A Simple Software Prototype to Enhance Academic and Industry Research Collaboration

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This paper introduces a software prototype designed to enhance local collaboration between researchers from across academic disciplines and institutions as well as industry partners. Academic departments can create barriers for new researchers identifying others working in their field. Industry practitioners also face challenges identifying potential partners in academia. All this is often compounded by lengthy publication cycles that can impede applied research outcomes. The prototype we propose (shell) in this paper is a database driven platform enabling researchers and practitioners to search through abstracts of works-in-progress, upload their own research, and contact or recommend others who share similar research interests.

INTRODUCTION

Throughout academia, as well as the private sector, an increasing emphasis on cross-disciplinary research practices is driving researchers to seek partnerships with people outside their departments, colleges, institutions, and fields of study at a growing rate. Cross-disciplinary research merges diverse areas of expertise and strengthens research outcomes through collaboration. However, there are many structural barriers to this type of research inherent within both higher education and traditional research practices themselves. Among these challenges is the initial need for researchers to find and connect with others in disparate fields who may study similar topics and have interest in collaborating on a specific project.

A major challenge for any researcher wishing to expand their studies by working in partnership with researchers and practitioners from other fields is the need for initial contact. Even on relatively small campuses, academic departments can produce insular environments, creating difficulty in identifying and initiating contact with researchers in other departments who may share similar interests. This obstacle is further compounded when scholars wish to reach out to members of other institutions or industries. Current research networks are in need of a centralized system to share research projects during the early development phases in order to identify potential collaborators. Such a system would enable researchers to recruit team members to current projects and generate new project ideas based on their most recent research interests.

Many technological solutions have arisen to facilitate research across disciplines, institutions, and physical space. In particular, academic libraries have stepped to the forefront by both developing and

implementing technology to assist emerging research practices. While these technological initiatives have filled many gaps in the interdisciplinary research process, there is currently no software to facilitate communication during the early phases of idea generation and project development.

This paper will present a simple yet effective prototype for a software program designed to help researchers (faculty, practitioners, students doing a thesis in a Masters or Ph.D. programs, etc.) share their research projects on certain topics during the initial idea generation phases in order to identify potential collaborators, build teams, and foster inspiration. It offers a unique alternative to existing platforms by focusing on the ability for researchers to find and connect with one another using a simple and streamlined interface. We will further suggest that such software is a natural fit and complements the scholarly communication initiatives already in place in academic libraries.

LITERATURE REVIEW

The rapid pace of change in the landscape of scholarly communication has created a need for software to support collaboration at each phase of the research cycle. In Tranfield et al.'s (2003) model of knowledge management for innovation projects, collaborative research is characterized by three semi-linear phases beginning with a search for information and opportunities in the discovery phase followed by implementation and development in the realization phase and finally ongoing management and a return to the innovation cycle in the nurture phase. This model describes a research process that both begins and ends with the need for an increased social network, yet current research suggests that opportunities for researchers to increase the size and diversity of their networks are significantly lacking. Several studies have found that academic departments and industrial organizations rarely initiate collaboration outside of previously established relationships (Muscio & Vallanti, 2014; Chin, Yap, & Spowage, 2011; Thune, 2007). Furthermore, organizations without a large existing network experience particularly high barriers to enter into multidisciplinary and interorganizational research (Muscio & Vallanti, 2014; Chin, Yap, & Spowage, 2011). At the same time, the diversity of one's network has been positively correlated with increased co-authorship and involvement in interdisciplinary projects (Mo, 2016). Even informal interactions have been shown to increase both the likelihood and the intensity of collaborative research (Ponomariov & Boardman, 2007). As Paul Courant (2006) pointed out, "collaboration across time and space is the fundamental method of scholarship, without it we can do nothing of value" making it crucially important to develop systems that support these initial social aspects of scholarship.

