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TOWARDS A CONTINUOUS PROCESS FOR USING AND SUSTAINING IS CURRICULUM GUIDELINES

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Abstract:

The Information Systems (IS) discipline has a long tradition of providing guidelines that recommend contents for IS curriculum. Regular updates are published, drawing on articles from IS education-related publications. Such guidelines have been one useful input to IS curriculum planning efforts in individual universities, bringing in IS community views on appropriate content. Although the system has served the community well for decades, there are now arguments that the process is no longer sufficient because of the changing nature of the discipline. The availability of stable digital platforms further supports such arguments. Based on a brief review of living community cases, we outline a process for moving towards a continuous process for using and sustaining the curriculum guidelines. This paper describes initial steps towards a more extensive design science research approach to map and establish an improved, sustainable process for the ACM/AIS model curricula.

Keywords: IS curriculum, digital community, design science

I. INTRODUCTION

It has become traditional for a set of Information Systems (IS) curriculum guidelines to be devised and promoted periodically, usually on a 5 - 10 year rolling basis. Such a process for updating these guidelines usually entails a group of qualified academics meeting over a period of 2 - 3 years to decide on the fundamental elements that the curriculum should follow. These guidelines

set expectations on the content and delivery of curricula across a range of contexts, from departments, schools to stand-alone faculty units, each of which will have a different focus on what content is best for their individual situation. These are then set as a static document until the next version is agreed upon and published. Given the accelerating nature of information systems and the necessity for academic units to adapt quickly to emerging innovations, the production of periodic curriculum models is somewhat out of step with the reality facing educators. Many recognize that there is now a need for a more continuous process to allow for sustainable, contemporary curriculum guidance. Such a model for a living curriculum would allow individuals and administrators to directly engage to help shape content and the expected competencies necessary to develop good work-ready graduates. The foundations for this paper have come from the investigative taskforce for IS2020 [Vreede, Karsten, Leidig, & Nunamaker, 2020] and best practice seen in Europe [SFIA, 2021a]. These frameworks address individual's competencies entering roles in the workforce but do not align with university undergraduate degree programs, which curriculum models have informed. As members of the IS2020 taskforce, significant discussion and debate into this conundrum has been expended, leading to a potential approach for developing such a community of practice and interest.

II. We reflect on recent experiences and draw from other communities of practice, interest, and design who have organized around sustaining and shepherding the shared resources for broader benefit. Moreover, a community-based approach, akin to, but not limited to, the concept of "crowdsourcing" [Estellés-Arolas & González-Ladrón-De-Guevara, 2012], is blended with approaches taken by not-for-profit organizations to promote and preserve communities of interest. In this regard, a shift towards a community approach is explored and elaborated upon here.

III. The paper is outlined in the following sections, the research method and sub research questions are described in section II, a curriculum development case study indicating current guidelines is discussed in section III, the current practice of curriculum guidelines maintenance and enhancement is presented in section IV. Section V evaluates the current process and its limitations. Section VI then describes the current open competency models. Section VII outlines a proposal for a community of practice approach to sustaining curriculum guidelines. Finally, section VII concludes the paper.

IV. RESEARCH METHODOLOGY

Given our current model of curriculum refreshment process entails a periodic activity of debate, consensus making and writing, resulting in a single publication, endorsed by relevant society groups such as the ACM and the AIS education councils. Given the acceleration of technology and its application to curricula, for example, IS, a more rapid cyclical refreshment of the curriculum is necessary. In proposing a new process for sustaining and using a curriculum model, we rely on the notion of continuous suggestion, debate and then improvement of the model curriculum, a method akin to [in the spirit of] design science in its approach [Cross, 2001].

Our approach continues to allow for broad consultation and international representation and the ability to cross-reference different programs globally from a course perspective. As such the influence of previous models is maintained as well as providing a sustainable model going forward. Successful curricula are continuously maintained and updated through such a continuous evaluative approach as new innovations and trends occur. In doing so, we posit the following research question:

"How can we design a continuous process for using and sustaining IS curriculum guidelines?"

This research question highlights many aspects around the maintenance of curriculum and has a significant bearing on the design of its process, technologies, and governance. This paper describes the use of our curriculum model as a feedforward process to influence

curriculum update and a potential proposed route for the future of continuous and sustainable curriculum model development.

