In addition to the need to consider evolving technologies for the teaching of resumes, instructors who teach resume writing also face the challenge of each discipline having some distinct conventions as well as some overlapping resume-writing conventions. At the same time, students often find resume advice in their textbooks to be outdated, generic, and irrelevant to their field [1], making the teaching of resumes a uniquely challenging, high-stakes task. While navigating these issues, resume instructors and writers must also consider other factors concerning the ways that resumes will be read and used, considering rapidly evolving technologies and disciplinary norms, such as the emergence of resume profiles. Given these shifts, the validity of the "rules" for resume writing as they have been traditionally taught warrants additional investigation.

In this article, we use qualitative and quantitative analyses to assess the quality and disciplinarity of online resume profiles and understand the typical

Manuscript received May 9, 2019; revised May 31, 2021; accepted June 1, 2021. Date of publication October 26, 2021; date of current version November 24, 2021. *(Corresponding author: Catherine G. P. Berdanier.)*
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IEEE 10.1109/TPC.2021.3110397

Practitioner Takeaway

- The disciplinarity of engineering resume profiles can be assessed quantitatively using metrics of disciplinary discourse density, a way of attributing numerical values to disciplinary discourse.
- Strong engineering resume profiles (from Indeed.com) differed statistically significantly from weak resume profiles with respect to disciplinary discourse density and use of conventions such as use of bulleted lists or verb-centric phrasing.
- Rather than being taught resume writing as a monolithic genre, students should be taught to demonstrate disciplinary mastery across conventional and emergent activity systems related to career preparation, such as online resume profiles.

style and format conventions used within engineering resume profiles. A variety of terms has been used in the literature to describe various resume formats hosted or uploaded to the web as digital applications evolve over time (e.g., web resumes [2], scannable resumes [3], online resumes [4]–[6], and electronic resumes [7], [8]). However, for the purposes of this article, we define "conventional" resumes as (normatively) one-page documents intended to be submitted to and reviewed by an employer and able to be easily printed out. In contrast, we define online "resume profiles" as the quasiresumes that are native to an online job search website, such as Indeed.com. Rather than being created in a word processing application, these resumes are constructed through online resume builders that guide users in the creation of a resume through a series of predetermined sections while also allowing ample personalization by including an open-ended description section for each experience. As one example, the current version of LinkedIn includes a similar feature that enables users to build their profiles, which may be used for job-searching purposes as well as for the site's larger professional social networking function.

In response to these modern manifestations of the resume and the challenges that they bring for writing instructors, while also anticipating future evolution of the genre, this article posits that disciplinary discourse is a bridge that can help instructors and engineering students alike consider expectations for resumes and resume-like genres in newer formats, such as resume profiles on job-search websites. The purpose of this study is to discern features of quality in engineering resume profiles, relying heavily on disciplinary discourse and disciplinary discourse density, a method proposed in prior work [9]. This research seeks to answer the following questions.

RQ1. How do online engineering resume profiles demonstrate disciplinarity?
RQ2. What formatting and stylistic conventions are observed within engineering resume profiles?
RQ3. How do rhetorical disciplinarity and conventions vary with resume profile quality?

As a result of this study, we call for additional research on resume profiles and the development of teaching methods that help engineering students and instructors navigate emerging genres of job-search materials.

Literature Review

Given the longevity of genres, such as the resume and cover letter within the job-hunting process, research across the disciplines has been invested in best resume-writing (and pedagogical) practices to prepare students for internship opportunities and postgraduate careers. Between the 1970s and 1990s, studies largely examined topics such as the order of information in resumes and comparisons between students, instructors, business communication textbook advice, and recruiters on resume preparation [10]–[17]. Attention to emerging, persuasive approaches to resume content, style, and delivery methods still remains prevalent [18]–[22], but more recent research has focused on comparisons between print and video resumes [23]; students' learning processes while crafting resumes [24], [25]; and the impact of race and gender on resume interpretation [26]–[28]. Other recent, comprehensive literature reviews of resume scholarship include research from disciplines such as career development and applied

psychology [1] and in technical and professional communication and STEM education journals [9].

Emerging digital technologies have ushered in discussions about new formats like the scannable resume and updated resume-writing practices for the web [29]–[32], compelling classroom assignments that guided students on how to create web-based versions of their conventional resumes. A new direction in resume research comes with the prevalence of online job-hunting websites that employ their own platforms for users to input experience data. The text boxes provided on these websites do not require specific formatting, nor are they necessarily intended to be printed out, although that is an option. Further, the job applicant often does not submit a tailored resume profile to a specific company using LinkedIn or Indeed.com; rather, the onus is on the employer to use such sites to "find talent," sometimes using a digital applicant tracking system (ATS) to digitally filter resumes to deposit a set of relevant and qualified candidates to a hiring manager.

Acknowledging the Role of ATSs While acknowledging the ATS as a valuable tool for employers but a potential obstacle for an applicant, articles that do discuss algorithmic filtering systems in sorting resumes and resume profiles acknowledge the need for applicants to learn to write digital resumes that can be applicable to multiple audiences. As a specific example, Diaz's [33] discussion of "electronic" and "scannable" resumes discusses the use of optical character recognition software, a precursor to modern robust text parsing systems that facilitate job application websites like LinkedIn and Indeed.com. She notes that

> updated best practices need to focus on writing one resume without knowing precisely how the employer, or even a specific resume reviewer, will approach the resume

and that

> once an applicant submits a resume, the applicant loses control over what happens to it: A paper resume may become an electronic document read by a computer search engine, and an electronic resume may become a paper resume read by a ballerina doing temp work between productions. [33, p. 433–434]

Most recently, Randazzo's [34] study of resume decisions from the points of view of applicants and employers notes that the employers interviewed said that they interact with resumes and resume profiles at a variety of points in the application process, such that the use of an ATS is common but not universal. Her study also found that although some applicants more specifically chose to design their online profiles and resumes for ATS optimization with respect to rhetorical choices and deliberate use of keywords, employers still expected pragmatic variation in the content, rhetoric, style, and form for resumes, especially for professionals with more expertise, when the profile was reviewed by human decision-makers.

