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Constructing a comprehensive and adaptive survey for cultural analysis of engineering departments

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ABSTRACT

CONTEXT
Culture influences the dynamics and outcomes of organizations in profound ways, including individual-level outcomes (like the quality of work products) and collective impacts (such as reputation or influence). As such, understanding organizational culture is a crucial element of understanding performance; from an anthropological perspective, 'performance' is not an outcome of culture, it is a part of culture. A key challenge in understanding organizational culture, especially in complex academic organizations, is the lack of a flexible, scalable approach for data collection and analysis.

PURPOSE OR GOAL
In this study, we report on our development of a survey-based cultural characterization tool that leverages both lightweight data collection from stakeholders in the organization and public information about that organization. We also integrate perspectives from prior literature about faculty, students, and staff in academic departments. Taken together, the resulting survey covers key elements of culture and allows for scalable data collection across settings via customizations and embedded logic in the survey itself. The outcome of this work is a design process for a new and promising tool for scalable cultural characterization, and we have deployed this tool across two institutions.

APPROACH OR METHODOLOGY/METHODS
We leverage prior research, our own preliminary data collection, and our experience with this approach in a different setting to develop a cultural characterization survey suitable for delivery to multiple engineering department stakeholders (faculty, staff, and students). We start with a modest number of interviews, stratified by these three groups and achieving saturation of responses, to understand their views on their organization, its strengths and weaknesses, and their perceptions of how it 'works'. We merge this information with public data (for instance, departmental vision or mission statements, which convey a sense of priorities or values) as well as prior literature about higher education culture. We also draw upon our experience in another setting as well as pilot testing data, and the result is a carefully-constructed set of dichotomous items that are offered to department stakeholders in survey form using an electronic survey platform. We also collect background and demographic information in the survey. The resulting data are analyzed using Cultural Consensus Theory (CCT) to extract meaningful information about the departmental culture from the perspectives of the stakeholder groups.

ACTUAL OR ANTICIPATED OUTCOMES
The resulting survey consists of two parts, each with sub-components. The two top level survey parts contain: (i) items common to all respondents in all settings (i.e. all institutions in this study), and (ii) a set of institution-specific items. Within those sections, the framing of the items is calibrated for the stakeholder groups so that items make sense to them within the context of their experience. The survey has been administered, and the data are being analyzed and interpreted presently. We expect the results to capture the specific elements of local culture within these institutions, as well as differences in perspectives and experience among the three primary stakeholder groups.

CONCLUSIONS/RECOMMENDATIONS/SUMMARY
This study demonstrates a scalable approach to survey development for the purposes of cultural characterization, and its use across settings and with multiple stakeholder groups. This work enables a very nuanced view of culture within a department, and these results can be used within academic departments to enable discussion about change, priorities, performance, and the work environment.

KEYWORDS
Cultural characterization, anthropology, survey development

Introduction

Motivation

Academic culture is a complex manifestation of an organization's history, development, people, facilities, and practices. Understanding academic culture can afford insights into how an institution operates and why it achieves specific outcomes. Both the day-to-day operation and the adoption of new innovations are affected by culture (Baba & Pawlowski, 2001; Merton et al., 2009), and from an anthropological perspective organizational performance is an integral part of, not an outcome of, organizational culture. The engineering education research community has begun to apply cultural perspectives to the analysis of our education enterprise (Besterfield-Sacre et al., 2014; Borrego et al., 2010, 2013). Academic institutions do not possess a single culture, but instead are composed of multiple subcultures. Even within stakeholder groups (faculty, staff, or students) multiple subcultures emerge that further complicate the cultural milieu within an institution.

A significant challenge in taking a cultural perspective on engineering education is that there are no standard, widely-agreed-upon approaches to characterizing culture within an academic organization. Within specific disciplines, certain methods might prevail: anthropologists might use ethnographic approaches, while business analysts are beginning to apply natural language processing (NLP) to mined evidence from sources like Slack channels (Pandey & Pandey, 2019). While often powerful, these approaches are also quite time-intensive, challenging to scale, and may involve specialized tools such as NLP that are not always accessible to researchers interested in culture.