V. USE OF GUIDELINES IN A CURRICULUM DEVELOPMENT PROCESS

This section discusses a concrete case study of the design, evolution, and sustainment of a course. The capstone experience for Information Systems majors at the university of one of the authors has been in existence for 20+ years. About eight years ago, due to various factors discussed below, it underwent some simple changes that significantly impacted various perspectives.

Task forces such as IS2020 (and all preceding efforts of the ACM, AIC, and IEEE) recommend a curriculum. A dictionary definition of curriculum from Merriam Webster [“Merriam Webster,” 2021] is:

1: the courses offered by an educational institution

2: a set of courses constituting an area of specialization

But in the spirit of Mark Twain's quip, "I don't let school interfere with my education", the educational experience of our students is much broader than just the curriculum. We believe the following components interact to offer an educational experience:

0. The curriculum (the actual set of courses)
1. The cohort and fellow students
2. The faculty
3. The educational setting at large --- academia
4. Industry (which includes alumni) where students seek internships and eventual employment
5. The broader society in which all of the above are embedded

The exact process of sustaining and evolving a curriculum (item 0) is informed by the context of the other 1--5 items. Following is a case study of how these forces have molded a segment of a curriculum.

The design and evolution of a capstone course.

The recommendations of IS2010 did not have an integrative capstone experience. IS2020 has addressed this perceived shortcoming by including "Integration" as one of the six core competency realms [Longenecker, Babb, Waguespack, Janicki, & Feinstein, 2015] and IS project Management / IS Practicum as a required competency area. At one of our universities, a course titled Information Systems Applications has been in existence since the early 2000s. The course's learning objectives included providing an integrative capstone experience for students in their 7th semester where they could apply the knowledge and skills they had acquired in earlier courses in the curriculum. The course involved students working in teams of 3--4 with a real-world client to solve the client's problem. While the course was deemed quite successful by various stakeholders [the students, faculty, alumni, and recruiters], we felt we also needed to evolve the course as the IT landscape evolved. The two major evolutions were (i) repositioned the course from the 7th semester to the 6th semester and (ii) changed the focus of the course from application development to a broader consulting perspective. Some of the forces that played into the curricular evolution were:

The original course was offered in the 7th semester. The evolved course was moved to the 6th semester. Feedback from students, alumni, and recruiters motivated this move. Recruitment for full-time positions usually takes place during the months of September and October [of the 7th semester]. Recruiters and students felt that by the time students searched for a full-time position, it would be helpful to have real-world experience working with a client.

The original version of the course had an application development perspective. As the IT landscape evolved over the years, our client problems and needs evolved to a consultancy perspective. Rather than always building a solution, students also started exploring the options of "buy" and "borrow" (in the triumvirate of build/buy/borrow). Emphasis also shifted toward capacity enhancement of the client.

Since the 7th semester involved a significant amount of travel when students participated in in-person interviews, it was turning out to be difficult for the whole team to meet with their client for their regular weekly meetings. Moving the course to the 6th semester facilitated regular client meetings.

Starting in the Fall of 2014, the course was moved to the 6th semester of our curriculum. The course continues to be a significant crown jewel of our curriculum. Even 10+ years after taking the course, students often remember the details of this capstone experience and the client they worked with. The competencies fostered in this evolved course is an illustration of a couple of tenets of the IS2020 recommendations (i) Curricular efforts can suggest broad guidelines. In the spirit of design thinking, each institution needs to adapt those guidelines and evolve their individual course offerings based on the input from the five forces listed above (ii) IS2020 takes a competency-based approach as opposed to a course-based approach to curriculum. In that spirit, our new course Information Consulting in the community combined the competency recommendations of the two core areas of the Integration realm (IS project management and IS Practicum)

VI. CURRENT PROCESS FOR SUSTAINING IS CURRICULUM GUIDELINES

The process for developing curriculum guideline reports has a long and well-established tradition. ACM and AIS jointly assign and authorize a taskforce to do the revision work. The taskforce engages in garnering input from the IS community on revision needs by organizing panels in conferences, by reviewing prior and related guideline reports, research on IS curriculum, and many other types of inputs. For example, when preparing the latest version [Leidig et al., 2021] the taskforce utilized additional inputs such as job placement of IS graduates (IS Job Index in the U.S.), competency frameworks for the IS profession (SFIA, e-CF), program contents in leading universities, and course listed in EDUglobedia [Eduglopedia, 2021], After collecting inputs, the taskforce prepares a new guideline report and submits it for approval by ACM and AIS. The report then provides guidelines for future years on the competencies that IS programs should deliver, together with a discussion on electives, specializations and career tracks.

