Partnering with Faculty for the Creation of Engineering Digital Projects: Process, Challenges and Opportunities

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Abstract
Nanyang Technological University (NTU) Libraries launched 'NTU Digital Projects' as a new service to showcase the innovative, digital research output of NTU faculty and researchers and facilitate the discovery and use of this valuable content by a global audience. Research output may include textual content, multimedia, images, creative works, new media and other non-traditional forms. Viewed as a kind of scholarly communication output, digital project content may differ in varied and diverse ways from more established types such as academic papers archived in institutional repositories, or datasets deposited in data repositories, which have clearer characterizations and descriptions in comparison. The focus of this paper is on sharing lessons learned from not-so-successful content recruitment efforts and describing sourcing strategies that worked better when finding engineering partners. We also discuss project team roles, concerns and key issues when collaborating with NTU faculty on the development of the Unsaturated Soil Mechanics for Sustainable Urban Living digital project.

Keywords
Digital Scholarship, Marketing and Promotion, Content Recruitment, Engineering & Technology, Faculty-Librarian Collaboration, Unsaturated Soil Mechanics

Introduction & Background

"Nanyang Technological University (NTU) has been placed amongst the world's best young, research-intensive universities globally. The university has colleges of Engineering, Business, Science (including medicine), Humanities, Arts, & Social Sciences and provides high-quality global education to about 33,000 undergraduate and postgraduate students." (NTU, 2016)

NTU Libraries has seven (7) subject libraries with the Engineering Library serving the largest community of about 560 faculty and 14,000 postgraduate and undergraduate students from the six (6) engineering schools under the College of Engineering.

In line with the university mission to be a global university founded on science and technology with a research focus on 'future learning', the library formally included digital scholarship

projects in its suite of research and publishing services in April 2014. Digital scholarship projects at NTU are hosted on library platforms managed by the Library Technology and New Media Groups, while collection development policies are supported by the Library's Scholarly Communication Group. The task of content recruitment as well as project management is primarily the responsibility of subject librarians.

Prior to the official launch of the digital scholarship service, the library had undertaken a few digital projects in collaboration with faculty from the College of Humanities, Arts and Social Sciences, which were then collated as the first exemplars under the branding 'NTU Digital Projects'. The engineering community has been and still is the largest college in NTU; with its size and long history (as the pioneer schools at NTU), having a presence in NTU Digital Projects would be ideal to showcase the strong engineering research focus to-date. With this in mind, engineering librarians embarked on a comprehensive drive to recruit content from their respective user groups. This early phase of promoting the new digital projects service to the NTU engineering community was more challenging without prior case projects in the technology domain to share with this group of users.

The successful soft-launch of the first digital project, *Unsaturated Soil Mechanics for Sustainable Urban Living*, from the School of Civil & Environmental Engineering in 2016 was a milestone in the library's work in digital scholarship services especially since there were no previous engineering digital scholarship projects as predecessors. This project was developed by the library in collaboration with a faculty member and his research team from NTU School of Civil and Environmental Engineering, and is about the application of unsaturated soil mechanics to slope and tree stability. It was successfully soft-launched in May 2016 and the digital project is listed on NTU Libraries Digital Projects page at:
http://www.ntu.edu.sg/Library/digital/Pages/default.aspx.

The process of sourcing for suitable scholarly content to project realisation had been challenging and this paper describes the digital project development with an emphasis on strategies and lessons learned at the content recruitment stage, some of which may be specific to the engineering discipline.

Literature Review

The term 'digital scholarship' has been described as "incredibly awkward" (Lynch, 2014) and may have resulted in a vague understanding about its definition, meaning and relationship with other terms such as 'digital libraries' and 'digital humanities'. The issue about lack of clarity in the use of the term is also reflected in Martin's comment "If digital is now the norm, then this suggests that there should no longer be any real distinction between scholarship and digital scholarship, … it is by no means a given that the use of new tools and technologies by scholars automatically results in digital scholarship." (Martin, 2016).

In Martin's literature review on the university library and digital scholarship, she summarises that "the literature … at the present time is neither broad nor deep", with "little shared understanding … a range of terminology and a variety of definitions dependent upon discipline and values, and there is little insight into … what it might mean to be a digital scholar." On the

role of libraries in digital scholarship, she describes the literature as 'slender' with varying approaches in scholar engagement (Martin, 2016).