Current advice from Indeed.com [35] notes that approximately 40% of employers use an ATS to prefilter candidates, using both the included information (particularly the inclusion of keywords and keyword synonyms with respect to a job position) and font styles, noting that digital ATSs have issues reading some bullet characters and font families (e.g., serif fonts and nonstandard bullets). Although the inclusion of keywords is important in getting past the ATS and into the hands of a human hiring agent, advice from Indeed.com emphasizes the importance of remembering that the point of the online profile is to demonstrate capabilities to a human employer.

Disciplinarity in Job Documents and the Purpose of the Paper Literature that studies or promotes a disciplinary approach to the study or teaching of resumes is limited, especially in engineering. Disciplinarity does indeed matter in resume writing and evaluation. Charney et al. [36] documented disciplinary differences between business and engineering recruiters' interpretations of resumes. Engineering recruiters, for example, focused heavily on descriptive titles and project design details and methods, compared with business recruiters who focused on the pitch and rationale for the projects described in a resume. These findings motivate a disciplinary approach to the teaching of engineering resume writing.

More recently, attention has turned toward the development of technologies such as machine learning to distill and filter digital resumes from an employer's point of view. For example, Valdez-Almada et al. [37] used machine learning and text mining methods to generate knowledge profiles for software engineers based on resumes to help employers identify technical knowledge in initial digital screening of job applicant resumes. Elliott's recent dissertation [38] similarly used machine learning to mine engineering resumes to

determine engineering competencies and attributes, again with the primary application of the research being to enable an employer to screen applicants quickly. These studies offer little advice to instructors or engineering students, nor do they discuss aspects of stylistic convention or rhetorical decision-making that can be integrated back into the professional communication classroom.

Motivated by this need, our past work examined the role of disciplinary discourse—the words, phrases, or patterns of language that have embedded meanings or values to certain disciplinary communities—in engineering students' and practitioners' conventional resumes to theorize how students can best tailor those resumes for engineering audiences. Through that research, we discovered a link between the quality of a resume and the way that disciplinary discourse is employed: namely, higher quality resumes were characterized by a statistically significantly higher density of engineering lexical occurrences [3], a parameter we called *disciplinary discourse density*. These findings suggested potential interventions in the teaching of resumes that could be introduced not only to engineering students but also to students across various disciplines.

In this article, we acknowledge the role of ATSs as they apply to the process as a whole, but we are interested in characterizing the conventions and disciplinarity present within engineering resume profiles broadly, taking the point of view that our study of disciplinarity and conventions in online engineering resume profiles starts after the resume profile has landed in the hands of a human (e.g., the goal of the study is not to analyze which conventions, style, or disciplinarity get past an ATS). Pulling from Diaz's and Randazzo's recommendations, as well as current advice from Indeed.com on not ignoring the human element while embedding thoughtful and relevant keywords "for" an ATS, we make the assumption that the applicants responsible for the resume profiles in our study understood that their resumes might be filtered digitally before being examined by a human hiring manager or employer, either on a computer screen or printed out for closer review. However, we also assume that the applicants hoped and planned for a human employer to evaluate their resume profile at some stage of the hiring process. From there, our goals in this work are to use quantitative measures of disciplinary discourse density and qualitative comparisons of conventions to propose standards of quality for engineering resume profiles that can be more agile in web contexts.

Theoretical Framework: Activity Theory This study is framed from the point of view of Activity Theory. Derived from Vygotsky [39], [40]; Leont'ev [41], [42]; and later developed by Engeström [43] and Cole and Engeström [44], Activity Theory [also known as cultural-historical activity theory (CHAT), which was introduced by Cole [45] to help unify the developments of activity theory stemming from Vygotsky's work] is concerned with the analysis of the system of "ongoing, object-directed, historically conditioned, dialectically structured, tool-mediated human interaction[s]" [46, p. 510] in which every human behavior is grounded.

When performing activity system analysis, rhetorical genre studies scholars often reference the model depicted by Engeström [43] to identify the various nodes that comprise an activity system [47]. These nodes, which include the "subjects, "mediational means," and "objects/motives," interact inseparably with one another to produce outcomes; these interactions, in turn, are supported by "rules/norms," "community," and "division of labor" [48]. Paraphrasing Kaptelinin [49], Spinuzzi [50, p. 450] identifies the object node at the center of the activity system, describing it as "the 'sense-maker' around which the rest of the unit of analysis, the activity system, forms." This object guides the action(s) of the subjects using mediational means such as physical tools (e.g., computer) or discursive tools (e.g., genre) to achieve the outcome(s). In the creation of the object, the subject may draw from "rules" established by the community concerned with the transformation of the object, and other agents involved in the activity—i.e., the division of labor—may influence the development of the object. More of "a powerful and clarifying descriptive tool" rather than "a strongly predictive theory" [51, p. 7], activity theory is a lens for understanding how such interactions within a system are mediated by the use of tools and symbols (e.g., language).

Activity theory has two main benefits for the study of resumes. First, it invites a deeper analysis of the development and impact of this genre in relation to the activity of resume writing for job search purposes in a field. Second, it affords the opportunity to consider not only the individual subjects and agents involved in the production of a resume, but also the specific disciplinary community and its coinciding rules, tools, and division of labor that influence the creation of the

TABLE I
ACTIVITY THEORY NODES FOR CONVENTIONAL RESUMES AND ONLINE RESUME PROFILES

Activity Theory Nodes	Conventional Resumes	Online Resume Profiles
Artifacts/Tools	Computer, Word Processing Software	Computer, Internet, Platform-specific Profile Builder
Rules	Typical "rules" for formatting (e.g., bullets, verb-focused statements, 1 page)	Few defined guidelines: some platforms may have character/word limits, or suggest guidelines for readability by digital systems if employers choose to abide by them
Object	Conventional 1-page resume, intended to be viewed on a computer or printed as a handout	Resume profile is housed online. Human recruiters will download resume profiles and/or view them online, and print them if desired.
Division of Labor	Applicant expected to tailor resume to each specific company and position	Applicant creates one resume profile hosted online to meet multiple potential jobs; employer does resume filtering work, potentially with the help of an ATS
Subject	Engineering Job Applicant	
Community	Engineering Disciplinary Community	

resume and its effectiveness. The ability of activity theory to "illustrate the dialectical relationship between genres, individuals, activities, and contexts" [52, pp. 98, 102] makes it particularly suited to contextually tracing the development of the artifact of resumes as subjects (resume writers, employers), media (print, digital, online, web), rules (genre conventions), communities (disciplines, employment websites), and divisions of labor (employers, applicants) continually interact.