In the current process, continuous and ongoing discussion on IS curriculum-related matters takes place in IS education-related journals and conferences. A recent literature mapping study found over 200 IS curriculum-related articles published during the years 2010 and 2019 [Feng and Salmela 2020]. Journals such as Journal of Information Systems Education; Information Systems Education Journal, and Communications of AIS ranked highest in terms of IS curriculum-related publications. Most popular conferences for presenting IS curriculum-related papers were the Americas Conference on Information Systems (AMCIS), Information Systems Education Conference (ISECON/EDSIGCON) and Southern Association for Information Systems (SAIS) and AIS SIGED conference.

The publishing of a new curriculum guideline report often intrigues researchers to write papers that compare model curriculum to existing programs, reporting both deviations [Apigian & Gambill, 2014, 2010; Clark, Clark, Gambill, & Brooks, 2017; Larson, 2013; Leidig, Leidig, & Ferguson, 2014; Lo & Cruz, 2014; Wibisono & Nisafani, 2013] and adherence to model curriculum [Bell, Mills, & Fadel, 2013; Osatuyi & Garza, 2014; S. C. Yang, 2016]. Other papers provide additional recommendations that build upon and elaborate the model curriculum [Bandi, Rao, & Gunupudi, 2014; Hwang & Curl, 2013; Hwang, Ma, & Wang, 2014; Karsten et

al., 2015; Larson & Harrington, 2012; Stefanidis & Fitzgerald, 2010; Stefanidis, Fitzgerald, & Counsell, 2013; S. Yang, 2012; S. Yang & Wen, 2017]. Also, members of the taskforce often publish additional views and materials related to model curriculum guidelines [Shah, Kumar, & Smart, 2018; Topi, Conboy, Donnellan, and et al, 2014; Topi, Helfert, Ramesh, & et al, 2011; Topi, Kaiser, Sipior, Valacich, and et al, 2010].

However, the majority of papers do not explicitly refer to curriculum guidelines but still address similar themes. To provide few examples, papers can provide reviews of contents in existing IS programs [Bandi et al., 2014; Hwang & Curl, 2013; Hwang et al., 2014; Karsten et al., 2015; Kasparian, Lieu, Winlaw, Cole, & ..., 2016; Larson & Harrington, 2012; Park, 2014; Stefanidis & Fitzgerald, 2010; Yang & Wen, 2017]. They can prescribe the entire curriculum, perhaps referring to a particular type of an IS program under labels such as CIS [Longenecker et al., 2015; Longenecker, Feinstein, & Babb, 2013] or MIS programs [AKÇETİN, ÇELİK, YALDIR, & KELEŞ, 2017; Erkollar, Oberer, & Kurt, 2016; Thouin, Hefley, & Raghunathan, 2018]. Papers can equally prescribe particular specialization modules, such as on data analytics [Jafar, Babb, & Abdullat, 2017; Lawler & Molluzzo, 2015; Mills, Chudoba, & Olsen, 2016; Waguespack & Hunsinger, 2015], or on security or cybersecurity [Foltz & Renwick, 2011; Raj, Blair, Sobiesk, & ..., 2018; Wang & Wang, 2019; S. Yang & Wen, 2017]. Also, the contents of specific courses are frequently addressed, for example, the IS introductory/core course [Chen & Holsapple, 2014; Fichman, Santos, & Zheng, 2014; Freedman & Wyner, 2012; Ghosh, 2012; Harden, Crocker, & Noe, 2018; Li, 2011; McCoy, Everard, & Jones, 2013; McGuire & Benamati, 2018; Schwieger, 2012; Ward, 2010; Whelan & Firth, 2012; Whitney, Guilbaud, & Romanova, 2019]. These papers and many others could provide important additional insights and extensions to curriculum guideline report themes.

At present, the impact of IS curriculum-related research articles on curriculum guidelines is inevitably somewhat indirect and slow. The integration of results and views from articles will have to wait until the next revision round, and although the research results are essential, they are still only one input. A more continuous process for updating the model curriculum could provide a means to transfer the insights and results from articles to a more coherent framework of curriculum guidelines, thus promoting them to a wider audience of IS curriculum stakeholders. The existence of a research tradition around IS curriculum also suggests that there are IS researchers who might be willing to contribute to a more continuous process for updating the curriculum guidelines. There are also many trends suggesting that a more direct relationship may be needed in the future.