In previous work (Berger et al., 2021), our team of engineering education researchers and anthropologists described a process for understanding faculty culture within a single academic department. In brief, we used data from a wide range of sources to construct a final group of 40 cultural statements. These participants, who all held faculty roles within an academic department, indicated their agreement or disagreement with each cultural statement using a dichotomous scale via an electronic survey; they also provided background characteristics (race, gender) that were not otherwise obtainable by our research team. We used Cultural Consensus Theory (CCT) to analyse the data, eventually uncovering two subcultures within this faculty group, and these subcultures were characterized by their sense of empowerment and disposition to change. We discovered no systematic relationships among any of the background variables (race, gender, years of service, research metrics, etc.) and membership in the subcultures. Survey-based cultural characterisation using CCT proved to be both useful and scalable.

In this paper, we extend our prior work by describing our design process for a multi-institution, multi-constituent survey. We are currently engaged in a large, funded project that spans five institutions with different histories, research/teaching priorities, and formal structures; we therefore hypothesize that they have measurably different cultures that affect adoption and adaptation of the innovation. Our goal with this paper is to share our experiences with survey construction, so that others might adopt this process in their own culture-oriented work. The larger project focuses on propagation of an educational innovation to new settings, and we expect alignment with local culture (example: expectations about faculty-student relationships) to be important influencers of successful adoption.

Background

Research contexts

The larger project of which this study is a part focuses on adoption and adaptation of a specific educational innovation with five institutions, all located in the central and eastern United States. The institutions are briefly described in Table 1, and each has its own history, traditions, and norms that have evolved over time in response to a wide range of criteria.

While these institutions share certain features (e.g., they all offer Bachelor degrees in engineering, they are all predominantly White institutions [PWIs]), we anticipate that their cultures are quite different and therefore that their implementations of the innovation will be different. Here, the term 'institution' refers to a research site, and the term 'adopter' to refers to an individual faculty member who has adopted the educational innovation.

Table 1: Institutions enrolled in this adoption and adaptation study. Carnegie classification is a framework for describing characteristics of US higher education institutions (Indiana University Center for Postsecondary Research, 2018)**.**

Institution	Description
A (5 adopters)	Comprehensive school in a rural setting with national (US) recruitment for Bachelor engineering programs. *UG enrolment*: 5,000 (40% in engineering). *Carnegie classification*: private, not-for-profit; Master's Colleges and Universities.
B (3 adopters)	Comprehensive school in an urban setting with national (US) recruitment for Bachelor engineering programs; historical religious mission. *UG enrolment*: 9,200 (13% in engineering). *Carnegie classification*: private, not-for-profit; Doctoral Research Universities: High Research Activity.
C (1 adopter)	Comprehensive school in a rural setting with regional recruitment for Bachelor engineering programs; strong religious mission; young engineering program (5 years). *UG enrolment*: 3,700 (6% in engineering). *Carnegie classification*: private, not-for-profit; Doctoral/professional Universities.
D (7 adopters)	Comprehensive school in a rural setting with international recruitment for Bachelor engineering programs. *UG enrolment*: 35,000 (28% in engineering). *Carnegie classification*: public; Doctoral Universities: Very High Research Activity.
E (2 adopters)	Comprehensive school in an urban setting with international recruitment for Bachelor engineering programs and a strong STEM emphasis. *UG enrolment*: 17,000 (60% in engineering). *Carnegie classification*: public; Doctoral Universities: Very High Research Activity.

In addition to the institutional differences, each of the adopters is a member of an academic department that varies in characteristics such as faculty size, career stage, and work history; number of Bachelor students and their backgrounds; financial health; physical infrastructure; and many other dimensions.

CCT Approach

CCT's history dates back to the 1980s, with origins in the medical and anthropology communities (W H Batchelder & Anders, 2012; William H Batchelder & Romney, 1988; Romney et al., 1986). In brief, CCT attempts to identify consensus views held by groups of individuals based upon their responses to specific items, which can be presented either via an interview or survey format. A common implementation of CCT uses dichotomous responses to cultural statements. CCT is a specific type of cluster analysis in which the clusters are groups of individuals who share certain viewpoints on the cultural statements presented to them. The mathematical details of CCT have been well described elsewhere (Batchelder et al., 2018), but here we emphasize the three key assumptions that must be satisfied in order for CCT to be a valid approach (Romney et al., 1986):

- participants experience a common culture, which means they have sufficient knowledge of the culture through personal experience to respond to each statement and that there is a 'common' response for each statement,

- participants' responses are independent of each other but related to the 'common' response, and
- statement difficulty (described below) is consistent with certain requirements about heterogeneity.