We draw on Spinuzzi's [50] approach to methodologically and theoretically contracting an object that emerges from his analysis of how the object has expanded over time. Spinuzzi categorizes this historical development as four method-movements: the triangular representation of an activity system as developed by Engeström [43], the concepts that two activity systems can share an object and that networks of activity systems may share components, and the transformation of Engeström's [53] conception of multiperspectival "runaway objects" via "knotworking" or irregular, distributed collaborations [54] within *mycorrhizae* or horizontal connections across activity systems. Applying this framework to our research, we analyze the production of an engineering resume and resume profile as the object(ive) that defines the activity of seeking employment opportunities.

At first glance, it may seem that conventional resumes and resume profiles operate within the same activity system, given their shared purpose. Both documents are used to apply for jobs in an industry or disciplinary context (in our case, engineering). When printed, the online resume profiles look much like a conventional resume. However, deeper analysis shows that the resume profiles operate in a parallel but nonequivalent activity system. Table I shows the differences. Although the subject (the engineering job applicant) and the community (the engineering disciplinary community) are still the same, the other nodes of the activity system are quite different.

The only overlapping connection between nodes is the subject–community junction. We posit that this junction is mediated by the ways that the subject communicates value, expertise, and experience with the wider community using discipline-specific language. Because of this link, we aim to characterize the disciplinarity of a corpus of resume profiles using our previous method for quantifying disciplinary discourse density to begin to discern patterns of disciplinarity. Further, because the "rules" for online resumes are ill-defined, this study begins to benchmark current conventions present for online engineering resume profiles.

Understanding that each activity system is a situated system within a larger network of related subjects, objects, artifacts, and rules dependent on the culture of the discipline or even a particular company (such as whether a company uses an ATS to pre-filter resumes), we must bound our activity

system. In this study, we define our activity system to *start after the potential use of an ATS*, when the resume is back in human hands, such that the ATS is not a relevant node in our interpretation of the activity. The ATS is instead embedded into the "division of labor" node to reflect that a human actor chose to use an ATS and defines keywords. After the ATS prescreens applicants, the engineering resume profiles are evaluated by the human employer.

We posit that this decision is appropriate for several reasons. First, although the authors of the resume profiles may or may not have considered the role of the ATS in their resume design, they certainly anticipated that their resume profile would be evaluated at some point by a human who would expect engineering disciplinary expertise. Further, deep disciplinary expertise will extend far beyond the keywords defined by an employer. Indeed, Randazzo [34] found that the depth of an applicant's experience—in addition to those experiences and competencies directly synonymous with keywords—is important to employers, especially for well-established candidates, regardless of whether the employers have chosen to use an ATS for preliminary screening. We follow the approach of Randazzo [34] to acknowledge the possible use of an ATS but to focus instead on the characterization of the genre of resumes and resume profiles from the point of view of the human hiring manager or employer. For these reasons, examining quality, disciplinarity, and conventions in engineering resume profiles from this defined activity system is valuable.

Research Methodology

This research employs both qualitative and quantitative analysis techniques to quantify rhetorical patterns in resume profiles and to qualitatively assess common conventions in engineering resume profiles across disciplines. The disciplinary discourse density scores and the conventions are then analyzed to understand how these parameters correspond with the quality of engineering resume profiles. In this section, we discuss methodological details on sampling, cleaning of the data, and data analysis. The research team includes engineering and communication researchers who together hold advanced degrees in engineering, English, and engineering education. Our methodological development is consistent with value to the technical communication community, aligned with engineering disciplinary expectations and values, and respectful of rigorous qualitative and quantitative research traditions.

Sampling and Description of the Corpus We compiled a corpus of $N = 200$ engineering resumes available publicly on the job-hunting and recruiting website Indeed.com from a variety of experience levels for all disciplines of engineering. Because of the public availability of the resumes, this research was classified as exempt and did not require Institutional Review Board approval. No efforts were made to quota sample based on engineering field, gender, or final academic degree, though we sought individuals who earned at least a bachelor's degree in an engineering discipline, engineering technology, computer science, or very closely related science discipline.

Resumes of individuals who held engineering degrees but were seeking jobs in other areas, such as business or sales, were removed from the corpus to maintain focus on the ways engineers communicate their expertise to other engineers. Several of the removed profiles applied "engineer" to other professions, such as audio engineers who work in recording studios, and Information Technology (IT) and network engineers, whose degrees in IT are applied to the administration of computers, printers, and company networks. A log was kept for consistency and justification for the eliminations from the data set.

After cleaning the corpus in these ways, a total of $N = 89$ engineering online resume profiles remained for analysis. All participants represented by the publicly available corpus were applying to work in the US, and all resumes were in English. No effort was made to assume gender or racial ethic background because we mined the resumes from a publicly available site and could not ask participants to self-identify these personal data. Resume profiles were downloaded in PDF format using Indeed.com's digital tools, just as a potential employer might download a resume to save it for reference.

Quantitative Resume Analysis Methods employed to analyze the resume profile follow those that we developed for earlier studies of conventional resumes [9], [55], [56], but are described again briefly here. The method is intended to quantify the disciplinary discourse density within engineering resumes by ranking disciplinary words and phrases (lexico-grammatical features) at higher or lower levels of disciplinarity. Coding is based on the engineering competency model first proposed by

TABLE II
ENGINEERING COMPETENCY TIERS BASED ON THE FRAMEWORK FROM THE AMERICAN ASSOCIATION OF ENGINEERING SOCIETIES [57] WITH CORRESPONDING NUMERICAL SCORE