Not surprisingly, an array of technologies has arisen to facilitate collaborative research at many stages of the research process – creating, sharing, disseminating, and curating knowledge. Academic libraries in particular have taken a lead in developing a growing number of digital scholarship services which expand traditional library roles into a wide range of offerings including data management, resource sharing, intellectual property consultation, electronic publishing, and repository services (Vinopal & McCormick, 2013; Walters & Skiner, 2011). From its position as a center of research and point of contact for all disciplines on campus, the academic library occupies a prime location for hosting solutions to emerging research issues. Two major developments, virtual research environments and institutional repositories, partially address the need for scholars to identify potential collaborators early in the project development phase. However, they fall short of facilitating the idea generation and team forming stages, especially in light of the challenges caused by disciplinary, institutional, and physical boundaries.

Of the research support technologies that assist collaborative teams virtual research environments (VRE) are perhaps the most extensive. VRE's can be defined as, "a set of online tools, systems and processes interoperating to facilitate or enhance the research process within and without institutional boundaries" (Borda et al., 2006). These technologies are typically designed at the request of particular research teams and customized to meet the needs of their specific research methods throughout the project's lifecycle, but particularly focused on the implementation and realization stages. By leveraging the strength of IT departments, in partnership with librarians trained in research facilitation, academic libraries have seen the success of many of these initiatives in meeting the needs of large, international,

and interdisciplinary research teams (Leonardo, Donatella & Pasquale, 2009). However, a major limitation, addressed by the present study, is the lack of structure to enable researchers from diverse fields to find one another and initiate collaboration in the first place. As Wusteman predicted in 2008, "social networking features will be just one component of VRE's, but they will be a central component" (p. 69). The software prototype proposed by this paper fills this gap by providing networking features such as email sharing and the ability to recommend and recruit other authors and contributors.

Academic libraries have also taken the lead in hosting software to facilitate scholarly communication at the dissemination phase through institutional repositories to archive university members' published work and make it easily accessible on the open web. Commercial services such as ResearchGate and Academia.edu also address the need for repositories by enabling researchers to upload and search through scholarly works for free. Both institutional and commercial repository services fill a pressing need to archive not only peer reviewed journal articles but also less traditional publication types such as conference presentations, white papers, research data, and other special projects (Lynch & Carleton, 2012). The unprecedented accessibility of scholarly works brought about by institutional and commercial repositories enables researchers to identify others working on similar topics with whom they can potentially collaborate, even across barriers of academic disciplines and physical space. Some citation management programs, such as Mendeley, have also harnessed their large collections specifically in order to facilitate "discovery of research and expertise" through integrated social features (Gunn, 2014, p. 99). However, while current repository systems enable researchers to identify others who work in a general field of study, their content is necessarily limited to published material, completed projects, and previous research interests which creates a significant lag between the discovered content and the researcher's current work. The refereeing process of many journals still suffers from lengthy publication cycles, which makes the gap between initial idea and publication too long for the researcher to benefit from collaboration and discovery of researchers in other institutions, nationally and internationally, working on similar topics. What is needed is a space to upload and share abstracts of current works in progress.

The software prototype presented in this paper offers a way for researchers to view what other researchers, regardless of their location, are beginning to develop in order to seek collaboration and involvement, in real time. Academic libraries have already demonstrated their ability to implement a variety of research support technologies, yet few technological solutions to date have been explored to support search phase discovery. This software prototype will complement research support systems already in place by adding this functionality while operating as a separate and independent system. It will benefit both libraries with established digital scholarship programs as a piece of their technology offerings and libraries without designated initiatives who wish to enhance their scholarly communication services.

THE SOFTWARE PROTOTYPE

The wealth of technological solutions libraries have offered to other scholarship issues provides a firm foundation (and justification) for libraries to integrate a new software platform that would enable initial discovery and contact between researchers from any field of study on a specific topic. Researchers can be from departments and colleges at institutes of higher education or practitioners in industry researching new trends.

The software prototype is not intended for commercial purposes, so there should be no cost to use it. The user, from a university or a company, accesses the software via the web and can immediately start browsing and searching for conference presentations, white papers, book chapters, and other scholarly work. The software also allows users to upload documents to the system for others to access.

