Business Process Oriented Knowledge Management System Design (Case Study Development Center of Metrological Human Resources, Ministry of Trade Republic of Indonesia)

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Abstract. *The aim of this study is to design a business process oriented Knowledge Management System (KMS) in government training institutions using knowledge modeling methods and knowledge infrastructure process design of Strohmaier. Lecturer (WI) business process is the main case study for this research. The preliminary identification and analysis showed that 7 of 10 business processes have not been fully identified in terms of their knowledge processes. Further analysis showed that in general, all business processes have not been optimized yet to fulfill all the components of knowledge creation to knowledge application. The results of the completed knowledge process design showed that there are 53 stages of the process (there are new additional 19 stages of the process). The new processes are largely on the knowledge transfer and knowledge application that have been defined. In addition, KMS architecture and IT tools as supporting knowledge infrastructure designs are defined. The IT tools are expected to support two knowledge process strategies :the codification strategy with the supporting IT Tools : content management system, information retrieval system, expert locator and the personalization strategy with the supporting IT Tools such as community of practice tool, virtual work space application and discussion group based application.*

Keywords: *business processes, knowledge process, knowledge management system, knowledge infrastructure, IT Tools*

1. Introduction

Bureaucratic reforms of the Ministry / Agency and Local Government is intended to promote the establishment of an effective and efficient organization. To realize such an organization, every government agency must be prepared to utilize its wealth of knowledge, including learning from the experiences of the past. In general, it is manifested in the form of rules and procedures within the organization. Obstacles often encountered is the fact that the knowledge and experience of these organizations are often scattered, not well documented and may even still exist in the heads of each individual in the organization (Permenpan, 2011).

Knowledge management is an effort toimprove the organization's ability to manage their intellectual assets: knowledge and experience. The goal is toutilize these assets to achieve better organizational performance to accelerate the goal achievement of bureaucratic reforms (Permenpan, 2011). Development Center of Metrological Human Resources (DCMHR) is one of the Echelon II units in the Ministry of Trade responsible for the development of metrological Human Resources throughout Indonesia. One of the form for Metrological Human Resources Developmnt is Education and Training. According to Permendag No.7 of 2010, the metrological training aims to increase knowledge and skills in the metrological field.

The presence of senior teacher / lecturer (WI) which has not been supported by the systematic knowledge transfer knowledge to the junior lecturer will raise the risk of losing training material knowledge. The absence of knowledge sharing culture among fellow lecturer along with supporting media is also a noteworthy phenomenon. The impact for junior lectureris they will require more time and more effort to master a subject of teaching materials, as well as DCMHR will depend heavily on specific individuals who master the material because the teaching materials have not been internalized into organizational knowledge.

Being viewed from the concept of knowledge process modelling of Strohmaier (2005) SECI and Ba (Nonaka, 1998), it can be seen that there is no system to regulate and organize the process of knowledge creation, storage and retrieval, transfer and application that plays an important role in the process of converting tacit knowledge into explicit knowledge. Besides, media/space provided for learning process is still limited in classroom and laboratory course, it has not given much chance against the other media (e-learning via the web, mobile learning, etc.). Knowledge Management System (KMS), as a knowledge management support system, (Alavi, 2001) is required to overcome the obstacles that arise in the process of Teaching and Learning Activities in DCMHR. The absence of systematic knowledge transfer from senior to junior lecturer is one of the problems that make the educational system in the long term will run into many obstacles.

In addition, DCMHR does not have a detail guide of the business processes and standard operating procedure (SOP) of each activity: pre-training, on training and post-training process. Clear business processes is necessary in order to manage lecturer knowledge. The main concept of the KMS is that everyone has to manage his own knowledge. Afterwards, the organization can collect, organize and use

knowledge of human resources to become a competitive advantage to face increasing competition (Hidayat, 2006).