	Example Competencies (Non-Exhaustive)	Numerical Score
Tier 1: Personal Competencies	Interpersonal skills; integrity; professionalism; initiative; dependability; reliability; adaptability; flexibility; lifelong learning	1
Tier 2: Academic Competencies	Mathematics; science and technology; communication (verbal, written, visual); critical and analytical thinking; basic computer skills; school-related research skills	2
Tier 3: Workplace Competencies	Teamwork; client/stakeholder focus; planning; organizing; creative thinking; problem-solving; decision-making; seeking and developing opportunities and solutions; working with tools and technology (e.g., engineering software packages); business fundamentals; teaching (not as professor)	3
Tier 4: Industry-Wide Technical Competencies	Foundations of engineering; design; manufacturing and construction; operations and maintenance; ethics; business, legal and public policy; sustainability and societal/environmental impact; engineering economics; quality control and quality assurance; safety; health; security and environment; general research competence; ability to write grants; publish internal reports; global competency	4
Tier 5: Industry/Sector Functional Areas	Demonstration of specialized expertise; industry-specific research; teaching at university level as an expert; earned advanced degrees; obtain industry-specific funding; membership in professional societies; connections to research advisor	5
Tier 6: Management, Technical Leadership and Occupation-Specific Competencies	Occupation specific requirements; management competencies; staffing; informing; delegating; networking; monitoring work; entrepreneurship; supporting others; mentoring; strategic planning and action; preparing/evaluating budgets; developing an organizational vision; monitoring and controlling resources	6

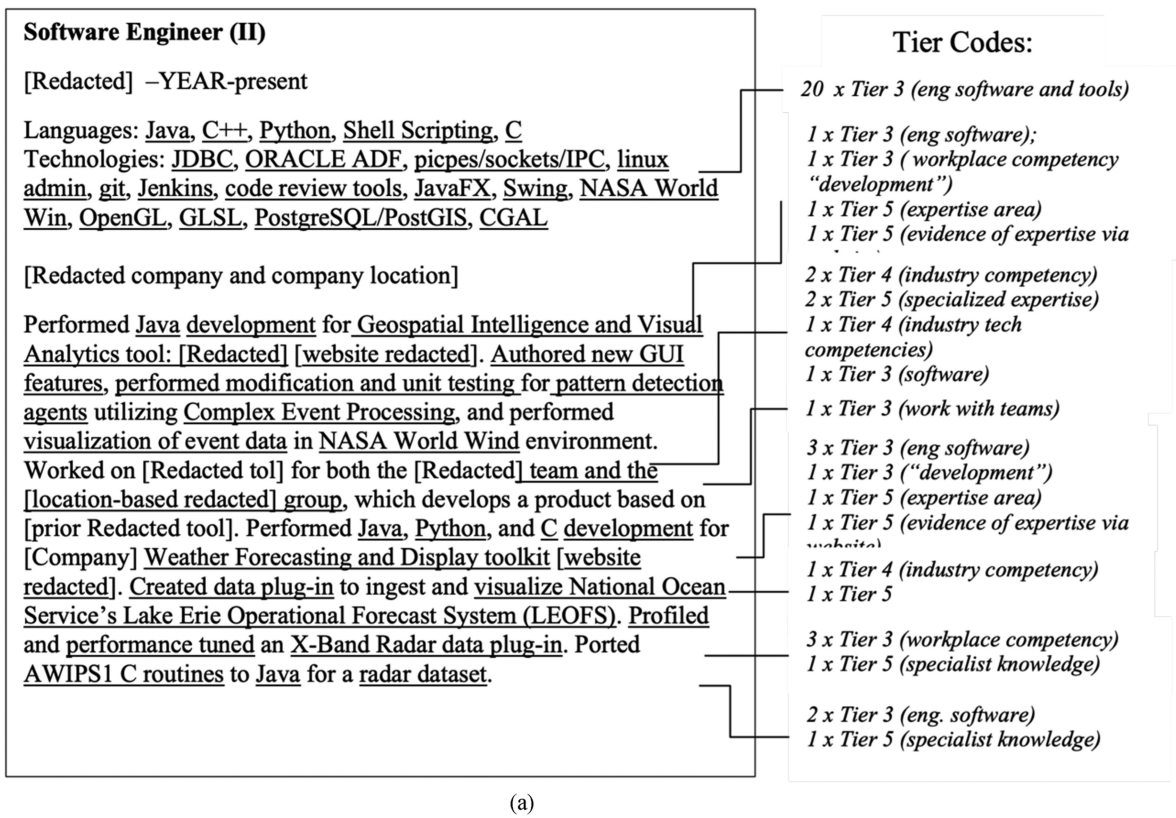
the American Association of Engineering Societies (AAES) [57] and documented in our prior work [55], [56] (note that the AAES has since dissolved). This six-tier model shows various "levels" of competency, with level one skills being professional skills like professionalism and integrity, and levels 5 and 6 skills being demonstrations of expertise and technical leadership within engineering. The framework is shown in Table II.

Words and phrases served as the unit of analysis such that the AAES model acted as an *a priori* framework by which to qualitatively code the resumes. Each coded phrase was assigned the number of the representative tier. Since more sophisticated and advanced engineering-specific competencies are on higher tiers, the coding schema serves as a quantitative measure of the level of disciplinarity within a resume. In coding, attention was paid to code only the rhetorical phrases given, avoiding inferences about roles, responsibilities, and scope unless provided within the coded phrase. Within a phrase, careful attention was given to the assigned value to the tier score of both the action and the demonstration of specialty areas because the resume profiles described roles, competencies, subject matter expertise, and experience with specialized software or applications to specific domains.