VII. EVALUATION OF THE CURRENT GUIDELINE UPDATING PROCEDURE

1. Strengths of the process

The iteration of designing model curricula for the IS discipline dates to the early 1960s. Multiple efforts have provided guidelines based on contemporary needs of industry employing graduates of IS programs, primarily [ACM, 1983; Couger, 1973; Davis, 1997; Gorgone et al., 2002; Leidig, Anderson, Sooriamurthi, & Babb, 2020; Leidig & Salmela, 2019; Longenecker, Feinstein, & Clark, 2013; Longenecker & Feinstein, 1991; Reynolds, Adams, Ferguson, & Leidig, 2017; Teichroew, 1971; Topi et al., 2010]. The guidelines were widely accepted and have been influential as the basis for curricular program and course design and accreditation of undergraduate programs in IS. Each of these guidelines responded to the changing nature of the IS industry and pedagogical expectations. In general, each successive work was built upon the previous design, making necessary changes instead of starting anew with a clean slate. All these curriculum models had a common goal of providing advice for university faculty to guide the preparation of graduates. These graduates will be better prepared to enter the

workforce successfully. This consistency led to stability in what constituents of these programs could expect from graduates.

2. Limitations of the process

The strengths identified above in the IS curriculum guideline process for updating and maintaining currency also become a limiting factor. By its very nature, it serves as a hindrance to the agility needed to address the currency of an IS curriculum. The field of Information Systems is dynamic in nature. More so than many other disciplines, the IS discipline is confronted with a seemingly continuous stream of technological developments. This dynamic context poses a significant challenge for faculty and administrators that are tasked to educate future generations of IS professionals.

Technological innovations have been a constant factor since the inception of the IS discipline over 70 years ago. The past decade has seen many technological trends and innovations that have and are still influencing the way individuals and organizations create value. While the role of IS within organizations has remained a critical one, the environment in which IS professionals work has become even more dynamic. IS represents a constantly changing discipline. As IS undergraduate curricula must remain aligned with the nature and needs of the IS job market, they are likely to be dynamic in nature as well. Given the many developments in terms of IS technology and the environment in which IS professionals work, it is not surprising that IS curricula at the institutional level have seen changes as well over the past decade.

To change the focus to a more holistic view that considers the outcomes of an IS program, MSIS2016 was the first of its kind that does not provide a predefined curriculum [Topi et al., 2017]. Instead, it focused on articulating competencies that graduates should have attained upon completing their degree programs. We believe that this approach is better designed to serve a broad range of degree programs around the world.

Model curricula and competency models have a variety of uses. For some institutions, they provide detailed guidance and a specific foundation for a curriculum. For others, they can be starting points for internal conversations, a source of ideas in situations when new perspectives are necessary, a benchmark for an internal development effort, and a structural guide. Historically, most computing curriculum documents have been built around a typically hierarchical knowledge area–knowledge unit–topic (KA/KU/topic) structure that forms a body of knowledge (BoK). These knowledge units are familiar to those who teach IS courses. A potential problem with the KA/KU/topic structure is, however, that it focuses mostly on cognitive aspects of learning and leaves experiential elements out. A curriculum based on a knowledge area structure conveys relatively little on what the graduates are able to do at the time of graduation. Some observers might find this perfectly acceptable because they do not view applicable skills and attitudes as a goal of university education. For others, it is a major problem because they hold a broader view of the goals of a university degree.

An increasingly common model identifies a set of graduate competencies. Competencies include abilities to use knowledge, skills, and attitudes to perform specified tasks successfully. Using more refined language, Lockoff et al. [2010, p. 21] define competencies as follows: "Competencies represent a dynamic combination of cognitive and metacognitive skills, demonstration of knowledge and understanding, interpersonal, intellectual and practical skills, and ethical values."

A major advantage of the competency model is the longer-term view of the outcomes of graduates while leaving flexibility in the delivery of the knowledge, skills, and experiences of programs delivering them. To avoid the lengthy revision cycles described above, these broader competencies create a foundation for creating a 'living artifact' that affords the framework for an ongoing work of the IS education community. The most recent and comprehensive application of defining competency-based models is the work of Computing Curricula 2020 [CC2020 Task Force, 2020]. This report articulates the roles of competencies

for computing programs in computer science, information systems, information technology, computer engineering, software engineering, cybersecurity, and data science.