The expected outcome of this research is the organizational capabilities. KMS design that is formed will be expected to support the lecturer competence and capacity building activities. Furthermore, the KMS is expected to increase the capability of DCMHR thus favoring the building of a learning organization, where the main asset of a learning organization is a living / intangible assets contained in the knowledge of all members of the organization.
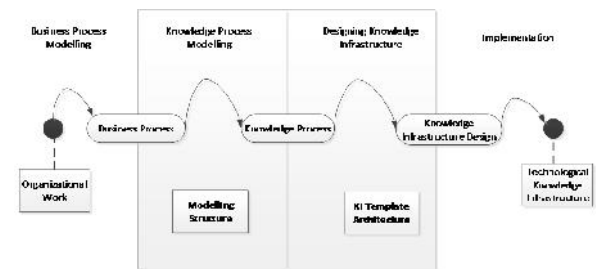
2. Literature Study

Figure 1. Knowledge Process Modelling (Strohmaier, 2005)

Figure 1 shows the framework that has been developed by Strohmaier. Stages in the framework is as follow.
1) Phase 1: business process modelling.
   at this stage, the business process can be represented by the method that is appropriate for modeling business processes. Business processes was obtained from: 1) analysis of existing business process models 2) the interview towards business processes involved. The result is then modelled as workflow method.
2) Phase 2: identification of relation between knowledge domain and the business process. at this stage, can be identified several knowledge domains and organizational roles involved in the business processes. knowledge domain is the relevant knowledge in performing an action. Organizational roles are

parties that involved in the execution of business processes.

3) Phase 3: Knowledge Process investigation from the relationship ofknowledge domain and business processes. Business processes are expressed as knowledge creation if it generates new knowledge in business process, expressed as knowledge storage if the knowledge is generated, stored as organizational knowledge, stated as knowledge transfer if the knowledge is passed on to other parties, and considered of knowledge application if used in creating other knowledge.

3.   Research Methodology

The design of KMS is divided into 6 (six) phase which using a qualitative method, as described in Figure 2 as follows.
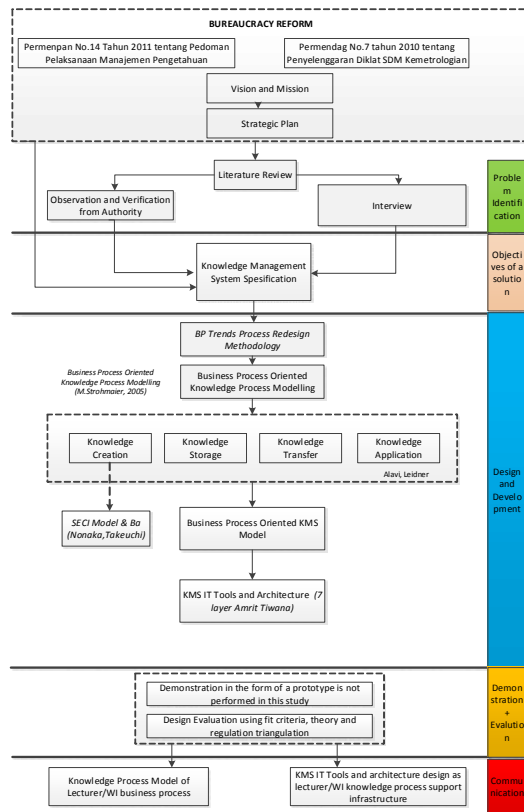

Figure 2. Research Method

4.   Finding and Discussion

In this knowledge process identification, four processes used are as follows (Strohmaier, 2005):