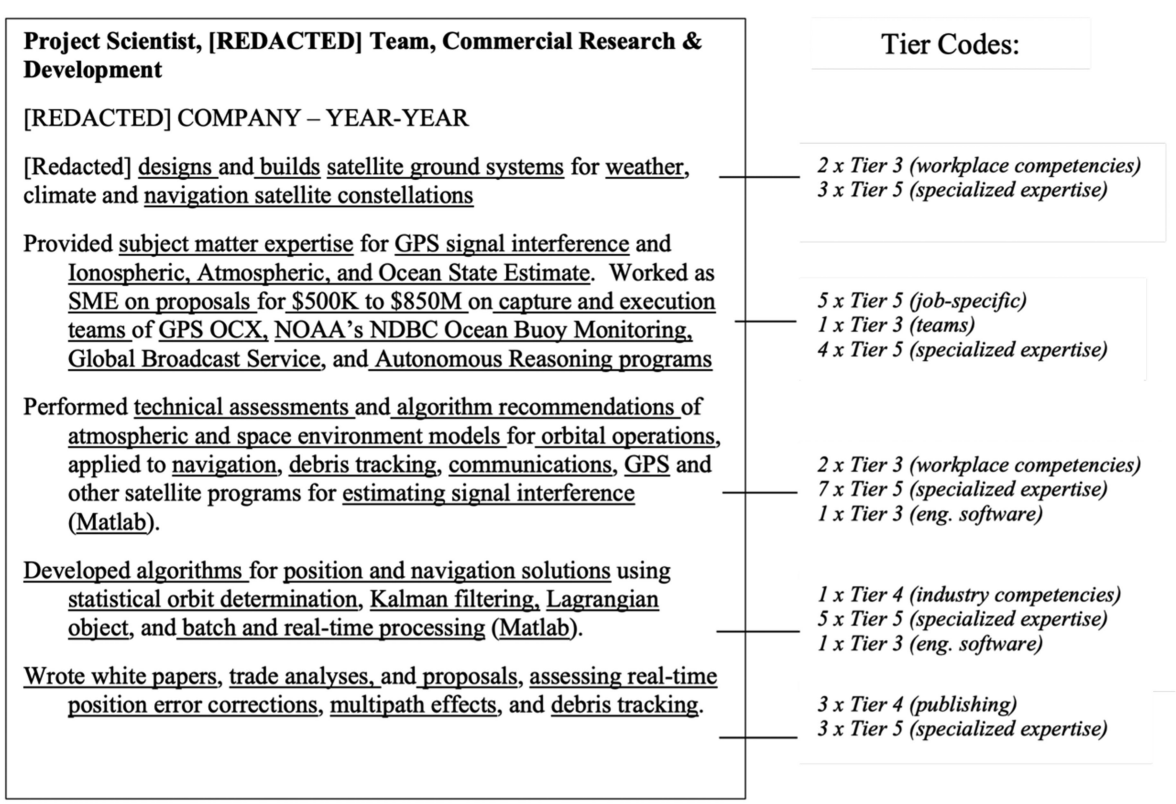
Examples of the coding schema as applied to resume excerpts are shown in Fig. 1. We calculated the disciplinary discourse scores (equation 2) for each document divided by the number of coded phrases to give the "overall disciplinary discourse density" for each resume

$$\text{Sum of Tier Scores} = \sum \text{Code Tier Score} * \#\text{ of Code Occurences} \quad (1)$$

$$\text{Disciplinary Discourse Density} = \frac{\text{Sum of Tier Scores}}{\text{Total Number of Codes in the Resume}}. \quad (2)$$



(a)



(b)

Fig. 1. Demonstration of coding schema for disciplinary discourse density. (a) Excerpt from a "strong" software engineering resume profile. (b) Excerpt from a "strong" aerospace engineering resume profile.

Evaluating Quality of Resume Profiles There are no existing rubrics available to assess the quality of resume profiles that result from online platforms such as Indeed.com. Therefore, we adapted an existing rubric, originally developed by the University of Iowa [58], that we employed in our previous work [9], [55], [56] to sort resume profiles into strong, moderate, and weak categories. This rubric was originally selected because it was one of the few rubrics available that explicitly includes the use of engineering-specific language in the criteria.

Many stylistic conventions "required" for conventional resumes appeared to be non-normative among the resume profiles. The largest example of this discrepancy is the individuality allowed in design: Conventional resumes are typically personalized to the writer's style and can be modified in terms of the use of columns, different fonts, novel section headers, and the like. Resume profiles, however, did not deviate from the prescribed format imposed by the online interface into which users type or copy and paste their relevant career information. Further, traditional conventions such as the "one-page" limit, consistent use of bullets, and short, verb-centric phrases were not regularly employed in the resume profiles.

To methodically investigate these characteristics and to understand how these characteristics varied across quality groups, we removed these stylistic aspects in our revised rubric for resume profiles to avoid self-fulfilling hypotheses. The revised rubric (see Fig. 2) delineates criteria that represent varying levels of quality (3 = strong, 2 = moderate, 1 = weak) across a variety of different aspects of resume writing to capture quality while removing features unique to conventional resumes. Resumes that scored mostly 3s across the criteria were considered strong, and so on. Two of us conducted the quality characterization to the agreement.

These measures of quality are used to statistically compare the differences in rhetorical and stylistic conventions between the quality categories in resume profiles. First, we sorted the resumes into quality groups (strong, moderate, weak) based on the rubric. Then, we analyzed the resumes qualitatively through a genre analysis to calculate disciplinary discourse density scores for all the resumes. Next, we systematically collected data on page length, the extent to which the resume used bullets (which we will refer to as "format"), and the extent to which the resume employed verb-oriented phrases (referred to as "style"). Finally, we conducted quantitative analyses [Analysis of Variance (ANOVA) and chi-square analyses] of these results to discern whether there are statistically significant differences between quality groups with respect to these characteristics.

Results

The $N = 89$ resume profiles analyzed in this study were distributed among the categories of strong, moderate, and weak, as determined by the rubric analysis portion of the analysis: 22 profiles were characterized as strong, 34 as moderate, and 33 as weak. First, we demonstrated and discussed the disciplinary discourse density scores, then the qualitative components of form for the resume profiles, before presenting how these features differ in resume profiles of different quality levels.

Disciplinary Discourse Density Fig. 1 exemplifies the calculation of disciplinary discourse density in resume profile entries. Identifying data such as company name, years of service, and very specific identifying information are redacted for anonymity, but otherwise, the textual data remain unedited to preserve capitalization, bullets, and indentation. We demonstrate the method of calculating disciplinary discourse density for these examples. (See Fillenwarth, McCall, and Berdanier [9] for more examples on coding in conventional resume contexts.)

The excerpt in Fig. 1(a), a "strong" resume profile, employing the equation for disciplinary discourse density (here applied to the entry, rather than the entire profile) would have a summed code score of 160 from a total of 46 codes, for a disciplinary discourse density score of 3.48. Similarly, the example in Fig. 1(b), also a strong resume, has a summed code score of 172 from 38 codes, for a disciplinary discourse score of 4.52. These examples, both from resume profiles deemed of high quality, show different approaches to style and rhetorical choices that can be applied in the same online resume profile tool.

