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Transforming LMS into KMS in Indonesia Educational Institution Case Study in Telkom University Open Library

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Abstract

Library is an institution that collects printed and recorded knowledge, manages it in a particular way to meet the intellectual needs of its users through various ways of knowledge interaction. In 2021, Indonesia provided 4605 active educational institutions, ranging from universities to community academies. All these institutions are obliged to provide library to create a better learning environment, by providing source of references for each course delivered by the institution. This obligation is encouraged by the government by considering library support within the accreditation system. In this accreditation system, a library should allocate books as a source of reference to each course. This establishes a paradigm that library is where we store books and where a member of the institution may borrow, learn, and return those aforementioned books. Today, educational institution deals with not only books but also thesis, dissertation, technical report, training/workshop report, research paper, etc. Authors believe it will be prudent to leave all these documents of knowledge to librarians, by changing the library's paradigm from managing books to managing knowledge. This study proposes a model of Knowledge Management System as a transformation from Library Management System. This study also explains about expected opportunities and benefits after the transformation.

Keywords: library management system; library paradigm; knowledge management system; workflow management; workforce management

1. Introduction

One of the main hindrances for librarians to expand library's functionality in an educational institution is the misperception that library is solely meant for storing books. Although it is true that a library should manage books to aid better learning environment, it would be better if librarians are there to manage knowledge in a centralized system. Whilst managing knowledge, librarians still run their main role as managing books, since books are also a type of explicit knowledge [1].

Shifting paradigm from managing book to managing knowledge should be started within the librarians. This can be achieved by changing their mindset and providing IS *(Information System)* solution using *Knowledge Management System*. One of the challenges in this research proposes a new and simplified model for a Knowledge Management System (KMS) while

still retaining its main functionality as a Library Management System (LMS) [2].

In 2021, Kalervo Javelin, conducted LIS research across 50 years: LIS research content analysis of journal articles, this study describes the development of types of knowledge that cannot be accommodated by LIS (Library Information System) or library applications [3].

In 2022, Assuntta et al. conducted a Digitalization and artificial knowledge for accountability in SCM: a systematic literature review, obtained the result Knowledge management is a very important role in increasing company productivity. This was stated by Assunta in his study explaining the role of knowledge production and dissemination in the SCM (Supply Chain Management) process. However, to our knowledge, there has been no report on the implementation of a Knowledge Management System

(KMS) with the case of main function as a Library Management System (LMS) [4].

Based on information from Wikipedia and JISC and SCONUL report, a Library Management System (also known as ILS or Integrated Library System) should provide several functionalities [5], including collection acquisition, cataloging collection, collection circulation, Manage special collection, collection retrieval, Online Public Access Catalog.

Collection acquisition, which starts from ordering the collection from publisher, taking care the invoicing materials, and up to the receiving the collection. In cataloging collection, which starts from classifying the collection, identifying the collection's bibliography, indexing the collection, and up to the shelving scenario.

Collection circulation mechanism, which allows librarians to lend materials to patrons, extend the lending period and return them to the shelves. Manage special collections, requires librarians to manage special collections, such as references like dictionaries, journals, newspapers, handbooks, encyclopedias, etc.

Collection retrieval allows librarians to track and locate a specific collection, retrieve it, and hand it to the patron who requests the collection. Online Public Access Catalog (OPAC) where patrons or guests are able to explore every collection maintained by the library, place a reservation, or borrow a specific collection, and even give payment when necessary.

To ensure that the LMS works properly, it needs a database with a unique ID for each patron and each catalog and collection. Besides a unique ID and full name, each patron may have additional information as an optional attribute such as email address and profile picture. In the catalog and collection, they may also have additional information such as the metadata as an excerpt of the catalog's content. Based on the patron and collection's unique ID, there exists transaction information describing the circulation for each of the collections (whoever borrows the collection) [6], [7].