Statement 'difficulty' is a CCT term-of-art that captures the idea that participants should have an experiential basis on which to respond (that is, they do not have to 'guess'), and that there is likely to be a difference of opinion across respondents about the statement. As a practical matter, statements that clearly have only one correct response would result in a monoculture (no subcultures) because all participants would agree on that response. Factual statements such as "This Bachelor program requires 120 credits for graduation." fall into this category of factual statements that do not shed light on the existence of subcultures.

Survey Development Approach

The survey development approach unfolds in phases and leverages our prior experiences (Berger et al., 2021). As detailed in the next three subsections, these three developmental phases provide a sound foundation on which to build the CCT survey and interpret its results. We use the term 'culture' to represent all the things people "have, think, and do" (Ferraro & Briody, 2017) within their environment. Each institution will have a culture within which we expect to find 'subcultures', or sub-group holding views or beliefs at variance from those of the larger culture or from other sub-groups. Subcultural alignment represents a set of views or 'ways of doing' that will likely affect adoption/adaptation decisions of our faculty partners.

Phase 1 – Cultural Exploration

In order to develop a CCT survey with the best potential to reveal extant subcultures, researchers must first become acquainted with the culture they intend to probe using the survey. This cultural exploration phase requires the researchers to balance two competing priorities: (i) to gain a reasonably thorough, if general, understanding of the culture including specific points of differentiation among respondent opinions (potentially differentiated by stakeholder group), and (ii) the resources required to gain this understanding. The goal is for researchers to be able to build dichotomous CCT statements that have the potential to uncover subcultures, and our approach rested upon several key actions and strategies.

We strongly advocate for a site visit to the location of the cultural characterization, because the first strategy (in-person **observation**) provides key details to researchers about *facilities and physical layout, relationships, and hierarchies*. In our site visit work, we request facilities tours, including classrooms, laboratories, student and faculty lounge areas, and so forth. The layout, access, usage, and frequency of pass-through all provide clues to the ways in which constituents work together and collaborate. In our work, we have visited academic departments in which the strength of student-staff relationships was very apparent as indicated by the frequent discussions, presence in shared spaces, and generally collegial interactions. In other cases (especially large-enrolment programs), the student-staff distance becomes obvious because of the relative lack of substantive interactions and the transactional nature of the discourse. In general, site visits allow the research team to pose CCT survey items about relationships, collaboration, and the role of the physical plant in creating a welcoming and productive environment.

We also recommend a set of **interviews** using purposive and snowball sampling stratified by the three departmental stakeholder groups; in our case, this included *faculty, departmental staff, and students*. We started with faculty allies with whom we had prior relationships, and they helped us establish a strong rapport with other faculty and staff members in the department. In our case, our faculty allies became primary sources of information because of their excitement about the project and their willingness to discuss their experience in the department at length. These faculty also have a relationship with the research team and trust us to faithfully interpret and represent their department in a fair and honest way. Other

interview participants may or may not immediately trust the research team, so we attempt to establish rapport with each interviewee via transparent communication before the interview. Our experience has been positive in this regard, and most constituents seem quite willing to discuss their department and its operations. The semi-structured interview protocol may be informed by on-site observations, and our protocol generally targets common features of academic cultures (Godfrey & Parker, 2010; Merton et al., 2009) and leverages our prior work (Berger et al., 2021) such as: resources (funding, space, time), relationships (collaboration, student-staff relations), leadership (trust, effectiveness, decision making), change (educational/pedagogical), scale (enrolment, staff), day-to-day life (work-life balance, priorities). When considered as a whole, the interview data generally reveal specific issues on which respondents hold differing views.

We also recommend **documentary evidence** as collected from university and departmental *websites*, *hard-copy literature* used for publicity, and other *public information*. These materials reveal how the university and department express their mission and vision. Public sources also provide factual information about enrolment, staffing, degree completion, drop-out rate, and so forth, all of which give a picture of departmental operation and may help contextualize information learned via interviews. Websites and publicity items may also convey a sense of the department's identity: do the communications typically highlight faculty, or students? Do they emphasize research projects driven by faculty and research sponsors, or student projects focused on independent, hands-on learning? Do they describe curricular features (and innovations thereof), or experiential learning such as study abroad? This public information conveys a sense of what the department thinks its identity is and helps the research team triangulate to understand the department in more depth.