VIII. REFERENCE CASES OF OPEN COMMUNITIES

1. Industry SFIA (Governance, Process, Technologies)

Several industry-focused groups have produced open community forums around competency and job roles. The skills-based frameworks provide common terminologies, models, guidance for the skills or competencies required for a certain sector [Brown, 2020]. These skills are a mix of soft and hard transferable skills essential for emerging career roles [Lewis et al., 2013]. Teaching programs aim to frequently integrate new skill requirements in their curriculum. However, it is a difficult process to identify the required skills and responsibilities for different career roles by each individual degree offering department. Hence, competency frameworks provide overarching guidance to degree offering institutions.

There are a further number of standards for the ICT or IT field i.e. e-Competence Framework (e-CF) standard [European e-Competence Framework, 2019]; Skills framework for infocomm technology [Skillsfuture, 2019] i-Competency Dictionary from Information-technology Promotion Agency, Japan [IPA, 2020]; Korea Employment Classification of Occupations (KECO) (The Ministry of Employment and Labor, 2007); ICT Competency Standards for Teachers [UNESCO, 2008] and one of the most prominent frameworks, The Skills Framework for the Information Age [SFIA, 2021a, 2021b; Von Konsky, Jones, & Miller, 2013].

There are several widely used competency frameworks. The Skills Framework for the Information Age [SFIA Foundation, 2015] by the British Computer Society, The Chartered Institute for IT (BCS) is used in Europe and in Australia. SFIA has been adopted together with Bloom's taxonomy [Bloom, Kratwohl, & Masia, 1956] by the Australian Computer Society (ACS). ACS plays a significant role in guiding master's degrees in IS/IT in Australia. A consortium of various organizations under the leadership of the BCS developed a Skills Framework for the Information Age (SFIA) in 2000 to guide ICT curriculum design in higher education [Brown, 2020; von Konsky, Miller, & Jones, 2016] and to guide executive teams to manage the day to day running of the organization in ICT industries [SFIA, 2021a]. SFIA provides a common reference model for the careers in the ICT domain and a common language for the skills in the digital world. In the past two decades, SFIA has provided a forum to individuals and organizations in which opinion and fact are debated from industry and learning perspectives. This enables the SFIA Council to remain in step with current thinking as it influences the development and adoption of the SFIA framework to ensure its continuing relevance through the regular release updates to the framework. The current SFIA framework 7 is expected to be updated with SFIA 8 beta in September 2021 [SFIA, 2021b].

SFIA is considered the most viable ICT curriculum and practice framework due to various attributes, i.e., a comprehensive coverage of the ICT domain, practical guidance for industry, relevance for curriculum development, ease of implementation, successful strategies to keep it updated, and continuous communication with stakeholders. It openly provides consultation to keep the framework relevant [SFIA, 2021a]. This comprehensive mechanism of evolution includes extensive engagement, consultation and feedback from industry, higher education sector, professional bodies. SIFA consultancy bodies and members continuously evaluate existing SFIA framework and about new emerging career needs. It also facilitates and encourages interaction among IS and computer sciences faculty members to develop relevant curriculum [Shah et al., 2018].

2. Open Source Communities of Practice [Governance, Process, Technologies]

SFIA has evolved with a community of practice that is governed by a set of principles to support its progress and priorities for development, adoption and change. The essence of the global community is maintained through various strategies of communication and engagement. For example, the community is facilitated by communication channels like

LinkedIn, Twitter, YouTube, dedicated websites, SFIA user forum, and the recruitment of people to manage different elements of the system and the associated ecosystem. Through these communication channels, SFIA communicates with the user community and the user community exchanges views, experiences, ideas and feedback with SFIA and other members of the community. Further, SFIA council establishes relevant sub-groups to facilitate SFIA initiatives to update its ecosystem [SFIA, 2021b].

Additionally, open-source communities provide governing organizations, such governance structures provide information and advice to its stakeholders and any controlling body by managing relationships between the governance group and other parties, e.g. higher authorities, industry and other users. The design of this governance structure is described in section VII.