Since the old paradigm treats the library as a place to manage books, to produce the IT solution for the library is also designed to manage books, which is an LMS. While librarians are busy managing books, other departments might be busy managing other types of documents, like theses, dissertations, research articles, training reports, etc. We found this will be possible as an IT solution for each type of document because each department has a different type of requirement, even though the type of document falls into one category, namely knowledge. The separation between books and other knowledge documents can result in difficulties in managing them. Therefore, it will be better to migrate from distributed knowledge to a centralized knowledge, and the librarians could start this initiative using Knowledge Management System (KMS) [1]. This is

simply because librarians are the one who has the expertise in managing catalog, which in this case is knowledge [6], [8], [9]

In most educational institutions, managing knowledge has raised awareness as a crucial foundation for business continuity [7]. Evolving from a document management system, which has the main role of managing documents for references, then it has now become a managing explicit knowledge in many forms. Explicit knowledge may come from any source, formal or non-formal discussions, training, workshop, seminar, or even by reading another literature. The explains of four important elements in KMS are shown in Figure 1 [10].
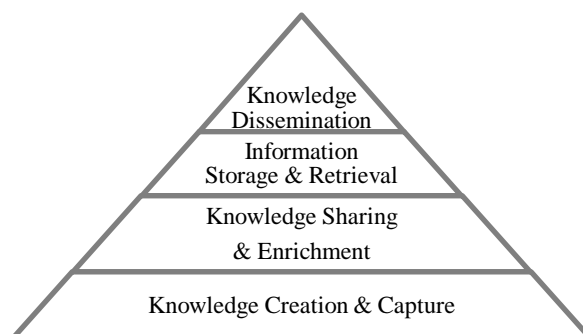

Figure.1. Four Elements of Knowledge Management System [10].

Based on Figure 1 we found that in the first stage, knowledge engineers may capture knowledge from many sources by transforming tacit knowledge into an explicit and structured document. Another option is by members voluntarily or enforced by the system initiate this stage by submitting a knowledge document. Along with capturing knowledge, it is also possible in this stage for members to create new knowledge based on existing explicit knowledge. Some references also name this capturing stage as knowledge acquisition.

In the second stage, after capturing all tacit knowledge into a structured and formatted document, now all that matter is to use them for sharing and enrichment purposes [11]. Several technologies are available to help at this stage, such as open access using OAI-PMH and collaboration functionality [12]–[14].

In the third stage, the main purpose is to provide a better learning experience for a member to understand the content of knowledge. Therefore, it will be up to the knowledge engineer to design how the system stores the knowledge document. A good storage design provides better accessibility and availability, which in return gives a better understanding [15], [16].

In the last stage, by using a good design of the user interface, we can expect better knowledge dissemination. This is done through several methods, like e-Learning and circulation (borrow, learn, and return mechanism) [17],[18]. In the knowledge

dissemination process, Assunta explained in his paper the important role of knowledge in the SCM process in companies. Assunta published Scopus and Google Scholar indexed publications from 1990 to 2022.

We organize the paper into several sections. The introduction provides information regarding the differences between LMS and KMS, and from these differences, we propose a new model of KMS that has similar functionalities with LMS.

The reason to do this is to minimize the risk of migrating from LMS to KMS. The next section explores more related works to emphasize the new model. As a closing remark, the last section explains expected opportunities for an educational institution by migrating from LMS to KMS.

2. Research Methods

In this study, we used a qualitative approach with the desk research method, in this method we searched for information from various sources to find related research that explained the relationship between LMS and KMS, especially for Educational Institutions in the field of libraries.

2.1 Related Works Comparing LMS with KMS

As an educational institution, it is common to find knowledge in many forms. Teaching materials, training and workshop outlines, seminar and conference résumés, and research articles are only a few to name. these types of knowledge. Based on the knowledge type, one dedicated unit is assigned to manage each knowledge type [7]. The librarians manage knowledge in the form of books and e-books, the faculty manages theses and dissertations, and the human resource department manages training and workshop documents. This, in return, creates difficulties in managing relations between knowledge and makes it harder to provide knowledge sharing and dissemination. Authors believe that it will be more practical to manage all these knowledge types in one centralized system, instead of using a distributed system and managing the interoperability among systems [11].

Since the KMS proposed in this research is an enhancement based on LMS, all functionalities from LMS are still available for librarians to use. These include collection acquisition, cataloging collection, collection circulation mechanism, managing the special collection, collection retrieval, and Online Public Access Catalog (OPAC) [19].

Table 1 explains the positioning between LMS functionalities and KMS elements. From this table, we can see that all functionalities in LMS have a matching element in KMS. Circulating the catalog in LMS is comparable to knowledge sharing and knowledge dissemination in KMS. OPAC, as to provide access to

LMS' catalog is comparable to knowledge dissemination, knowledge retrieval, and knowledge sharing in KMS. Retrieving the catalog in LMS is comparable to knowledge retrieval in KMS. Managing catalog in LMS is comparable to knowledge storage in KMS. Catalog acquisition in LMS is comparable to knowledge capture in KMS.