There are several benefits to our proposed prototype:

- Secured Login: In order to login into the system, a user has to provide their username and password if they are an existing user. New users need to create a new account by registering their contact information, selecting their affiliation (university or company), and entering a username/password before they can log in.

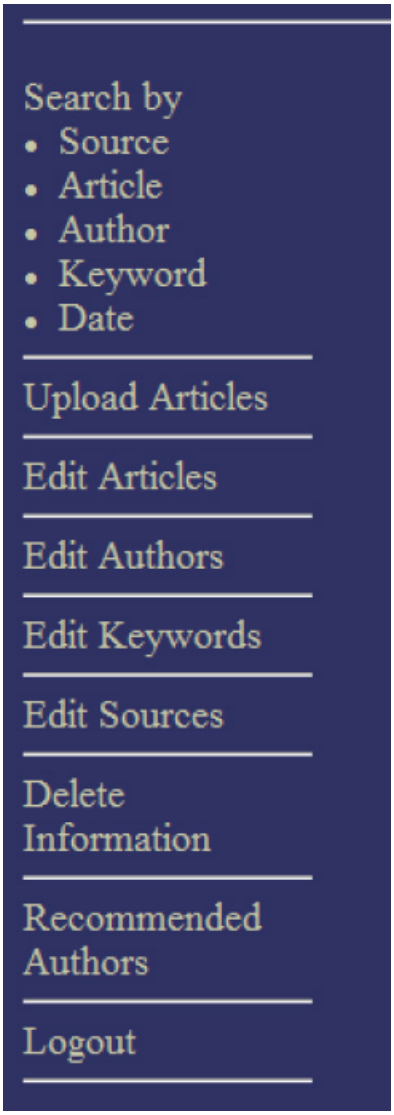
- Multiple Users: This application allows multiple users to gain access to the system over the web at the same time. A User can be uploading an article, another searching for a presentation abstract, and yet another recommending other authors to join the system.
- Upload Articles: A User can upload an abstract of a published article or white paper, book chapter, white paper, conference presentation etc. Details of the article abstract (authors, source title, keywords, publication date, etc.) are also uploaded by the user. Such uploads to the system can be from university researchers or practitioners.
- Multiple Searches: There is a number of criteria to search by. These include searching by Article, Source, Author's first name/last name, keywords, and by publication date. A search can be conducted by any User, regardless if they are university researchers or practitioners, and regardless if they uploaded anything to the system.
- Recommend Authors: Once a User logs into the system to search for or to upload an article or just to browse, an important feature is to recommend other users/authors who could potentially be interested in working on the same topic. This allows the community of authors to grow from the inside out and reach as many potential users as possible.
- System Storage: As the system grows with users, it also grows with available authors, conference titles, publications, keywords, etc. So when a user enters the system to upload a conference abstract, s/he can select from the stored list of conference titles, co-authors, keywords etc. in the system. If none exist, they create new ones. This saves time and improves consistency.
- Administrator Account: In addition to the user account, there is an Administrator account (under the control of a library employee), which allows the monitoring of the system, checking its accuracy, fixing errors as they arise, and blocking users if necessary.

Figure 1 and 2 show the interface for the user and the administrators menus respectively. The administrator page comprises of the user menu plus more administrative duties that are not available to the user. These include:

- EDIT of Article, Author, Keyword, and Source information: the most common potential problem is that the User doesn't see that an author or keyword or source already exists, but because of a typo they do not show in the search. So the user ends up making a duplicate entry. The administrator can then go in and fix such issues.
- DELETE Information: this can include deleting any of the items in the database: article, author, source, keyword, etc. for a valid reason.
- RECOMMENDED Authors: When the user logs into the system and recommends another user who may be interested in the system topic, the recommendation goes to the administrator. A report is generated daily of all recommended authors. The administrator then has a template email that is sent to all the recommended authors describing the system, mentioning its purpose, and inviting them to join.