1. Knowledge creation:
   Identify the need for knowledge background.
2. Knowledge application:
   Identify the knowledge required by each knowledge domain.
3. Knowledge transfer:
   Compare the activity of existing condition to the organizational roles that need.
4. Knowledge storage:
   Evaluate the content of storage, backgrounds and shapes.
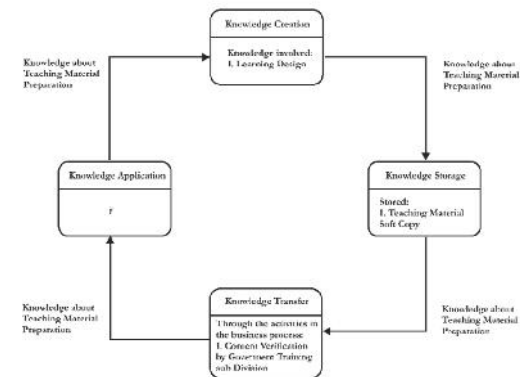

Figure 3. KM Cycle of KD B (teaching material preparation)

Figure 3 shows that knowledge creation of teaching material preparation involves knowledge of Learning Design (RB/RP) documents, which is then saved as a teaching material draft (softcopy). However, it can be seen in figure 2 that knowledge application of teaching material preparation has not been well defined, it means that this knowledge has not been used by other organizational roles to create new knowledge. Similarly, knowledge transfer has not been well defined (marked with question marks). Being analyzed further, it is not only Learning Design (RB/RP) documents that have a role in the creation of knowledge regarding teaching material preparation, but also there are several other knowledge background that affect it.

Knowledge background is useful in the creation of new knowledge, so that the resulting knowledge have more complete perspectives. Table 1 Identification of KD B Knowledge background identify the knowledge background required by lecturer in generating knowledge about teaching material preparation.

Table 1.Identification of KD B knowledge background

No	Code	Knowledge Domain	Description
1	A	Learning Design	WI can use Learning Design as guideline for the teaching material preparation including the ability to be owned by the students after attending lesson as success indicators, subject, teaching methods, media and time allocation
2	B	Teaching Material and Training Modules	WI can take reference from previous teaching material. From this knowledge lecturer can learn from the best practice of teaching material design
3	C	Presentation Slide	WI can process any information from presentation slide to complete the teaching material
4	D	Face to Face Learning	WI can process any knowledge arising from the discussion in the class, including a case study in a Particular area, local regulations, etc. to renew teaching Material
5	E	Exams	WI can process any information contained on the exam that has been published as reference material for teaching material (which are relevant to the subject).
6	F	Essay Guidance	WI can use research finding/analysis from the training participants essay to renew teaching material (which are relevant)
7	G	Training Material	WI can use and process the knowledge gained from the training module to renew and update teaching material
8	H	Scientific Paper	WI can use the results of the research / study / analysis made in scientific papers to update the teaching material.
9	I	Translation	WI can process and use the results of translation journals, reference standard or the latest from abroad to renew and enrich its teaching material
10	J	Event Reports (Moderator/Speaker)	WI can use the knowledge of the event report to renew and enrich its teaching materials

Furthermore it will be showed knowledge that use the KD B and organizational roles that use it.

Table 2. Knowledge Application of KD B

No	KD	Knowledge Involved	Code	Organizational Roles
1	A	Learning Design Document	WI	Widyaiswara
2	B	Teaching Material	WI	Widyaiswara
3	C	Presentation Slide	WI	Widyaiswara
4	D	Face to Face Learning	WI	Widyaiswara
5	E	Exams	WI	Widyaiswara
6	F	Essay Guidance	WI	Widyaiswara
7	G	Training Material	WI	Widyaiswara
8	H	Scientific Material	WI	Widyaiswara
9	I	Translation	WI	Widyaiswara
10	J	Event Reports (Speaker, Moderator)	WI	Widyaiswara

Table 2 noted that KD B is used by lecturer (WI) organizational role. Therefore, knowledge transfer to the lecturer must be ensured in the business processes to facilitate this. As knowledge transfer occurs between one lecturer (WI) and the others, then alternative forms of transfer are shown as follows, in Table 3.