Mackenzie's book chapter on how digital scholarship is supported in practice, analyses the results of a survey of UK and Irish Higher Education libraries and compares the growth of digital scholarship centres in the USA to UK. The chapter also summarises 5 selected case studies, 3 of which a related to digital humanities, one project is digital repository solution and one is related to digital media technology in education. The 2015 ACRL book "*Digital humanities in the library: challenges and opportunities for subject specialists*", includes several case studies in the humanities as suggested in the title. It was noted that while recent literature on digital scholarship acknowledges issues on re-examining the concept of digital scholarship, there is still growing activity and developments in USA and UK. Recently in Singapore, a digital humanities project presentation by the National University of Singapore Library was included in the 2016 Library Association of Singapore conference program.

The focus of this literature review was on digital scholarship case studies with similar context to NTU Libraries i.e. digital scholarship projects that were open access, unique, scholarly, self-contained original works produced by their institution or organisation, particularly academic libraries with projects in the engineering discipline. It was observed that there was not much literature published on digital scholarship case studies in this discipline when compared to digital humanities case studies. In many digital scholarship case studies, authors were affiliated to libraries or research centres and projects involved the transformative use of technology, however there were few case studies with engineering content.

Since this is a new research area, and the terms used in the knowledge domain are not so well defined, it may be that there were engineering digital scholarship projects in technology and education or other disciplines that are not found due to the limitations of search terms, inconsistent descriptors and differences in contextual meaning. The scarcity of literature on this topic presented challenges since the availability of example projects would support the promotion of digital scholarship services by subject librarians. There may be differences in the way librarians work with faculty or the process of sourcing for appropriate content in engineering domains compared to available literature in the humanities so we hope this paper can contribute ideas to further digital project development in technology disciplines.

Promoting 'NTU Digital Projects' and preparation for content recruitment

Content recruitment was the critical first step in the process of creating digital projects at NTU Libraries. This was an important learning area for subject librarians working in digital scholarship, so it is discussed here in detail.

There are two main methods for identifying suitable content for digital projects:

1. Users approach subject librarians to request assistance to curate, store or archive content utilising library technology platforms.
2. Subject librarians approach faculty and researchers to source for content, with knowledge of their research area.

The earliest NTU digital scholarship projects were the outcome of subject librarians' liaison work with faculty mainly from the School of Humanities and Social Sciences and also the School of Art, Design and Media. In those projects, faculty approached the library to assist them in specific projects such as creating a specialised database of annotated records using library technology systems. In the engineering discipline, digital technology can be seen to be well integrated into scholarly work processes and activities, scholars may be "unaware of librarians' expertise and uninformed about library services available to them, to the extent that they bypass the library as a source of support." (Martin, 2016), justifying the need for active promotion of the digital scholarship project service to this user group.

We observed that NTU engineering faculty behaviour was more aligned to the second content recruitment method so to prepare for the marketing campaign and familiarise engineering librarians about potential content sources, an environmental scan for engineering digital projects that were accessible and discoverable online was conducted. Some of the findings from that survey indicated that engineering digital collections available at that time (end 2014) comprised images, technical drawings photographs, documents, tables, survey results, datasets from research dissertations and theses, audio, video and technical reports collected, managed and preserved by libraries to support teaching, learning and research. An example collection is Princeton University Digital Library's 'Engineering in the Modern World' (Princeton University Digital Library, 2010) which highlights selected collections of working technical drawings of structural engineering works. ISRIC (International Soil Reference and Information Centre) World Soil Information (ISRIC World Soil Information, 2017) is another example of a major data centre for soil data that provides online services including soil data supply and access to an online catalogue of bibliographic records of maps, reports and books.

Almost all the collections were 'first-order' content projects i.e. "digital re-creation of already existing materials such as digitized collections of drawings. Little or no analysis of the materials is included. Second-order content projects take digital materials and enhance them, using any of a variety of digital tools and techniques …" (Gibson et al, 2015). NTU Libraries policy on digital projects described content characteristics as being "substantive, scholarly, NTU produced and containing new value add in the form of (an) NTU Digital Project" so the target content identified should also contain potential for second-order projects. An example of this would be the ISRIC data centre.

Although the survey gave a good idea of the current digital project landscape, it could not give a clear direction of the type or medium or format that could serve as a good representation of the kind of material subject librarians could easily identify and use as a reference or example when soliciting for potential second-order content from engineering faculty and researchers.