Other referents that are informative are open-source communities that have arisen to sustain and support open-source software resources. In most cases, when the residual value of these resources becomes broadly impactful, these open-source resources tend to develop a governance structure meant to ensure vitality and viability. Many examples exist, such as the Free Software Foundation (2021), the Python Software Foundation (2021), and the Django Software Foundation (2021). Common elements in these endeavors is formation as a 501(c)(3) non-profit organization under Title 26 of the United States Code, requisite governance structures thereon, mission statements supporting and espousing the conditions required to operate as a 501(c)(3) non-profit, and some expectation that the value of the artifacts of interest is protected. Governance in these organizations is designed to serve the community that draws benefit from the resources of interest given that their open-source licensing suggests that the continued availability and efficacy of the software is sustained out proprietorship from a single entity and largely from volunteer effort.

IX. DESIGN PROPOSAL FOR A NEW GUIDELINE UPDATING PROCESS

As is the case with some of the open-source community examples highlighted earlier, it is presumed that a repository for curricular deliberation, designs, and discourse - and the community interested in extending and cultivating that repository - would be the central purpose of any living document effort. As such, we would refer to this as a living document community. This model deviates from an appointed expert volunteer group model that has fostered many curriculum modeling efforts but does not necessarily intend to supplant that model. Rather, a community that surrounds a living document repository could sustain the process and feed a more formalized editing process. To wit, there is little reason in the context of computing to wait for a decade in-between model curriculum efforts. As developments in any field are ongoing, and especially so in computing, so too should the process of discovery and debate of practices and approaches to curricular design. There is less need to distribute a curriculum model as canonical and more of a need for patterns of best curriculum practice to emerge from repeated examination of exemplars and perspectives. This is a central conceptual tenet of the open-source communities that the espoused designs share here predicates upon - the power of broad review in service to continuous improvement. Coined as "Linus's Law" [Raymond, 1999] there is a supposition that underlies open-source software communities where the main benefit of openness is the possibility of spotting and correcting defects. Moreover, if there is uncertainty or discord regarding the nature of a discrepancy, there is a possibility of finding consensual and/or pragmatic solutions to obstacles and setbacks. Linus's Law has been simplified to imply that with enough participation and input, "...all bugs are shallow." In a discipline such as Information Systems, the need for discursive consensus-building becomes more pressing given its interface to organizations and the myriad ensuring nomenclatures.

1. Design of governance and processes

Following the lead from open-source software organizations, a proposed governance structure would be managed by an overarching governing organization. The composition of this governing organization will be contingent on its scale and availability of resources. It would consist of an administrative structure consisting of roles to manage regular processes such as editing and moderating, management of user groups, and community relations. The charge of the board is to maintain continuity and relevance in terms of the content and the platform/organization longevity. In doing so, it sets priorities in terms of development, how the system and the community are managed and enhanced. Over time, this will also lead to change management and the adoption of emergent ideas and technologies. A representative structure of such a board of directors could consist of the roles detailed in table 1.

Table 1: Example of possible roles and key tasks of the board of directors

Role	**Key Tasks**
President	Presides over the board Takes decisions on the day to day running of the system. Provides direction. Engagement
Vice President [President elect]	Assists [as above] more hands-on with the system
Secretary	Keeps the minutes and records of the board
Treasurer	Accounts for any contributions made for the maintenance, upkeep, and promotion Actions payments and financial responsivities Provides period financial statements as required
ACM Representative	This person should be connected to the particular interest group of that organization.
AIS Representative	This person should be connected to the Education Committee or the special interest group on Education.
Technical Lead	Ensures the design and development of all applications, systems, and interfaces are consistent with the goals of the ISCCF and C3T as directed by the membership and the board.
Editorial Lead	Oversees the editorial aspects of the ISCCF community.
Operations/Data Lead	Ensures that all tools, systems, and facilities are operational and maintained.

The governing organization will provide information and advice to the computing curriculum community on the state and status of community resources. The board would also liaise with interested parties such as higher authorities, industry, and the interested public. In this regard, and consistent with a tax-exempt status, the imperative is outreach and education. Shared resources requiring oversight and support would include an Internet-mediated platform providing the infrastructure necessary to gather the community and make available any services to that community that pertains to curriculum development, design, and discourse thereon.

As a code of conduct, to ensure that the quality of shared resources and effort are not diminished, some form of membership would be required for any engagement beyond read access. Membership will enable authentication and accountability together with attribution and authorization to participate in the activities and discussions of the community.