Table 3. Knowledge Transfer of KD B

No	KD	Knowledge Involved	Transfer	Knowledge Transfer
1	A	Learning Design Document	WI - WI	
2	B	Teaching Material	WI - WI	Teaching Material coordination Meeting with WI (lecturer) in one expertise group, if required can be held more extensive and depth discussion on particular topic through all of WI meeting or In House Seminars, etc
3	C	Presentation Slide	WI - WI	
4	D	Face to Face Learning	WI - WI	
5	E	Exams	WI - WI	
6	F	Essay Guidance	WI - WI	
7	G	Training Material	WI - WI	
8	H	Scientific Material	WI - WI	
9	I	Translation	WI - WI	
10	J	Event Reports (Speaker, Moderator)	WI - WI	

The last step is about knowledge storage. To design a good knowledge storage there are several things to note as follows:

1. Teaching materials knowledge should be stored properly and the changes / improvements made from year to year are recorded.
2. Knowledge background about the changes / repairs of teaching material must also be clearly recorded in neat chronological order changes. Suppose there are regulatory changes that resulted in an improvement in the teaching material, the changes and the reasons (of the change log) should be written clearly. Later the lecturer and training participants can learn from these changes.
3. The form of knowledge storage must also be considered, it should be structured in electronic files both in writing and storage. More details about the form of knowledge storage will be addressed in designing the technology for supporting knowledge infrastructure.

The above analysis can be summarized into a cycle of knowledge management that has been completed as follows in Figure 4.
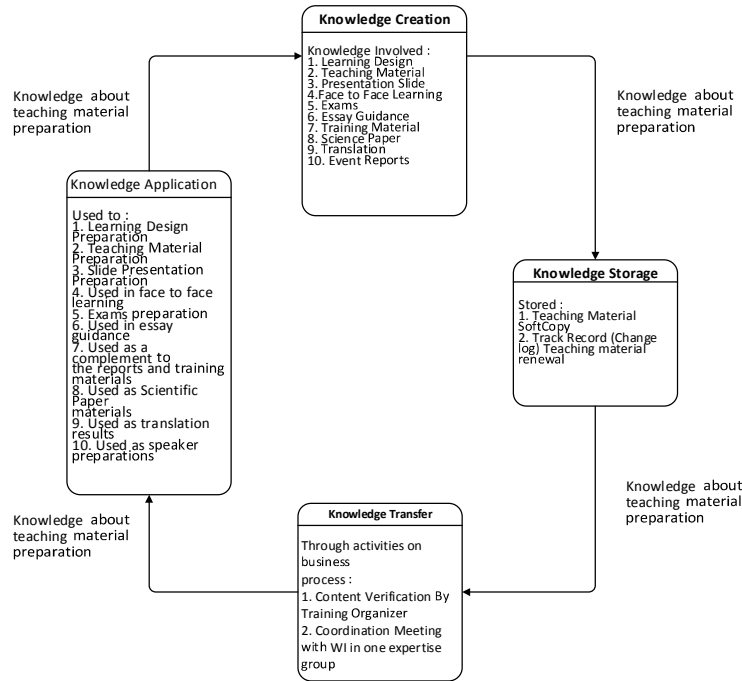
Figure 4. KM Cycle that have been completed from KDB

4.1. Business Process Oriented KMS Design
Once the knowledge process completed, the next step is preparing a business process-oriented KMS model. Modeling is visualized using knowledge identification process from Strohmaier (2005). KMS models are designed to accommodate the latest changes. With these changes the flow of knowledge from KM cycle is well defined so that the KM cycle can be created smoothly. More detailed diagram can be seen from the figure 5 below.