One of the key challenges faced in recruiting content and promoting this service was the difficulty in describing the exact content sought, together with the lack of good and available examples to support show-and-tell conversations. As the ideal content characteristics seemed at the same time broad, ambiguous and not well defined whether by characteristics or by format type, or when described verbally or in text, this was the cause of much inconclusive discussion.

After deliberation, it was identified that visual material in various forms, whether images or photos or graphic data, had interpretative as well as primary source characteristics that may be cues to recruitment of prospective content, although textual material was not absolutely excluded. Additionally an online, digitized collection of historical engineering drawings was selected as an illustration model since the link could be easily shared via email communication.

Some researchers have noted that "Unlike visuals in popular media, which are used to attract a general audience, visuals in professional science and engineering discourse report data for the purpose of showing and convincing an expert audience of the validity of the findings. Scholars have argued that compared to text and tables, graphs and other visuals are a more advanced form of communication and that widespread use of graphs in the sciences contributes to the authority of scientific discourse." (Mogull & Stanfield, 2015)

Using knowledge of specialised subject research areas and communication forms, especially visual formats, subject librarians pre-identified potential content that could lend itself to re-organisation when curated in a meaningful structure. The content could also have potential for re-purpose whether in story-telling, creation of teaching and learning resources or records of research funding. Where necessary and working in teams, the selected exemplar project or a demo test project may be created from a sample of available content and shared with the faculty prior to follow-up discussion.

Lessons learned and start-up challenges

Despite research and preparation for the digital project marketing plan, some content-related issues encountered by subject librarians during the promotion of the digital scholarship service to faculty proved to be too difficult to manage. The main issues that hindered content recruitment were intellectual property and copyright, and confidentiality; some unsuccessful and unresolved case instances of these are described in the two sections below.

1. Intellectual property and copyright

A collection of engineering construction drawings of dams, hydraulic structures and a hydroelectric plant from the 1980's which were donated by an overseas retired professor was identified by subject librarians as potential content for a digital project. From their assessment of the material, the technical working drawings represented unique material, and students and researchers could benefit from improved accessibility via digitization. The digitized format would also have the potential to be re-purposed into formats that would be suitable for multiple use and purpose e.g. exhibitions, course material, posters, etc. After the initial step of creating a project demo or capsule framework, an internal review by a member of the faculty was arranged. Some positive comments from the faculty reviewer were that the digitization would contribute in providing better access to otherwise hidden material. However, he highlighted that ownership of the content was a contentious issue as it involved multiple content owners including government agencies, consultants and contractors, most of whom were not contactable in present day. There was also the risk of third parties re-using calculations contained in the drawings without knowing the contextual information related to the original projects. Based on this and the complex intellectual property issues raised, it was decided to put this potential project on hold.

NTU Digital Projects also showcases student research works, and over the past two years, the library has been working on an ongoing project showcasing a collection of engineering student works. The subject librarian had worked with the School of Mechanical and Aerospace Engineering annually to host an exhibition of student project design prototypes related to a course module on Engineering, Innovation and Design (EID). In 2015, the course administrators requested library assistance when students sought out past year projects as a reference. The subject librarian proposed creating a repository for project abstracts, drawings and photos that would serve as a community knowledge base for this course, similar to the role patent databases play in the information cycle when researching for ideas. Work on this prospective project is still in progress and one of the ongoing challenges is determining the appropriate process for obtaining permissions since the intellectual property involves multiple owners.

2. Confidentiality

In another promising project, appropriate content was identified from scanning visual content from a research group's institutional website. The subject librarian was able to successfully gather enough interest via email communications to set up an initial meeting with the research group members to promote digital scholarship services as a research showcase. During a follow-up meeting, some examples of current NTU digital projects were presented and potential content from their research data was discussed. Although the outcome of the first meeting was positive, the researchers subsequently raised confidentiality issues related to the possible commercial application of their research as well as unforeseen future requirements from their research project funders. Their concerns were strong enough to put further project discussions on hold. This is a relevant issue in technology-based research since applications, patents and inventions form the outcome of many engineering research projects.