Membership can be of two types: institutional or individual. The institutional members could be academic, municipal, or corporate. They could contribute resources that enable maintenance of the competency tooling infrastructure, curriculum development and review, sponsoring participation at academic workshops and conferences, and contribute to the ongoing development and maintenance of the facilities that keep the organization in operation. Institutional members would receive one individual voting right at meetings and have their organization logo, details and description displayed on a page on the organization's website. They would be provided with a membership badge for use on their institutional websites.

Individuals are the core member type as it is envisioned that all contributions and participation would be generated at that level. A distinction would be made between members designed as *Participating* and *Contributing*. *Participating* individual members are those who sign up with a validated academic or institutional affiliation who wish to participate in the discourse surrounding the resources that appear within the organization's tools and websites. Access to this participation level is granted upon verification of affiliation. While participation in discussion and comment is possible at this level, editorial and content creation are not.

Contributing members are appointed to the organization in recognition of their contributions to the community by virtue of, but limited to, active participation in discussion and review, scholarly contributions to computing curricula, or other noted activity in computing curriculum development. This is more of an editorial role rather than a "gatekeeping" role. Thus, it is by active participation that a participating individual member becomes a contributing member with access to edit content in the community. All members may work with some aspects of the organization, but contributing members are part of the editorial oversight of the community. Whether a "Wikipedia" model could evolve or not depends on whether "Linus's Law" would take root within the community and organization.

To engender participation and maintain an on-going focus on the living community's goals, the board and membership should regularly participate in curriculum-related scholarly activities such as, but not limited to: workshops, panels, papers, presentations, and related events for sharing ideas for this perpetual project to shape and design a computing curricula. On at least an annual basis, some or all of these activities should be intentionally planned and supported. Institutional members shall endeavor to oversee, validate, and support the activities of members as meaningful professional contributions to scholarship. In addition to supporting on-going operations, the board of directors would meet on an established frequency and provide a factual account to the community as a result of these meetings. These meetings should be arranged as necessary, facilitating attendance through a wide range of media. As is customary for such meetings, an agenda should be circulated, and documents, minutes and addenda be available to the governance group.

Transformation towards a more continuous and community based approach has not yet been initiated. It seems likely, however, that the new process will also benefit from institutional support from central organizations, such as ACM and AIS, and other institutions engaged in IS education. These organizations would assign the permanent board of directors that promotes and coordinates smaller community based projects, each focusing on specific areas of the curriculum and leading to improvements or additions to the model. The need for minor or significant revisions will evolve based upon the work done in previous years. A role for this living community would include informing the central organizations when a more formal reassessment of the IS2020 model is warranted, or formal appendices and updates are appropriate.

2. Design of digital technologies

In a contemporary manner and consistent with the operations of many other non-profit organizations related to software, the community would be supported with information systems that concentrate, aggregate, and avail examples and foundations for curricular design. Specifically, the competency-based approach reported in both CC2020 and IS2020 would shape any initial tooling and repositories meant to warehouse and share curricular designs. This would be a web application designed to facilitate the creation and archive of competencies built around the following structure. Figure 1 illustrates the atomic and compound structure of a competency specification using the example of normalization within database design.

- Competency Realms
- Competency Areas
- Competency Specifications
    - Competency Statement
    - Dispositions
    - Knowledge-Skill Pairs
    - Sub Competencies [for composites]

A similar web application would exist to provide moderated discourse on computing curricula, including an opportunity to add and/or edit to a "living" version of a model curriculum report which could inform future teams that may be called upon to produce a computing curriculum model for a given computing sub-discipline.