Figure 5. Knowledge Process Modelling of KD B

4.2. KMS Technology Analysis

The design framework of knowledge infrastructure from Strohmaier (2005) will be used to design aspects of technology (knowledge infrastructure) as follows in Figure 6.
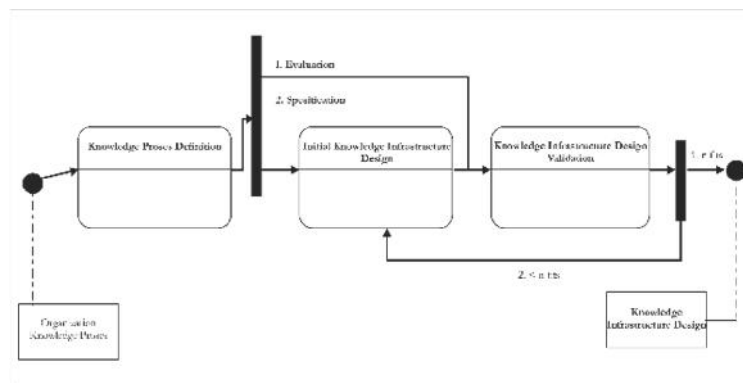

Figure 6. Design step of Knowledge Infrastructure (Strohmaier, 2005)

According to the framework, there are three steps to design knowledge infrastructure as follows.

1. Knowledge Process Definition
    At this early stage, as-is and to be knowledge processes are defined. At this stage the fit criteria (objectives to be achieved by designing knowledge infrastructure) are also defined. Fit criteria will be used in the validation of knowledge infrastructure.

2. Design of Knowledge Infrastructure.
    At this stage IT Architecture and IT Tools will be designed based on fit criteria and analysis result of business process knowledge modelling along with alternative technologies derived from literature studies. The design on this paper will focus on IT Tools particularly on the data, infrastructure and knowledge service layers. Besides IT Tools, KMS conceptual model is also described at this stage.

3. Knowledge Infrastructure Design Validation
    Validation step is the final step of the design knowledge infrastructure. At this step, validation is conducted in terms of support for knowledge process using fit criteria. In this phase it can be determined whether the design meets the criteria or do not, if not then second stage of process can be repeated again. In addition to the fit criteria validation, comparisons to theory and regulation are used resulting triangulation validation.

4.3. Definition of Knowledge Process

Knowledge model process identification can be seen in Figure 3, while the design of process knowledge that has been completed can be seen in Figure 4 and 5. From here fit criteria will be designed as a knowledge infrastructure design purposes (KI). Fit Criteria will be designed based on some theory of KMS (Strohmaier, 2005) (Alavi, 2001) and in accordance with the regulation of KemenPAN on knowledge management in government agencies (PermenPAN, 2011). The summary of fit criteria are as follows:

1. Organizational Roles should be able to access the knowledge they need.
2. Organizational Roles should be able to provide / fill knowledge in KI.
3. The stored Knowledge must be supported and managed by KI.
4. KI should handle knowledge transfer smoothly.
5. KI should be able to facilitate knowledge collaboration between knowledge worker.
6. Collaboration model should also facilitate the need for collaboration anytime and anywhere (not confined to the office only).

4.4. Design of Knowledge Infrastructure

From the design of lecturer (WI) business process knowledge flow, there are two strategies related to the way individuals (lecturer) acquire and share knowledge required to perform duties as lecturer. The strategies will affect the design of knowledge infrastructure. The strategies are as follows (M. Ribiere. 2006).

1. Codification Strategy: This strategy focuses on the collection, codification and dissemination of information (explicit). This strategy will depend heavily on IT. One advantage is the reuse of existing knowledge. Codification strategy at lecturer business process can be seen in Table 4.

2. Personalization strategy: This strategy focuses on developing a network to connect people so that tacit knowledge can be shared. This strategy emphasizes the dialogue between individuals. Personalization lecturer business processes can be seen in Table 5.

Table 4. Knowledge Process and supporting technologies (codification)

Knowledge Process	Supporting Technologies
Content Documentation	*Doc/ Content Management (Wiki, blog)*
Search and Information Retrieval	*Search Engine/ Information Retrieval System, Expert Locator*
Interconnection among knowledge workers	*Intranet*

Table 5. Knowledge Process and supporting technologies (personalization)

Knowledge Process	Supporting Technologies
WI Discussion Meeting and discussion with WI on one group expertise WI Forum In House Seminar	*Mentoring/ Tutoring* *Working Group / Communities of Practice (expert locator, collaboration, virtual work space application, knowledge repositories, discussion group based application)*

The following are the proposed design based on the results of the analysis and fit criteria (design of data and knowledge sources, infrastructure services and knowledge services) (Maier, 2007).