The promotion and content recruitment process was an important learning journey and the lessons learned from the above-mentioned projects that did not materialise or still have ongoing unresolved issues, helped to consolidate best practice in sourcing for content going forward. In summary, some of content recruitment strategies that were useful are listed below:

1. Leverage on knowledge of institutional research areas from subject librarians' faculty relationships to identify and shortlist target content
2. For technology disciplines, visual research data formats have good potential as target content
3. Clarify intellectual property, ownership, permissions and confidentiality issues related to content upfront since these can be potential 'show-stoppers'
4. Gather interest by creating test or demo projects from sample content which is already available on institutional websites or use current projects as exemplars

Partnering with faculty for the Unsaturated Soil Mechanics for Sustainable Urban Living Digital Project

In the case of the digital project, *Unsaturated Soil Mechanics for Sustainable Urban Living Digital Project,* all the content recruitment strategies mentioned in the previous section contributed to the success of the project concept. The subject librarian was familiar with the faculty's expertise in the research area of unsaturated soil mechanics. He was also mindful of the substantial research data in visual formats, e.g. site photos and drawings, created by the faculty arising from collaborations with external government agencies like National Parks and the

Housing Development Board in Singapore. Since these comprised original research material, there may be less complex intellectual property issues to manage. When marketing the service to busy faculty who do not have much time for promotional talks and presentations, the strategy was to rely on customised mock up prototypes to get stakeholder buy-in. The demo project 'capsule' for this faculty's research content was created using sample content from a recent seminar monograph available from the institutional website. The use of faculty's original research material would give a deeper impression of the potential of the digital project as an engineering research showcase compared to sharing a digital project example from another discipline. Sharing the online test site via email with the faculty garnered enough interest such that a subsequent meeting was held shortly after to discuss more details about how to move forward. The project was envisioned as an online knowledge base for sharing and showcasing research on unsaturated soil mechanics and its impact on sustainable urban development, in particular slope stability and tree stability.

Since that initial meeting in April 2014, the faculty has committed research team staff to work with subject librarians on curating content, developing content framework and user interface design. With this working partnership, the design development progressed smoothly and the digital project was completed two years later. The library has also addressed concerns about long-term sustainability of the collaboration and expressed commitment to future content updates for the digital project arising from faculty's new research developments.

Digital projects are highly collaborative and the subject librarian is the project manager driving the entire life cycle of the digital scholarship project including resource requirements necessary for project execution, technology support, metadata production support, copyright advice, promotion and marketing, and ensuring timelines are met and communicated to the whole team i.e. faculty, users, as well as internal library stakeholders.

The project was soft-launched in May 2016 and the library is currently working with faculty on plans for the formal launch and promotion of the digital project to NTU engineering community. Some feedback that had been received since the soft launch has given an early indication of the digital project's impact as a research showcase, an innovative teaching and learning resource, and as an important resource to the geotechnical engineering research community beyond Singapore. We have also received requests to share "the making of" the digital project to faculty and researchers in the School of Civil and Environmental Engineering. We hope this suggests that users are able to visualise their own technical content showcased via this example project, and that as anticipated, the digital project realisation would assist in marketing digital scholarship to other engineering researchers.

Conclusion

In the digital scholarship service model at NTU, partnering with faculty on digital projects has clear roles where faculty are content creators and librarians are system owners, partners and consultants in delivering a specific set of digital content hosting services. This model has limits to the extent of collaboration and integration into scholarly workflows; yet this 'light-weight' partnering, which works towards common outcomes, has facilitated subject librarians developing capability to establish and build digital scholarship library services. The Unsaturated Soil

Mechanics for Sustainable Urban Living Digital Project is a starting point for the inclusion of more engineering content in NTU Digital Projects and is an important step towards creating a unique scholarship collection representative of the strong technological community at NTU.

As librarians move further up the scholarly communication production chain, they are more involved in novel forms of digital communication output and are able to offer these new media channels to their faculty for integration into scholarly workflows. Leveraging on subject librarians knowledge of faculty research output particularly technology output types in visual formats, they may broaden their role in the selection of 'inside-out' (Dempsey, 2010) unique, innovative institutional resources beyond the traditional collection development of purchased and licensed materials. Additionally librarians may need to expand and strengthen their project management capabilities when partnering faculty and other collaborators in the co-creation of digital scholarship projects (Clay, 2016). There is opportunity for engineering content to be showcased in digital scholarship projects, and also opportunities for librarians to participate in the creation and dissemination of open access information and knowledge. We hope the practical strategies listed here can encourage more participation between librarians and their faculty partners in technology domains.

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