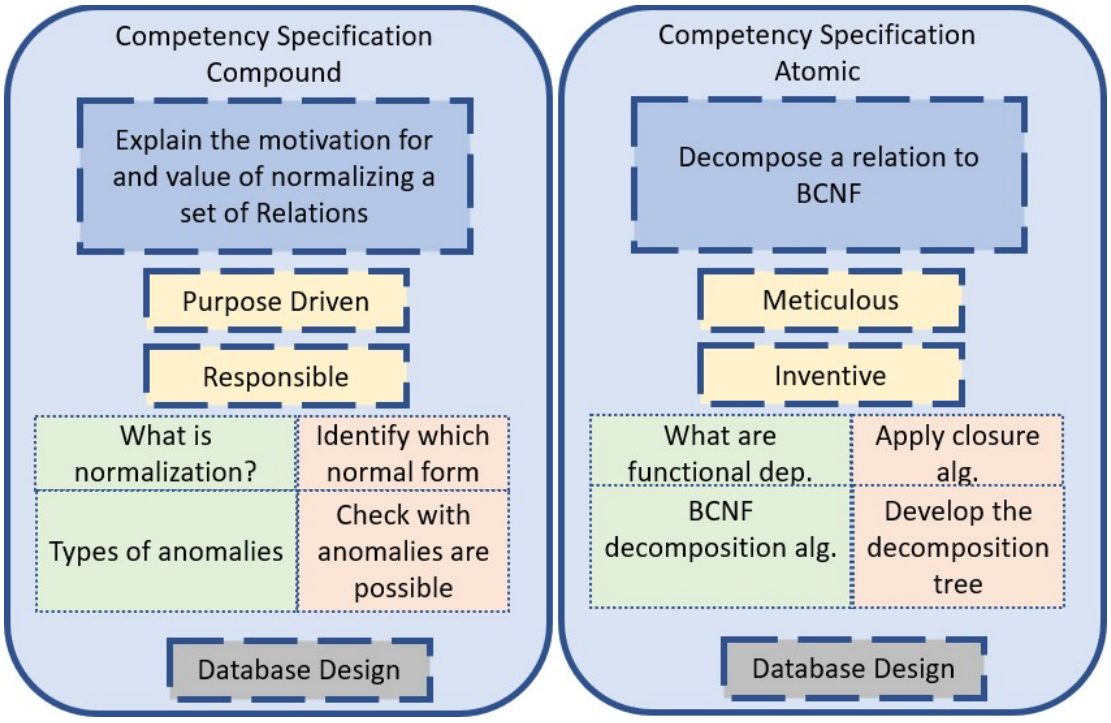

Figure 1: Competency Specification

X. CONCLUSIONS

1. Contributions

Whereas a curriculum implementation is often localized by context and application, curricular models attempt to establish shared aspects that assist in defining a discipline. During the course of normal activity, a natural ebb and flow arise as the discipline encounters change and innovation within that discipline. This modeling process has existed as a series of projects, engaged by authorized and knowledgeable individuals, to sequester in sense-making and deliberation such that a new model is developed. The drawbacks and advantages of this approach have been elaborated in this paper. Principally, the main drawback is the pace of change and assimilation both within computing practice and within academic programs meant to prepare students for practice. In this regard, comprehension and sense-making would do well with broader inclusion and more frequent deliberation and discourse. The design approach articulated here is both heed to a call for a more dynamic and persistent process and acknowledging that design processes can be more distributed, and communities of interest and practice are increasingly accustomed to collective processes.

A living document and community have been proffered as a possible solution to improve the process for curricular modeling by suggesting that a more inclusive community be developed around the process. The community would gather for discourse and nurture resources - a repository for curricular design elements and a provision for community authoring and editing of the module curriculum report - that provide value.

2. Limitations and future research

The proposed approach is in a nascent and cursory state with respect to an instructive and illustrative design. Without more detail and designed prototypes, the feasibility of the proposed approach is more conjectural than empirical. However, the design approach is informed by experience with model curriculum design. Thus, lacking some of the prototyping and validation of a more extensive design science approach, the approach described here is propositional. Moreover, there are assumptions informing the outlined approach that a strong community response is available. While some evidence exists that model curricula reports do inform curricular design decisions, there is less evidence that many are willing to participate at the level implied here. Future research would entail further inquiry to determine the use of model curricula and interest in participating in curriculum modeling initiatives. Further, the assumptions of the design approach would benefit from the design science processes such that prototyping and testing can further validate assumptions.

The process of developing a model curriculum reveals the greatest value in the evaluation, sense-making, and consensus-building that occurs among participants. This is a discursive and exploratory process that encourages lateral thinking and consideration of multiple perspectives. As such, it is somewhat natural to imagine that broadening participation in this process would yield positive results. Further, given the trend towards competency-based curriculum modeling and design, the need to archive, share, and compare examples of competency-based curriculum design artifacts is present. The exchange of curriculum design examples presents the opportunity to recognize deficiencies, opportunities, and proof points for the process of developing computing curricula that best suits a given program and its objectives. While there is more work to be accomplished in this regard, broader participation and input would most likely aid in the continuous improvement of the process of curriculum modeling and the utility of the models.

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