1. Data and knowledge sources: Here all the database of lecturer (WI) business processes (knowledge domain D to J) are stored.

2. Infrastructure Service: The main supporting Infrastructure is intranet network via Local Area Network (LAN) and Wi-Fi to connect all the knowledge worker with the KMS. Intranet is also connected to the Internet via an Internet Service Provider (ISP) to access external online databases.

3. Knowledge Services: In this layer there is a service of the application to be used to support the knowledge process. Based on the fit criteria and KMS strategy, the applications to be used are described in Table 6 as follows.

Table 6. Knowledge Process supporting application (knowledge process)

| Fit Criteria	Knowledge Process	IT Tools
Organizational Roles must be able to provide / fill knowledge in KI.	Knowledge Creation	Learning Tools
Knowledge that is stored should be supported and managed by KI. Organizational Roles should be able to access the necessary knowledge.	Knowledge Storage and Retrieval	Wiki, Blog, Document/Content Management System Search Engine/Information Retrieval System, Expert Locator
Knowledge must be able to transferred by KI	Knowledge Transfer	Discussion group based application

4.5. KMS Conceptual Model
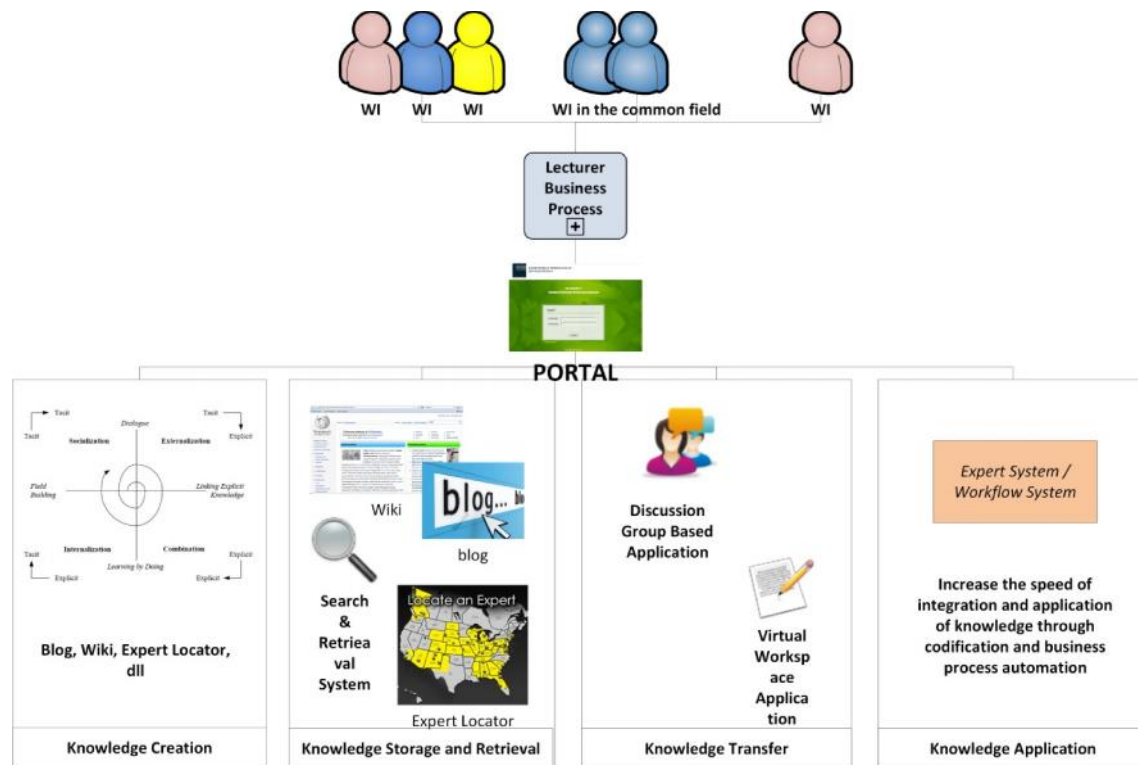
Figure 7. KMS Conceptual Model on DCMHR

Conceptual model in Figure 7 can be explained as follows:
1. Knowledge background needed to support creation process in teaching material preparation consists of 10 business processes identified earlier (Table 1), for example: earlier teaching material is used at the beginning of the preparation of the teaching material, then updated content (may be added or lessened) is adjusted by: RB / RP, reports of technical training (both national and international), the scientific papers of training participants, the translation of

internationally accepted standards (of course in accordance with prevailing regulations in Indonesia), the discussions of the participants and other relevant information. The initial content can be put into a wiki where later it will contain a teaching material according to the subjects taught. Before writing to a wiki, a lecturer must access portal (as a one stop information system) that serves as an access and authentication systems (giving access to the application based on roles and responsibilities). It is necessary to manage all applications KMS well. The main principle is that the access to the application (read only, write and edit or full access) is given to the organization roles in accordance with his or her needs. All KMS application can only be accessed through this portal (also functions to provide guidance of each application).