Analysis of Qualitative and Quantitative Characteristics of Online Engineering Resume Profiles Structure within the resume profiles varied widely. As shown, the excerpt in Fig. 1(a) is oriented in the characteristic verb-centric language of conventional resumes, but formatted as a narrative paragraph, while that in Fig. 1(b) is in bullet format. To examine patterns of conventions

CRITERIA	STRONG (3)	MODERATE (2)	WEAK (1)
Overall Appearance and Format *Goal:* Ensure résumé is well-structured and highlights skills, strengths, and experiences that are relevant to the employer	▪ Appropriate formatting ▪ Relevant information appears throughout résumé ▪ Section headings reflect content; content substantiates headings	▪ Some instances of inconsistent formatting ▪ Some relevant information throughout résumé ▪ Important information may not be clear or stand out to reader	▪ Résumé formatting is inconsistent throughout ▪ Information is not presented or articulated clearly ▪ Lack of relevant information throughout résumé ▪ Section headings do not accurately reflect content
Typos, Grammar, Spelling, and Style Errors	▪ Free of spelling, punctuation, and spacing errors ▪ Grammar is appropriate and consistent ▪ Consistent use of style	▪ Few and minor spelling, punctuation, or spacing errors ▪ Few instances of inconsistent style	▪ Résumé is difficult to understand due to numerous errors in spelling, punctuation, grammar, or spacing ▪ Many inconsistencies in style
Education *Goal:* To convey academic qualifications, training, or certifications	▪ Entries in reverse chronological order ▪ Academic qualifications (degrees, years, majors/minors, GPA) are clear ▪ Each institution includes name, location, dates of attendance ▪ Relevant training or certifications listed and complete	▪ Degree or institutional information is abbreviated and incomplete ▪ Academic qualifications are incomplete ▪ Some training or certifications are irrelevant	▪ Missing information related to institutions, degree, major, concentrations, or dates of attendance ▪ List institutions from which no degrees were earned ▪ Entries in an order other than reverse chronological order ▪ Statements or omissions seem misleading
Experience *Goal:* To highlight relevant experiences, skills, and accomplishments	▪ All positions are listed in reverse chronological order ▪ Positions include organization or company name, position title, location, and dates ▪ Highlighted experiences contain strong action words ▪ Results and impact are stated strongly and quantified when possible ▪ Use industry- and discipline- specific language correctly throughout the résumé	▪ Some positions are out of order ▪ Missing minor information related to organization or company ▪ Highlighted experiences are mostly relevant ▪ Results or impact could be stated more strongly or quantified ▪ Industry- and discipline-specific language is inconsistent at times or could be strengthened	▪ Order of experiences is illogical ▪ Missing substantial information about organization or company ▪ Highlighted experiences are vague, irrelevant, or contain weak language ▪ Results or impact is unaddressed or vague, not quantified when appropriate ▪ Little use of industry- or discipline-specific language throughout
Additional Sections *Goal:* Demonstrate other relevant experiences, skills, and accomplishments	▪ Listings relevant to targeted discipline ▪ Listings are concise	▪ Most listings are relevant ▪ Most listings are concise	▪ Listings are vague or irrelevant ▪ Listings are wordy

Fig. 2. Rubric for evaluating online resume profiles; adapted from Kain and Wardle [47].

TABLE III
DESCRIPTIVE STATISTICS FOR DISCIPLINARY DISCOURSE PATTERNS AND CONVENTIONS BETWEEN RESUME PROFILES OF DIFFERING QUALITY

Quality of Resume Profile	Mean Page Length	Mean Overall Summed Tier Score	Mean Disciplinary Discourse Density Score	Format: Using Primarily Bullets (% Split Between Bullets and Narrative)	Style: Using Phrases Starting with Verbs (% Split Between Verb-Centric and Other Phrasing)
Strong	$\bar{x}$ = 2.34 SD = 0.69	$\bar{x}$ = 516.77 SD = 248.19	$\bar{x}$ = 3.89 SD = 0.37	72.7% (18.1%)	81.8% (18.1%)
Moderate	$\bar{x}$ = 1.57 SD = 0.48	$\bar{x}$ = 211.23 SD = 120.76	$\bar{x}$ = 3.68 SD = 0.56	70.6% (14.7%)	70.6% (32.4%)
Weak	$\bar{x}$ = 1.01 SD = 0.51	$\bar{x}$ = 95.79 SD = 71.80	$\bar{x}$ = 3.48 SD = 0.52	53.6% (6.0%)	65.2% (31.8%)

in engineering resume profiles, which have not been captured before in the literature, we analyzed the qualitative components that accounted for the primary differences between web and conventional resumes per the categories in the rubric by which we categorized the resumes: length, format, and stylistic convention. The descriptive results are summarized in Table III.

Length of Engineering Resume Profiles Differs With Quality: We acknowledge that "length" is somewhat arbitrary for resume profiles, which do not have general length conventions. However, as a basis for comparing and characterizing typical conventions within resume profiles, we chose to employ the length of the resume as one of the features captured. To standardize the process, we saved each resume as a PDF by using the download feature of Indeed.com and did not change formatting or reduce spacing within the resulting files. Therefore, we could compare the *relative* length of the documents to get an understanding of how long these documents are when printed out by a prospective employer.

Default formatting does influence the length of the resume profiles, which arranges resumes such that the person's name, location, and hiring notes (e.g., willingness to move; international work visa status) fills approximately one-quarter of the first page, perhaps resulting in the spillover of resume credentials onto the following page. For this analysis, we rounded the page length up to the nearest quarter page from the downloaded PDF that could be printed. This decision was made because many of the weak resume profiles were half a page or three-quarters of a page long, a detail that could not be conveyed if page length were calculated by rounding up to the full page.

We sought to understand whether page length varied in statistically significant ways based on the quality of the resume profile. After testing for homogeneity of variance using Levene's test, a one-way ANOVA was conducted to compare the mean page length between the strong, moderate, and weak engineering resume profiles. There was a statistically significant difference at the $\alpha = 0.05$ level in the average page length [$F(2,86) = 38.55$, $p < 0.001$]. Post-hoc Tukey HSD analyses revealed that mean page length differed statistically significantly between the strong and moderate engineering resume profiles ($p < 0.001$, $d = 1.39$); between the moderate and weak resume profiles ($p < 0.001$, $d = 1.03$); and between the strong and weak resume profiles ($p < 0.001$, $d = 2.42$). This finding means that for the engineering resume profiles, the strong resumes were statistically significantly different between all three groups, with the strong profiles being longer than the moderates, and the moderates longer than the weak. The default formatting for resume profiles may influence this finding: The unlimited text format for the Indeed.com resume profile generator enables applicants to write without editing or conceptualizing the use of space as they might in a conventional resume. To this end, many of the resume profiles only partially filled their last page. We do not know whether the people feeding their information into the Indeed.com resume generator checked to see how their content is translated into printed text.