FIGURE 1
USER MENU

FIGURE 2
ADMIN MENU



TECHNICAL REQUIREMENTS

The proposed software prototype is a database-driven web application (see Figure 3). Its functionality requires interaction with database records via an ASP Server. When a user queries the system, the request is sent as an ASP page (not an HTML page) to an ASP Server, which in turn requests the relevant data from the database. The database processes the request and sends it back to the ASP Server, which returns the requested output to the user as an HTML page.

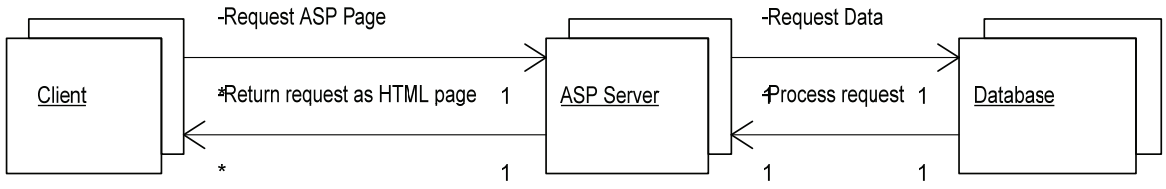
The technologies utilized to build the SCM system are as follows:

- Microsoft SQLServer database: is a full featured relational database management system (RDBMS) that offers a variety of administrative tools to ease the burden of database development, maintenance and administration.
- JavaScript and VBScript: All the pages are written in ASP using HTML, JavaScript and VBscript. JavaScript is used for the validations and event handling for the client browser pages.

VBscript is based on Microsoft visual basic scripting language, used here to link to the SQL server database and other data sources.

- ActiveX Data Objects (ADO): is used in the ASP pages to connect to the database and plays a critical role in reading and updating the data. The ADO model contains six objects, namely Connection object, Recordset object, Error object, Field object, Command object and parameters collection.