Table 1. LMS to KMS Mapping Functionalities

LMS	KMS	New Model KMS
{not available}	Knowledge Enrichment	Knowledge Empowerment
{not available}	Knowledge Creation	
Collection Circulation + OPAC	Knowledge Sharing & Dissemination	
Collection Retrieval + OPAC	Information Storage & Retrieval	
Managing Special Collection	Information Storage & Retrieval	Knowledge Management
Collection Circulation + OPAC	Knowledge Sharing	
Cataloging Collection	Information Storage & Retrieval	
Collection Acquisition	Knowledge Capture	Knowledge Acquisition

This simplified model of KMS is to ensure lower risk in migrating from LMS to KMS and achieves easier change management by lowering user resistance. The simplified model is designed for application in an educational institution as a place where many forms of knowledge are available and dispersed [7]. The illustration of the simplified model of elements in KMS is shown in Figure 2.
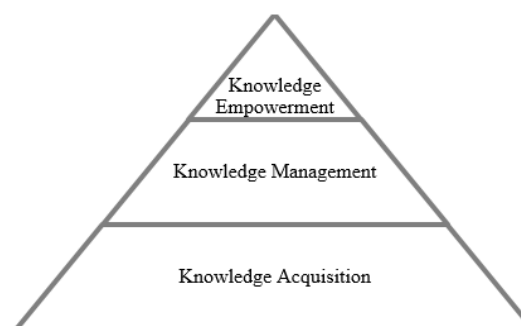

Figure 2. Simplified Model of Elements in KMS.

Based on Figure 2, there only three elements in this model, which are is knowledge acquisition, knowledge management, and knowledge empowerment. The Knowledge acquisition stage is comparable with knowledge capture, where all members of an institution are eligible to submit, review, and approve based on their privilege. This stage starts from the submission of a knowledge document and ends when it became a knowledge catalog [12].

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The Knowledge Management stage is responsible for managing the knowledge, starting from designing the storage to ensure better availability and accessibility for faster and simpler knowledge retrieval. This stage also manages knowledge dissemination mechanisms, including the circulation process [15], [16].

The last stage Knowledge Empowerment is providing flexibility to KMS designers to use and reuse all knowledge provided in the second stage, which is not available at LMS. Several possibilities of empowerment are E-learning, sales portal, and discussion forum [17].

The simplified model of KMS complies with previous research, which is Academic ERP (Enterprise Resource Planning) for academic institutions [20]. An illustration of the High-level Architecture for Academic ERP is shows in Figure 3.

Figure 3. High-level Architecture for Academic ERP

Figure 3 depicts the high-level architecture for Academic ERP, where all application within Academic ERP is built on top of master data as a base for shared data reference, such as students, lecturers, staff, curriculum, and course description [20]. Just like Academic ERP, the design of this model of KMS uses master data as a reference, for example, to find a lecturer who will be in charge of reviewing paper submissions in a specific knowledge domain. Another example is to find a program director that will be in charge of approving a workshop outline submitted by his/her staff after attending a workshop.

2.2 Proposed Design Simplified Model of KMS

Based on Figure. 3, we can design the business process within the new model of KMS. There are two main modules in this new KMS, which work based on master data. They are workforce management and workflow management. These two modules are in charge of managing knowledge acquisition. After the explicit knowledge is stored in the knowledge catalog, we can use other modules for circulation, transaction, and dissemination via open access. Other modules provide knowledge empowerment like e-Learning and sales portal [17]. The illustration of the scheme from the Business Process within the new simplified KMS is shown in Figure 4.

In Figure 4 the business process within this new model of KMS. The bottom layer displays another system that provides reference information, such as the list of users, students, faculties, staff, and external users, curriculum,

academic transactional (which students enroll in specific courses and when), and questionnaire.
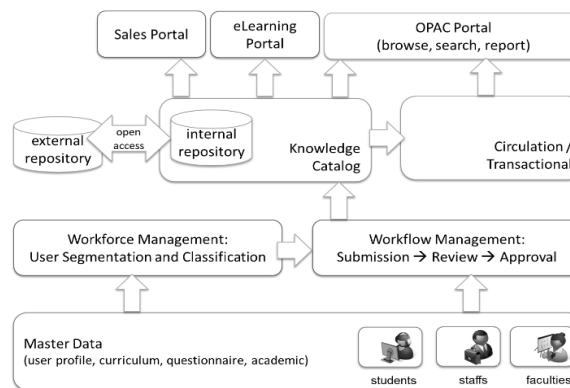

Figure 4. Business Process within the New Simplified KMS.