Disciplinary Discourse Density and Disciplinarity of Resumes Vary With Quality: After testing for

homogeneity of variance with Levene's test, a one-way ANOVA comparing the mean disciplinary discourse density between the strong, moderate, and weak engineering resume profiles revealed a statistically significant difference at the $\alpha = 0.05$ level in the average disciplinary discourse density score ($F(2,86) = 4.08$, $p = 0.02$). A post-hoc Tukey HSD analysis revealed statistically significantly differences between the strong and weak categories ($p = 0.02$, $d = 0.78$). This result means that strong engineering resume profiles had higher disciplinary discourse density (e.g., used disciplinary language that met, on average, higher tier categories from the AAES model) than the weak resumes.

As the variances in the mean overall tier scores between the groups were found to be heterogeneous using Levene's test, a Welch's ANOVA test was employed. Results showed that there were statistically significant differences at the $\alpha = 0.05$ level in the mean overall tier score between the groups ($F(2,56.48) = 5.35$, $p = 0.007$). A Games-Howell post-hoc analysis revealed that the mean overall tier score differed statistically significantly between the strong engineering resume profiles and the weak profiles ($p = 0.005$, $d = 0.88$). Although there were no statistically significant differences between the strong and moderate profiles or between the moderate and weak profiles, these findings show that the stronger resume profiles tended to have higher summed tier scores over the entirety of each resume.

Rhetorical Style and Format of Resume Content Vary With Quality: In determining format, we categorized each resume in terms of whether it was *primarily* structured using bullets. There were a few resumes that used numbered lists instead of bullets or wrote short phrases on separate lines but did not use actual bullets. Other people used symbols such as an asterisk or equal sign in place of bullets. All of these scenarios were counted as bullets because they were non-narrative in format (e.g., not a block paragraph describing a person's position). Some resumes were split such that there was not a true primary format. We described these as "split format" and we noted the percentage of split-formatted documents in parentheses in Table II. Trends indicate that only about half of the "weak" resume profiles were primarily in bullet format. "Moderate" resumes more often used bullet format, with nearly 70% subscribing primarily to bullet format, and nearly 73% of "strong" resume profiles primarily used bullets.

To analyze whether the use of conventions differed significantly with quality of resume, we performed a nonparametric chi-square test for independence at the $\alpha = 0.05$ level and determined that the differences between categories did not occur by chance, χ^2 (4, N = 89) = 0.05, $p < 0.001$. In sum, the quality of a resume is linked with the likelihood of using bullets, with moderate resume profiles most likely to employ bullet formatting.

The rhetorical style of sentences and phrases within the resume profiles also varied. Approximately 65% of weak resume profiles used sentences or phrases that started with verbs, with an additional 31% employing a split style comprised equally of phrases that start with verbs and phrases that started with other syntactic elements. Moderate resume profiles employed verb-centric phrases in approximately 70% of the sample, whereas ~82% of strong profiles employed a predominantly verb-centric approach. For both the moderate and strong profiles, a substantive number of the remaining resumes were in a split format.

To analyze whether the use of rhetorical styles differed significantly with the quality of resume, we performed a nonparametric chi-square test for independence at the $\alpha = 0.05$ level. We determined that the differences between categories did not occur by chance, χ^2 (4, N = 89) = 0.71, $p = 0.001$. Therefore, the quality of resume is statistically linked with the likelihood of using verb-centric phrases, with strong resumes usually employing verb-centric phrasing and weak resumes usually employing sentences to describe their roles.

Although the assumption may be that the resumes that did not employ bullets may be more likely to use nonverb-centric language, this trend did not hold. For example, Fig. 1(a) shows an excerpt where the writer does not use bullet formatting but does use the verb-centric style in his or her resume (in the form of grammatically incorrect sentences). These "mismatches" between format and style were common across quality designations. Of the weak resume profiles, 39% used bullets with split or nonverb phrases; narrative formats with verb-based or split phrases; or split formatting and rhetoric together. Similarly, 32% of moderate and 36% of strong resume profiles were mismatched. This mismatching may be a result of web-editing, haste, or—potentially—a sentiment that a resume profile isn't a "real" resume (though we did not investigate rationale). Indeed, many of the weak

resumes seemed incomplete, hosting only the educational background of a potential candidate.

Discussion and Conclusion

While our prior research with conventional engineering resumes indicated that disciplinary discourse density could be an effective way to quantify and teach rhetorical strategy in engineering resumes, this research sought to extend the method to resume profiles. We posited that this application would be effective because, although the activity systems of web and conventional resumes are similar, they are nonequivalent except for the junction between the subject and the community. Therefore, disciplinary discourse density represents the connection between the job seekers and the engineering disciplinary community, represented through the choice of words and phrases that mean something particular to that community. These do not change with the venue of a resume profile. Indeed, our statistical analysis found that there is a statistically significant difference between quality levels for both the overall tier scores and the mean disciplinary discourse scores for engineering resume profiles.

These findings emphasize the importance of disciplinary language in both resume research and pedagogy. With disciplinary discourse remaining stable across the subject–community junction for both traditional and resume profile activity systems, it is imperative for researchers and instructors to explore the role of lexical choices in resume quality. Although scholars like Diaz [33] have begun to move in this direction by discussing how choices regarding language may influence readers, there is room for more robust research and development of teaching practices regarding language use in resumes and resume profiles. Especially given the wide-ranging, continually changing array of print and digital contexts in which resume content may appear, it is essential for researchers, instructors, and writers to understand the role that language—as one of the only constants among resume writing activity systems—plays as applicants showcase their qualifications and demonstrate their fit within a disciplinary community. In terms of helping students analyze the rhetorical situations for which they are producing resumes, exercises that ask students to actively investigate the activity systems at play in the workplace and in the job application process, such as those described in Kain and Wardle [47] and Randazzo [1], may prove to be particularly useful pedagogical tools.