2. Knowledge creation can not be separated from knowledge storage and retrieval, this is actualized by the codification strategy (knowledge storage). Point 1 has explained that the main content for storage (teaching material) can be stored in wiki, then the supporting content as knowledge background to update the content can be stored on a blog. The stored content can be varied, ranging from text, images, audio, video, animation and other multimedia content. Later, any change (either increase or decrease the contents of the teaching material) on the wiki will automatically be added to his description of the change (change log) including what changes were made and when those changes occured. At this stage a specific mechanism as a function of approval of the updated content can be added. Knowledge storage and retrieval are also equipped with search and retrieval systems for ease of finding the desired information and knowledge. Besides, expert locator function is also added to make it easier to find people who are experts in a particular field.

3. Personalization strategy is located on knowledge transfer. This stage emphasizes the management of tacit knowledge where new knowledge that emerged from discussions between lecturer and forum or in-house seminars. For example in a discussion that will determine whether a new test method can be included or not in a teaching material, if all the participants present at the same time and place, then the process of knowledge sharing / knowledge transfer / discussion can take place via the meeting or discussion forum. Then the results are incorporated into the wiki based on an agreement on the discussion forum. KMS enables a wider discussion forum, if there is one participant who was not present or at a different place, for example, the discussion can still be done via supporting technologies such as: video conference, discussion groups based application, virtual workspace application and others. In essence KMS enables knowledge transfer and knowledge sharing anytime and anywhere.

4. The last stage is knowledge application in the form of the application / implementation of existing knowledge in order to provide value-added (continuous improvement) on the other processes. From the identification results was found that the process of developing a teaching material can be used to increase the 10 other processes. As described in Figure 3, it is a repeating cycle. To speed up the implementation process knowledge, KMS can help in terms of linking information from multiple sources and make it accessible to organizational roles that need it easily and quickly. KMS can further support the application of knowledge in a way embedding knowledge into the organization's business processes through expert / workflow system (codify and automate business processes).

4.6. Validation of Knowledge Infrastructure Design

Beside fit criteria, validation is performed also by comparing to the theory / other literature as well as to applicable regulations in order to make sure the validity of the design. It is shown in Table 7 and 8.