FIGURE 3
THE SOFTWARE PROTOTYPE DESIGN

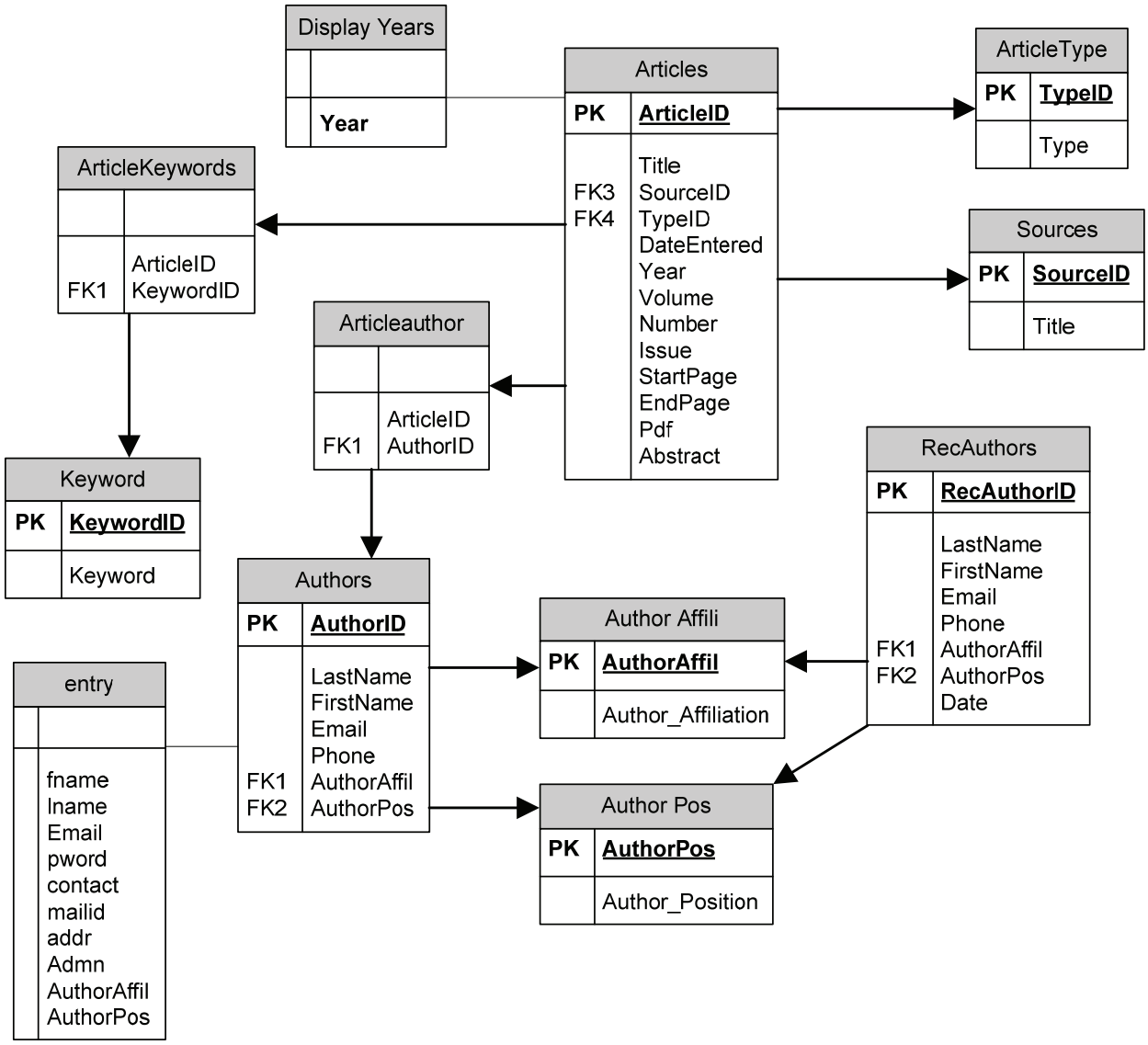


The proposed software prototype consists of one database and over 60 ASP, 4 HTML and 3 JavaScript files. Each file handles a section of the project like searching, uploading, editing, deleting etc. The database is the heart of the application. It stores both the user information and the various details about the authors' sources of research. User information consists of name, affiliation (university or company), position, contact information, etc., which the user enters at the initial registration screen. The user gets to select a password and use it together with their username (email address) to log into the system in the future. Once logged in, the user gets to search the system by source title, author, keyword etc. The user can also be an author wanting to upload an article abstract or a conference presentation summary. Therefore, the entry table is linked to the Authors table to avoid redundancy in repeating the information.

The database consists of a total of 12 tables (see Figure 4) connected together using a primary key (unique for each table) and foreign keys (primary in other tables). Some examples follow. The AuthorID is the primary key for the Authors table, The ArticleID is a primary key for the Article table. Both AuthorID and ArticleID are then foreign keys in the ArticleAuthor table. Similarly, AuthorAffil and AuthorPos are foreign keys in the Authors table, but are primary keys in Author Affiliation and Author Position tables respectively. The Articles table holds all the details about the article, and has ArticleID as the unique primary key. The Source Type table stores the information about different types of sources such as journal, presentation, working paper and book chapter. The SourceID is a primary key in the Source table but a foreign key in the Articles table. The keywords for the Articles are stored in Keyword table where KeywordID is the primary key. The keywords for a specific article in the Article table are then connected to the keywords in the Keyword table via the ArticleKeyword table, where both ArticleID and KeywordID are foreign keys.

The technical requirement to implement the software prototype is minimal. A library employee with knowledge of database and website management can implement the system and become its administrator. After the initial implementation, the time involved to manage and monitor the system is minimal. A key advantage of such a system, is that once it is in place, it grows from within by allowing authors with interest in a common topic to share ideas and recruit others. Additional advantages include the full control of the system with local hosting and the full ability to customize the system with minimal costs

FIGURE 4
THE SOFTWARE PROTOTYPE DATABASE



IMPLEMENTATION EXAMPLE

We decided to select the topic of Supply Chain Management (SCM) as an example for the software prototype we are proposing in this paper. "Supply Chain Management encompasses the planning and management of all activities involved in sourcing and procurement, conversion, and all logistics management activities" (Council of Supply Chain Management, 2016). Supply Chain Management has been a key topic among industry researchers as well as researchers in colleges of Business and Engineering all over the world. The interdisciplinary nature of the topic can attract researchers from Marketing, Decision Sciences, Management Information Systems, Industrial Engineering, manufacturing companies, and even service companies. Therefore, the test topic makes it a great pick for our software prototype.