Workforce Management: the information provided by master data, the workforce management module is in charge of segmenting and classifying users. The examples of the user segmentation are shown in Table 2.

Table 2 The Examples of User Segmentation

User	Description
Undergraduate students	Who are segmented from every undergraduate student
Undergraduate students with thesis	Who are segmented from every undergraduate student who enrolled in undergraduate thesis
Lectures	Who are segmented from every lecturer
Robotic	Who are segmented from every lecturer who has the competency in robotics
Staff	Who are segmented from every staff
Staff in The Office of Academic Affair	Who are segmented from every staff who works in academic affair office
External reviewers	Who are segmented from every invited and registered external reviewer

From Table 2, we found that the administrator of this KMS should be able to define new segments using parameters provided by master data. This is to ensure the flexibility of the system by accommodating all possible future needs.

Workflow Management: based on Figure 4, the information provided by master data, and workforce management, the workflow management module responsible for creating a specific document workflow for a specific type of knowledge. A workflow document defines four roles of responsibilities can be shows in Table 3. Therefore, such as in workforce management, the administrator of this KMS should be able to define new workflows for specific knowledge types. Using the segment defined in workforce management, the administrator can further define which segment is in

charge of a specific role. This is to ensure the flexibility of the system by accommodating all possible future business processes. To provide flexibility in workflow management, a state diagram is proposed to exchange authorization from one role to another.

Table 3 The Summary Roles of Responsibilities

Roles of Responsibilities
Who is eligible to submit a knowledge document?
Who is eligible to review the content the submitted document?
Who is eligible to approve the document?
Who is eligible to transfer the document to become a unique entity in knowledge catalog?

An example of this workflow management is a workflow for a graduate thesis, where a graduate student is allowed to submit for this workflow, a group of lecturers with related competency with the subject area of the thesis is allowed to review the document, and the supervisor of the graduate student will finally approve the document after the reviewer gives the authority to the supervisor. The last role may be given to librarians to recheck the metadata; i.e., title, subject, abstract, keywords, and reference of the document, and transfer the document as a knowledge catalog. The illustration of Workflow Management is shown in Figure 5.

Figure 5 Example of Wokflow Management

Figure 5 there explains an example of a possible workflow to handle dissertation approval and its relationship with roles. There are five roles shown in this example: doctoral student (author), editor, reviewer, promoter, and librarian. Fig. 5 also shows an exchange of state from the reviewer going back to the editor and from the promoter going back to the editor. This will allow a reviewer or promoter to return the document to the editor due to, for example, a formatting mismatch.

Knowledge Catalog: based on Figure 4, this module is in charge of storing all transferred knowledge within an internal repository in a structured format. This structured format ensures high availability and fast accessibility to be used by other modules. One implementation of this structure is the metadata, for example, title, author(s), abstract, keywords, and references. This metadata ensures integration with other systems through knowledge sharing.

Interoperability: based on Figure 4, this module is in charge of interoperability with other external KMS or repositories via standard protocols, such as OAI-PMH, SPARQL, and KQML. The main purpose of the interoperability module is for knowledge sharing, where a KMS may obtain new knowledge from another KMS. For this interoperability to work properly, it needs a common data format to share its content. An example of this common data format is the metadata, which, for example, uses a standard format like Dublin Core.

Knowledge Circulation: based on Figure 4, this module is in charge of knowledge dissemination through the circulation process, based on the definition "who may access which document type". The knowledge circulation module also uses the segment information from Workforce Management. An example of this is when a graduate student may borrow up to 2 books at one time, but a graduate student who enrolls in a thesis may borrow up to 4 books at one time. A lecturer may borrow book(s) for up to 3 months, but an undergraduate student may borrow book(s) only for up to 4 weeks.