From an activity theory perspective, this research also highlights significant shifts in the nodes in the activity systems of conventional resumes and resume profiles. The division of labor for the resume profile's activity system represents a particularly notable role reversal. For conventional print resumes, the burden of argumentation is on the resume writer, who is responsible for choosing among relevant experiences and describing them in a way that will align with an employer's job ad and expectations. In the employment website environment, the resume writer is targeting a broad range of jobs and employers. Rather than carefully curating one's experiences for a particular audience, the resume writer instead presents as much information about him or herself as deemed relevant. The employer, then, is responsible for determining to what extent a candidate's resume reveals a capacity to succeed in a job position—whether relying on human readers or applicant tracking software.

This change in roles in the division of labor highlights particularly well the constitutive function of the genre; that is, the way that genres make possible (and, in this case, demand) certain activities. (See Bawarshi [59] for a fuller discussion.) By providing a much broader and less succinct overview of a candidate's qualifications, the genre of the resume profile necessarily shifts how the employer will approach the resume review process. As a result of this shift, researchers and educators must consider, and teach students how to consider, the differences in how recruiters will approach the task of reviewing applicants based on the way resumes are received. Although numerous past studies have researched employers' perceptions of resumes and job applicants [60]–[63], it becomes evident that additional research is needed to understand how employers process and assess resumes in this new activity system.

Implications for Teaching With the emerging differences in activity systems between web and conventional resumes, we as instructors must question whether some conventions of the resume from the era before resume profiles (e.g., the one-page standard for entry-level resumes and the amount of detail provided about experience) need to be reconsidered. From an activity theory perspective, the division of labor for resume profiles shifts from the applicant to a generic employer, such that the resume is no longer a tailored artifact for a specific company.

At the same time, though, in teaching resume profiles, we must also help students navigate this new activity system and the "more is better" position that platforms like Indeed.com may invite. With open-style text boxes and a lack of strict length limits, our results indicate that applicants used this space, but not necessarily in the most productive way. Although it is possible to create a resume profile that is both long (compared to conventional resume standards) and strong, we observed many resumes, particularly in the "moderate" category, that did not use the added length to their advantage. It will be important to help students learn how to utilize this additional space strategically. Teaching the importance of disciplinary discourse patterns for both conventional print resumes and resume profiles can help students develop a heightened rhetorical sensibility, enabling them to identify specific engineering audiences and to make language choices that best convey their specific engineering expertise to these audiences.

Another area of interest to researchers, instructors, and students involves resume organization and design. As noted above, many of the stylistic and formatting changes present in the resume profile venues result from the fill-in format of websites like Indeed.com. For researchers and teachers, this predetermined format is an important change to take into consideration and address with students. With the use of prebuilt forms, classroom discussions can shift away from the importance of including required elements like job title and dates of employment and toward how to work with a "description" box to clearly convey experiences, expertise, and achievements both verbally and visually.

Though resume design has long been a topic of study (e.g., [11], [17], [21], [22], [33]), the standardized format of resume profiles also notably eliminates opportunities for personalization and the display of design skills, therefore nullifying many of the rhetorical strategies that resume writers can access in conventional forms of the genre. This de-emphasis on design calls for extra attention to the importance of clear language that meets disciplinary expectations to stand out from competing candidates. In the classroom, instructors are compelled to prepare students for the range of resume writing activity systems—conventional and emergent—that they will encounter throughout their careers. Teaching "the resume" as a monolithic, print-based genre is no longer a viable approach.

Limitations and Opportunities for Future Work

As with any study, there are limitations to the reach of the study that motivate opportunities for future theoretical and empirical work relating to conventional resumes and resume profiles. The first limitation is the sample size. Although the sample sizes are appropriate for qualitative data analysis (indeed, $N = 89$ is a great deal larger than most qualitative corpuses), it would be interesting to extend to a much larger sample size of engineering resumes or to extend across resume profile platforms to generalize findings more extensively.

Because of the research questions that we asked, this study did not investigate whether there are differences in how web-based resumes operate in relation to a user's conventional print resume. In other words, we do not know whether users digitally copied and pasted information from a conventional resume into the web form (e.g., *transforming* their conventional resume into a resume profile) versus those who used the Indeed.com platform to *generate* a resume from scratch. Future studies could compare the same participants' conventional resume and resume profiles to highlight potential differences.

We also did not capture whether the participants designed their online resume profiles to optimize an ATS or the extent to which they felt such optimization was necessary. Similarly, we did not explore how the employers or other hiring decision-makers employ web-based platforms like Indeed.com. Therefore, an opportunity for future work is to explore the relationship between making job materials "compatible with both electronic and human requirements" [29, p. 18], including how employers actually read and interpret resume profiles, through actor-network theory (ANT), which is a theoretical and methodological approach to understanding the "social" not as a homogeneous entity, but as a "trail of *associations* between heterogeneous elements" [64, p. 5, emphasis in the original].

One of ANT's most discussed features is its insistence on the symmetry between human and nonhuman actors—actants—whose assemblage creates a network of relations [65]–[67]. A follow-up study could explore these research topics with engineering employers and hiring stakeholders. This might also be an opportunity to critically reflect on the role of ATSs as actants and gatekeepers within a disciplinary hiring process.

Concluding Thoughts In this study, we posited that conventional resumes and resume profiles belong to the same genre but are produced in different activity systems and different media, a fact that leads to similar yet divergent genre conventions. The findings from our study not only validate the significance of disciplinary discourse and use of disciplinary discourse density in considering quality within web engineering resumes but also characterize stylistic conventions that differ from those of conventional resumes. We showed that the use of disciplinary discourse and various format and style conventions differ statistically significantly with the quality of the resume profiles. We situate the qualitative differences between the two within the parallel, but distinct components of their respective activity systems. The differences between the two activity systems in which conventional and web-based engineering resumes are deployed can highlight areas for potential educational interventions for technical and professional communication instructors who teach resume writing practices to students for conventional and online venues.

As the web continues to grow as a dominant tool used in job searches and recruitment, it will be critical to continue studying the resume's evolution as a genre. Of interest will be exploring whether the conventional resume and resume profile eventually grow apart in audience, purpose, content, style, and design such that these types of resumes move from having a handful of divergent genre conventions to eventually becoming two entirely distinct genres. This continued careful attention to the rhetorical function of the resume and related job application documents—the same attention that we seek to cultivate in our students—is essential to preparing engineering students, as well as students from a range of professional and technical majors, for the job search and their future careers.

Fig. 2 shows the rubric used to evaluate online engineering resume profiles.

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