Knowledge management system in a higher education institution: Development of an expertise search system

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Abstract. Knowledge management constitutes determining factors for organisational effectiveness, organisational performance, and sustainable competitive advantage in higher education institutions (HEIs). HEIs create new knowledge through research works and community services, distribute knowledge through teaching and learning, and transfer knowledge through consultancies and scientific discussions. A knowledge management system (KMS) is considered essential for HEIs to facilitate knowledge management. This paper outlines the KMS development process of the Faculty of Mathematics and Natural Sciences of Universitas Negeri Semarang as a platform for advancing the faculty as an organisation. Data collections were conducted through forum discussions to gather information and identify current issues related to data used in KMS development. Some information technology experts, faculties, and top management staff were actively involved in the discussions. The obtained data were analysed and then applied in the system, namely the expertise database and conference database. The iterative model was employed as a guideline for the development of KMS. This model enables the developer to revisit the system once it needs to be updated in the future.

1. Introduction
Higher Education Institutions (HEIs) constitute organisations that are able to create an abundance of knowledge either for their institution improvement or for business purposes [1]. Therefore, an HEI needs to make a strategy for effective management [2]. The more knowledge is managed, the faster the institution will advance, outperforming another institution. HEI's well-organised knowledge can be employed to make important decisions, take action, and problem-solving, leading to knowledge creation. The created knowledge is required to be disseminated and implemented effectively; hence the cycle on managing the knowledge keeps on moving [3].

Managing knowledge processes are the key to the success of a knowledge management system (KMS) in any HEI. KMS makes internal knowledge available to all individuals and provides organisational learning information [4]. KMS is a form of an information system. Thus the concepts and discussion of the information system are appropriate to KMS. Since the emergence of KMS, many HEIs have been actively engaged in KMS to get benefits from the system use. There are three main strands of knowledge management in HEI, namely knowledge creation, knowledge sharing, and knowledge transfer. HEIs create new knowledge through research and publication, share knowledge through teaching and learning activities, participate in conferences/seminars, and transfer knowledge...
through downstreaming research results by building harmonious relationships between all nation elements, specifically the academics, business, and government. The use of KMS in HEI relies heavily on information (knowledge) to expand their innovations and services. The effective use and management of knowledge have been recognised as the most significant aspect for identifying current issues that can be used as research material, updating the latest information, and promoting new innovations to the public.

This paper discusses how KMS is developed to improve the academics' experiences and help them achieve success in branding themselves to create and influence public perceptions using KMS features. In this regard, KMS is developed in the form of an expertise search system, an application used to find an expert. Hence, the study is intended to address the research question: how to build an expertise search system to manage knowledge so it can be used to improve the personal branding of academics?

2. Literature Review
HEIs have always been engaged in knowledge management. Three pillars of HEI (in Bahasa called Tri Dharma Perguruan Tinggi), comprising education, research, and community service, are closely connected to knowledge creation, knowledge sharing, and knowledge transfer, respectively [5; 6]. Ramjeawon and Rowly [1] suggest that HEI's successful knowledge management can be achieved by enhancing awareness of the factors that promote or impede knowledge creation, sharing, and transfer in HEI. Knowledge management (KM) is considered to be an affecting aspect of organisational outcomes of educational institution innovations, academics improvement, and service improvement [7]. Knowledge is defined as a combination of experiences, values, contextual information, and expert understandings that provide a framework for assessing and integrating new experiences and updated information [8]. KM can be described as "the effective learning processes associated with exploration, exploitation, and sharing of human knowledge (tacit and explicit) that use appropriate technology and cultural environments to enhance an organisation's intellectual capital and performance" [9].

In the HEIs point of view, KM constitutes a set of practices that support educational institutions to improve teaching and learning activities, study works, and administrative roles and encourage the concerned stakeholders to use and distribute data and information in decision making [8]. HEIs create knowledge from their academic and administrative processes and try to make policies to manage knowledge to improve knowledge distribution, effective decision-making, and critical thinking within institutions [10].

There are some critical factors that affect the distribution knowledge in HEIs, namely benefit and rewards for those who have published publications, leadership style in endorsement and advancement of knowledge exchange behaviour, and organisational structure which supports the exchange of knowledge [7]. These factors must be taken into account to continuity the knowledge management.