Our preferred execution of this plan involves a site visit team of 3-4 researchers being present within the department for 2-3 days to focus on the **observation** and **interview** portions of the cultural exploration (the third portion focused on **documentary evidence** does not need to be completed while on site). We acknowledge the resource requirements for this approach, and we have been fortunate to be supported by a grant from a US funding agency for this work. The interviews can be completed by phone/teleconference, although our experience has been that rapport-building with interviewees is more effective in person. Obviously in-person observation of the departmental environment can only be done by visiting the department in person. We recognize the resource requirement as a limitation of this work that will prevent many others from duplicating our approach. We also acknowledge the consequences of COVID, and we were unable to perform an in-person site visit at one of the institutions (institution B from Table 1) due to travel restrictions. In this case, we relied on faculty allies at the institution, Zoom-based interviews, and documentary evidence.

Phase 2 – Statement Formation and Down-Select

From the evidence collected in Phase 1, our research team then assembles a large collection of candidate dichotomous items for potential inclusion on the CCT survey. We first review the data to form a set of categories that appear to be "on the minds" of department constituents, especially those for which the data show differences of opinion. In our experience, scale, change, relationships, leadership, resources, and workload are common dimensions of disagreement

We then construct candidate items according to several important criteria derived from the literature or from our prior experience (Berger et al., 2021). CCT items should:

- use a mixture of forward and reverse formulations. (Example: "This department embraces opportunities for change…", or "This department does not embrace opportunities for change…"). (Romney et al., 1986)
- express a cultural feature that is likely to reveal disagreement among respondents. (Example: "In this department, the student academic workload is so high that it is difficult for students to participate in extracurricular activities.") (Romney et al., 1986)

- make it very unlikely that an individual respondent would indicate agreement ("yes") or disagreement ("no") to a large majority of the statements. (Rationale: such a response pattern ("all yes") can be interpreted as an attention check and be used to discount certain respondents from the dataset.)
- use language calibrated for each constituent in the respondent group. (Example: an item targeting workload might include different details for faculty (teaching and research) than for staff (administrative and other duties).)

Our experience is that an initial, very large number of items (>100) can be generated quickly to capture the main themes observed across the Phase 1 data. Phase 2 involves:

1. Calibrating language. Each CCT item should be composed using language that is unlikely to be misunderstood by respondents, is calibrated to their environment, and is streamlined for easy reading (for instance, we recommend using active voice and colloquial language, and avoiding idiomatic expressions).
2. Evaluating strength of evidence. The group of CCT items should represent the most likely distinguishing features of the culture, and as such each CCT item should be carefully evaluated against the evidence collected in Phase 1. Items that are based upon weak evidence may not be suitable for inclusion in the final survey.
3. Down-selecting for final inclusion. Because the CCT items are short (a single sentence), and the answers dichotomous), our research team has deployed CCT surveys with as many as 60 items. To be sure, the completion rate decreases as the survey length increases, but our experience with surveys of this length has been reasonably positive, with response rates above 60% on a 40-item faculty survey (Berger et al., 2021) and nearly 20% on a 60-item student survey (unpublished). Response rate also depends upon recruitment efforts and incentives for respondents.

Phase 3 – Implementation and Delivery

The practicalities of survey delivery are important because they substantially enable data analysis in a number of ways. First, our team has delivered surveys electronically, using the survey landing page to present respondents with the details of informed consent (and the option to opt out of participation), and the CCT items themselves broken into sections of approximately 20 items per survey page.

The electronic implementation of the survey also provides an opportunity to collect data that is not available from other sources, which may include gender and race/ethnicity information. Research teams generally do not have access to faculty and staff personnel files, so it is useful to ask for information about job history (years of service in the department, etc.). These questions reveal respondents' level of exposure to the department's culture and may be important in interpreting their subcultural membership. It may also be useful to ask questions about other workload, which for faculty could be roles in professional societies, conference organizing duties, roles on editorial boards, and other non-trivial time commitments. For staff, this could include items about university-level service or other workload not readily apparent from their job title alone. For students, these questions might focus on other time commitments (a job, or extracurricular activities) or their future career path (industry, government, academia). Our research team certainly recommends augmenting the CCT items with these other demographic and background questions.

For faculty at our own institution, we have also used other public sources of information to augment our dataset with professional information such as number of publications, h-index, external research funding, and teaching responsibilities (such as number of students or number of credit hours taught; see description of matching mechanism below).