Sales and E-learning Portal: based on Figure 4, these two modules are examples of possible extensions for knowledge empowerment. The sales module allows this new KMS to become a profit generator, by selling access to a specific type of knowledge catalog. An example implementation of sales is selling access for a non-member to download a restricted catalog. The E-learning module allows an additional layer on top of this new KMS to become a course generator by using Knowledge Catalog as the foundation (reference) of each e-learning course. An example implementation of e-Learning is by creating a Network Security Course, using several catalogs as the references.

2.3 Putting it all Together Transforming LMS into KMS

In the simplified KMS model, there have six modules explained above that can be categorized into each stage of simplified KMS in Figure. 2, namely knowledge acquisition, knowledge management, and knowledge empowerment.

Knowledge Acquisition: every educational institution has a unique character and business process for managing knowledge. This includes which knowledge type to store, how to manage the stored knowledge, and how to process the knowledge until it becomes accessible on the KMS. Thus, it is necessary for the KMS to be flexible enough to accommodate many possible business processes, starting from submission, reviewing, and approval. Examples of knowledge acquisition using workforce management and workflow management. It is possible to design each of knowledge type with a different process can be shown in Table 4.

Knowledge Management: after knowledge acquired and stored within the KMS, the next step is managing the knowledge to ensure that all knowledge is accessible with high availability. In managing knowledge, we are going to need several modules as shown in Table 5.

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Table 4 The examples of knowledge acquisition using workforce management and workflow management

Knowledge Type	Submitted by	Reviewed by	Approved by
Diploma final assignment	Diploma student	Assessor Panel	Supervisor
Undergraduate thesis	Undergraduate student	Assessor Panel	Supervisor
Graduate thesis	Graduate student	Assessor Panel	Supervisor
Doctoral dissertation	Doctoral student	Assessor Panel	Supervisor
Fieldwork report	Student	-	Student's Advisor
Teaching material	Lecturer	Course Director	Dean
Workshop outline	Staff	-	Supervisor
Case study	Student / Lecturer	Group of Lecturer	Librarian
Proceeding	Author	Assessor Panel	Librarian

Table 5 Managing Knowledge

Managing Knowledge Module
Circulation ensures knowledge dissemination to all users based on its privilege.
Sharing catalog provides interoperability with other external KMS using standard protocols like OAI-PMH, SPARQL, and KQML [1], [13], [14].
Rating and commenting provide feedback response from other member and provide quality of the knowledge.

Knowledge Empowerment: this stage allows an educational institution to empower knowledge stored in KMS, with including three element which are E-learning, where lecturer may create an online course by orchestrating underlying knowledge documents. Sales portal, where librarians, as appointed publisher, may provide special catalogs with additional fee. Discussion forum, where members may discuss on a specific topic based on knowledge document.

3. Results and Discussions

The implementation of transforming LMS into KMS undergoes several phases at Telkom University Library, started from 2011 and finished in 2013. It was then given the codename of OpenLibrary to Telkom University. In 2013, there are only 56 documents from OpenLibrary indexed by Google Scholar, and now as per May 2021 it has reached 1620 documents.

However, there are many more documents registered inside the KMS. Based on the platform's home page, there are 158,482 registered collections, including circulation books, e-books, undergraduate theses, graduate theses, teaching material, etc. From these registered collections, approximately 150,000 documents in pdf format are indexed by Google Search Engine, of which more than 20% are undergraduate theses that have reached 32,136 pdf documents.

There are two main reasons why the indexed documents by Google Scholar are far less than the indexed documents by Google Search Engine, they are Google Scholar. Google Scholar has more filters and restrictions on which document they would like to index and if the student's research advisor did not approve for publication on OpenLibrary platform, either the research is not of good quality, or the research is published elsewhere.

4. Conclusion

Changing paradigm on library functionality in an educational institution should be started from the librarians itself, including their mindset. In addition to that, with the help of ICT driven way of thinking, Knowledge Management System is one solution to provide such paradigm changing, which in return may move the library functionality from managing book to managing knowledge. Many benefits offered by using KMS instead of LMS are: better open access mechanism by using not just OAI-PMH, but also other interoperability mechanisms such as SPARQL and KQM; capabilities on workforce and workflow management modules provides flexibility to accommodate future needs without the need to go into the application core; opportunity on using knowledge catalog as a foundation for better e-Learning; and opportunity on using knowledge catalog and eLearning as another source of fund besides tuition fee, which might be used to provide better service.

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