3. Methods
This study focuses on developing an expertise search system as part of the knowledge management application in one of the faculties at a public university in Semarang. The system development followed the waterfall-software development life cycle (waterfall-SDLC) method to create, test and deploy an information system in optimum conditions [11]. The waterfall-SDLC model is the sequential development model in which the development phases are processed without overlapping. The waterfall model is recursive in that each phase is repeated in order until it is completed. Figure 1 depicts the different phases of the waterfall-SDLC model.
The waterfall-SDLC model used in the current study consisted of five phases:

1. Requirement analysis phase was conducted comprehensively before moving to the next phase of design. This phase included setting the goals, defining software attributes, identifying user characteristics, determining functionalities specifications, interface and database requirements.

2. Design phase focused on designing aspect of the system regarding the selected technical and functional requirements. In this phase, all the requirements were transformed into a suitable structure for being implemented in web-based system programming.

3. Coding/implementation phase was focused on building the expertise search application to perform a code review and ultimately create the solution itself.

4. The testing phase was essential in developing a system. The developers performed some activities such as detecting defects, bugs, and errors in the system solution and ultimately have a good system quality that meets the expectations.

5. Maintenance phase in this current study was performed by keeping the expertise search application completely operational, updating it to meet the goals, and improving it throughout its life.

4. Results and Discussion

The expertise search system development began by inviting several officials and information system experts in the forum group discussion (FGD). The FGD was set to provide insights and explore any ideas of how the system is designed and set the goals for what the system is developed for. This section discusses all the process of how the expertise search system is developed.

4.1. Identifying requirements and its analysis

Identification of requirements was accomplished through FGD. The discussion results provide input for the development of the expertise search system. The system is considered more appealing when it is designed on a web-based. In this current study, the expertise search system was then developed on a web-based. Some of the considerations included accessibility across devices for users, customisation for different devices, and increased flexibility and scalability. Further, the FGD also identified any features that should be put on the system, such as expertise search engine, login page for users, user view page to share users' experiences and resumes, institution's conference information, and publication statistics. These features are considered essential for users either from internal or external institutions to easily find information related to the institution's expertise. Moreover, providing conference information on the system will help the institution to disseminate its programs. The login feature was required to give access to the users to update their professional resumes.

4.2. Designing and coding the system

The expertise search system was initially designed using Balsamiq Wireframes, a wireframing tool for sketching user interface ideas in creating low-fidelity prototypes [12]. Every page was sketched as a means of discussion material before any code was written. Figure 2 depicts the sketch of expert details.
The wireframe, as shown in Figure 2, guided researchers the conversation with the team. The monochromatic sketch did not distract research members in early project discussion and kept lower expectations on fidelity.

When wireframing all the pages of the expertise search system was finished, coding of the system was performed. In this current study, the system was developed using PHP language. Furthermore, the framework used was Laravel 5.6, the markups used were HTML and CSS. The database used was MySQL. Figure 3 is one of the examples of the expertise search system page.

4.3. Testing the system and keeping it operational

BlackBox testing was conducted to validate the functionality of the developed system. The BlackBox test instrument was administered to the potential users working in the internal institution. By providing input to each function, we ensure that the function works as expected. This testing is done based on the user's perspective. The results of the BlackBox test is shown in Table 1. All the results are good. It means that system is well-programmed.

| Process Name          | System response                                                                 | Result |
|-----------------------|---------------------------------------------------------------------------------|--------|
| Login                 | If successful, the user will be redirected back into the system that contains several additional menus for managing data. | Good   |
| Searching data        | If successful, the user will be redirected to the page which contains search results according to the search keyword | Good   |
| Displaying detail data| If successful, the user will be redirected to a page displaying detailed data of an institutional member | Good   |
| Editing biodata       | If successful, the user will be able to view their biodata and make changes to it | Good   |
| Managing conference data | If successful, the user will be able to save, edit and display conference data | Good   |
The expertise search system can be reached on http://kms.mipa.unnes.ac.id/. Publishing the expertise search system online is making the system accessible so that the users can update their personal data at any time.

5. Conclusion
This study has successfully developed the expertise search system, as part of KMS that developed to manage HEI's knowledge. This system can be used to monitor the professional development of academics. With this ability, the institution will know its current capability and project steps in the future that will maintain an excellent competitive advantage.

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