After pilot survey testing with a small group of respondents, we draft a final version of the survey that is estimated to take respondents 10-12 minutes to complete. Depending upon the population and available funding, we have offered a monetary incentive for completion of the survey, and this incentive has been reviewed and approved by our institution's human

subject protection office. When deploying within our home institution, we generate custom email invitations and survey links for each individual, with a personalized greeting to the email invitation. For deployments outside our institution, we use an anonymous link sent to email alias lists via our partners at the other sites. Obviously in the case of an anonymous link, we cannot connect a respondent's data to other public data sources (such as, for faculty, citations and h-index), so the demographic information on the survey itself becomes even more important for our interpretation of the results.

Discussion and Lessons Learned

Our research team has engaged in this process with constituents in academic departments at three institutions so far, with one more under way and one planned for a site visit in Fall 2021. We have significant experience building CCT surveys to characterize culture, and we have learned several important lessons about survey deployment and results interpretation.

Experiences with Cross-Institution Delivery

As part of our on-going research, we recently delivered a CCT survey to three constituent groups (faculty, staff, students) at two partner institutions. To enable cross-institution comparison, we built a single instance of the electronic CCT survey with built-in logic to present certain items to respondents based upon their institution and role. First, we built a master set of CCT items that are presented to all constituents, regardless of role or institution. These items were built according to the three phases described above, with the added steps of synthesis across the two institutions to identify items relevant to both settings. Then, we considered items that would be most relevant to only one institution, with further consideration of the strength of evidence from each institution and appropriateness for each constituent group. We then constructed the survey according to the design principles above, integrating survey logic to ensure each respondent was presented items relevant to their experience. The survey was distributed via anonymous links, and after respondents provided their consent on the first page of the survey, they were asked to indicate their institution and role. Using this information, the survey flow directed respondents to the relevant CCT items.

Survey delivery using an anonymous link holds several consequences as well. First, because of human subjects protection policies and practices, it is time-prohibitive to obtain identified information from another university's data systems for students, and it is virtually impossible to obtain HR-related records for faculty and staff. In addition, the scale of data collection may make it quite labour intensive to obtain the kind of public faculty information we were able to efficiently collect for the modest number of faculty respondents at our own institution. *As such, identified data collection at any institution other than our own was beyond the scope of what we could reasonably achieve given our resources and time allotted to the project*. The implications are important, starting with recruiting participants. Using an anonymous link, we could not personalize the email invitation with an individual's name, and the invitation itself had to be sent by a local ally on the other campuses because they have access to email lists that our research team does not have access to. We suspect response rates were affected as well; the human subjects research approval was secured through our institution, which means respondents were aware that the survey was being delivered by a member of their community (our research team's ally on the campus) *on behalf of an external research team*. Invitees were likely less motivated to spend their time responding to the survey in the service of researchers at another institution. Finally, as a practical matter, we could not effectively follow up with potential respondents, and we had to rely on our local contacts at each institution to send follow-up reminders to the email lists and encourage individuals to respond. We suspect this lack of personalization, while a consequence of our resource and time situation, negatively affected the response rate via selection bias of respondents.

Experiences with Data Analysis

CCT is a powerful method for detecting subculture sentiment within a broader population, and survey-based CCT can be executed at a large scale. However, data analysis requires careful consideration of subsetting decisions along with CCT analysis itself. The survey created in this research affords two main categories of analysis that provide significant flexibility in exploring the data: (i) subsetting, then CCT (the 'subsetting' approach), and (ii) CCT with descriptives (the 'descriptive' approach). In the subsetting approach, we explore hypotheses about the ways in which specific constituent groups respond to the same set of items. For instance, if we use the subset of student respondents, CCT explores questions about the extent to which students share views about specific issues like student-faculty relationships or peer-to-peer collaboration. On the other hand, we could do a similar subsetting procedure by institution, by role (faculty or staff), or in many other ways all of which have implications for interpretation and constraints related to (sub-)sample size.

In the descriptive approach, we use the entire dataset in the CCT analysis, identify the number of subcultures present in the respondent population, and then examine the descriptive characteristics of those subcultures. For instance, if one of the subcultures is populated primary by staff respondents or by respondents from a particular institution, then we can draw some conclusions about that constituent group.