Table 7. Theory Based Validation

No	Research Findings	Supporting Theory
1	The role of IT in supporting the management of explicit codified) and tacit (personalization) knowledge	Alavi (2001) states that the role of IT in the management of KM as follows: coding and sharing of best practices, creation of corporate knowledge directories, creation of knowledge networks
2	IT is use to support the management of tacit knowledge (working group / CoP) and explicit knowledge (document management system)	Moffet and McAdam (2003) stated that KM Tools consists of 3: collaborative tools, content management and business intelligence. Collaborative tools such as groupware, discussion forum (tacit), content management systems such as document management, office automation system, etc
3	Knowledge dissemination via collaboration model (anytime, anywhere)	Nonaka (2000) stated that SECI Model consist of, Socialization Originating Ba (same time same place), externalisation interacting ba, combination cyber ba(different time different place), and internalization exercise ba.

Tabel 8. Regulatory/Policy Based Validation

No	Research Findings	Regulation
1	Knowledge Process which will be managed consists of knowledge creation, storage and retrieval, transfer and application	According to PermenPAN No.14 Tahun 2011 regarding Guidelines for Knowledge Management, there are three basic processes in Knowledge Management,the process of knowledge acquisition, knowledge sharing and use of knowledge
2	Knowledge Transfer found consists of two strategies, codification (explicit) and personalization (tacit)	According to PermenPAN No.14 Tahun 2011 transfer process can be a discussion and through technology-based medium
3	The study consisted of two phases, knowledge modeling and design process knowledge infrastructure	According to PermenPAN No.14 Tahun 2011 stages on knowledge management implementation planning consist of Identifying Knowledge Management Context within the organization, identify Knowledge Management Practices (knowledge modeling process) and the use of technology strategy (knowledge infrastructure).
4	Document/Content Management System, Search Engine,discussion group	According to PermenPAN No.14 Tahun 2011 , in the technological aspects of data acquisition using an electronic system to record data, tools for communication and collaboration (portal and intranet) and electronic discussion forums and search and retrieval system

5.   Conclusion

Lecturer (WI) knowledge process modeling can be done using a knowledge process modeling framework from Strohmaier (2005) which is modified using PermenPAN No.12 tahun 2012 on business process guidelines. The further analysis showed that in general, all business processes have not been optimized yet to fulfill all the components of knowledge creation to knowledge application. Starting from the knowledge creation, it was found that the Lecturer (WI)   business process knowledge background in creating a new knowledge has not yet been fully identified, then in knowledge storage yet using a structured system and it is easy to be accessed again, knowledge transfer is also not yet optimal due to not support the activities of the collaboration, cooperation and teamwork while for knowledge application loads that has not been defined so that utilization of knowledge not optimal**.**

From the results of the knowledge infrastructure design indicates that there are two strategies used to support the Lecturer (WI) knowledge process as follows:
1. Codification Strategy is an explicit strategy (managing documented knowledge) and the supporting IT Tools as follow: Document/Content Management of Wiki and Blog, as well as Search Engine/Information Retrieval System and an Expert Locator.
2. Personalization Strategy where the This strategy focuses on the management of tacit knowledge (discussion between lecturer, lecturer forum, in house seminar, etc) with the supporting IT Tools as follows: Working Group/Community of Practice Tool, virtual work space application and discussion group based application.

6.   Further Research

Further research can be done to develop an IT Tools prototype that have been proposed, such as making KMS Portal application that consists of Wiki, blogs, expert locator and Community of Practice tools in the form of virtual work space application and discussion group based application to be applied in the DCMHR of the Ministry of Trade.

Prototype development of IT tools should keep abreast of the latest technology in order to get the IT tools that are truly effective and efficient. The use and integration of social network software (wikis, blogs, microblog, forums, social networks, etc) should be studied in depth so that the function of KMS to connect information and knowledge from various sources and make theme asily and quickly accessible can be achieved. Further research can be done with the main focus of the people aspects of KMS (organizational culture, motivation, awareness, reward, regulatory support) to complete process and technology aspect. Further   research   can be   done   in   the aspect of Knowledge Management Maturity Model Measurement / Assesment.

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