FIGURE 5
IMPLEMENTATION EXAMPLE – SCM

Once we inserted the topic of SCM into the software prototype, we decided to title the system "Online Database for Supply Chain Research." You can give the system any title you wish for a research topic. In our case, we wanted to emphasize that the online web interface has a secure database in the background to collect all the information in one place. The system was implemented locally at our university, and included faculty and graduate students. Also, we purchased the APICS directory and sent an invite letter to all practitioners in the region who work in Supply Chain Management to join the new system. We got some, but not in the numbers we were hoping for. We learned from this implementation example that not only do we put the system in place, we do need to "initialize" it somehow with a startup pool of faculty and practitioners. This can be done in various ways, depending on the topic and the region you are in. In a way, it becomes a marketing issue – how to spread the word about the new system? One way of course is email blasts, but people may ignore those because they are overwhelmed with emails daily, several of which are scams. Another way could be free seminars at the university and local libraries. Also advertising in graduate classes is an option. Regardless of the method used to publicize the availability of the system, it should target both practitioners and academic researchers. It should also start locally but then grow nationally and internationally.

CONCLUSION

To the best of our knowledge, secure software programs that facilitate work-in-progress research and idea generation have not been adopted by scholarly communication networks and academic libraries. Our proposed software prototype offers a guideline to build such a system quickly and easily. The prototype is a database driven web application that allows researchers (faculty and students) from multiple disciplines in one institution, researchers from multiple institutions, and practitioners to collaborate and share their

work-in-progress on a common topic of research. The resulting system has unique advantages over and above what is available in libraries today. Advantages include local hosting, customization, and creating duplicates of the system for different research topics.

We used the topic of Supply Chain Management (SCM) to illustrate how the prototype can be put to use. The system provides a platform for authors from academia and industry to share their initial ideas for projects, articles, abstracts, etc., avoid the lengthy timeline between idea generation and final publication, and grow the community of authors from within by recommending other authors with similar interest in the topic. Also, a system like SCM allows academics to collaborate with companies to do applied research, which is very encouraged in academic settings. Many times, companies are not actually interested in the final publication anyway and this system allows them to bypass that process. Companies usually have a problem and may/may not have an idea how to solve it. They sometimes reach out to faculty in universities for help. By logging into a system like SCM, practitioners will be able to identify who in academia is working on a similar topic. This creates a connection that would not have been found in any existing system to date. The ultimate result is a win-win situation for both a practitioner (who gets his/her problem solved) and a researcher who gets the company's data to test a model or theory that he/she designed to solve the problem.

Global trends in scholarship indicate a steady increase in collaboration between researchers from diverse institutions and industries. However, a researcher's ability to identify potential partners is usually bounded by barriers between different academic disciplines in the same institution, between different institutions, and between academics and industry practitioners. In addition, the lengthy time to publish (sometimes years) inherent in many journals' refereeing process is an obstacle to putting the idea out there in a program like SCM and receiving feedback on it from multiple other researchers working on the same topic. We are not suggesting that researchers post articles they have submitted to journals. This is often in violation of the journal copyright guidelines. A program like SCM acts as a great virtual gathering place for researchers in the initial phase of doing research to collaborate on a research topic or/and work-in-progress. Academic libraries have become technologically equip to implement our proposed prototype solution on a research topic that is of interest to faculty at their institution and to local industry. A system like the SCM software provides libraries the opportunity to enhance scholarly communication and improve academic-industry collaboration.

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