The sample size and representativeness issues are significant, and the strength of inference possible depends upon the subset sample sizes and the size of the populations in the descriptive analysis. In either case, the CCT data are compared against data from other sources (collected in Phase 1 and/or via member checking) to substantiate any inferences and build trustworthiness of the data and our interpretations. The optimal response rate depends upon the number of subcultures present and the extent to which the sample spans those subcultures. In our prior work with faculty (Berger et al., 2021), a sample *size* of 54 (a response *rate* over 60%) was sufficient to confidently identify two subcultures, and we further established trustworthiness via comparison with other data collected and member checking.

Conclusions

This paper explains the development, deployment, and data analysis associated with large-scale, survey-based data collection for cultural characterisation in academic organizations. We describe a systematic approach that seeks to balance the intensity/cost of preliminary data collection and survey development against the results of the CCT analysis. Our experience with CCT thus far demonstrates the insights available to researchers using this survey-based approach to cultural characterisation. Our continuing work focuses on critically evaluating the subsetting and descriptive approaches to CCT data analysis to obtain the most complete picture of academic culture.

References

Baba, M. L., & Pawlowski, D. (2001). Creating Culture Change: An Ethnographic Approach to the Transformation of Engineering Education. *Proceedings of the International Conference on Engineering Education*, Oslo, Norway (5 pages).

Batchelder, W H, & Anders, R. (2012). Cultural Consensus Theory: Comparing Different Concepts of Cultural Truth. *Journal of Mathematical Psychology*, *56*(5), 316–332.

Batchelder, William H, Anders, R., & Oravecz, Z. (2018). Cultural Consensus Theory. In E.-J. Wagenmakers (Ed.), *Stevens' Handbook of Experimental Psychology and Cognitive Neuroscience, Fourth Edition, Volume 5: Methodology* (pp. 201–255). John Wiley & Sons, Inc.

Batchelder, William H, & Romney, A. K. (1988). Test Theory without an Answer Key. *Psychometrika*, *53*, 71–92.

Berger, E. J., Wu, C., Briody, E. K., Wirtz, E., & Rodríguez-Mejía, F. (2021). Faculty subcultures in engineering and their implications for organizational change. *Journal of Engineering Education*, *110*(1), 230–251. https://doi.org/10.1002/jee.20370

Besterfield-Sacre, M., Cox, M. F., Borrego, M., Beddoes, K., & Zhu, J. (2014). Changing engineering education: Views of U.S. faculty, chairs, and deans. *Journal of Engineering Education*, *103*(2), 193–219. https://doi.org/10.1002/jee.20043

Borrego, M., Cutler, S., Prince, M., Henderson, C., & Froyd, J. E. (2013). Fidelity of Implementation of Research-Based Instructional Strategies (RBIS) in Engineering Science Courses. *Journal of Engineering Education*, *102*(3), 394–425. https://doi.org/10.1002/jee.20020

Borrego, M., Froyd, J. E., & Hall, T. S. (2010). Diffusion of Engineering Education Innovations: A Survey of Awareness and Adoption Rates in U.S. Engineering Departments. *Journal of Engineering Education*, *99*(3), 185–207. https://doi.org/10.1002/j.2168-9830.2010.tb01056.x

Ferraro, G. P., & Briody, E. K. (2017). *The cultural dimension of global business* (8th ed.). London UK: Taylor & Francis.

Godfrey, E., & Parker, L. (2010). Mapping the Cultural Landscape in Engineering Education. *Journal of Engineering Education*, *99*(1), 5–22. https://doi.org/10.1002/j.2168-9830.2010.tb01038.x

Indiana University Centre for Postsecondary Research. (2018). *The Carnegie classification of institutions of higher education*. http://carnegieclassifications.iu.edu

Merton, P., Froyd, J. E., Clark, M. C., & Richardson, J. (2009). A Case Study of Relationships between Organizational Culture and Curricular Change in Engineering Education. *Innovative Higher Education*, *34*(4), 219–233. https://doi.org/10.1007/s10755-009-9114-3

Pandey, S., & Pandey, S. K. (2019). Applying natural language processing capabilities in computerized textual analysis to measure organizational culture. *Organizational Research Methods*, *22*(3), 765–797.

Romney, A. K., Weller, S. C., & Batchelder, W. H. (1986). Culture as consensus: A theory of culture and informant accuracy. *American Anthropologist*, *88*(2), 313–338. https://doi.org/10.1525/aa.1986.88.2.02a00020

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