Transition from Observation To Knowledge To Intelligence (TOKI)

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Knowledge Management System for University System: A Case Study of University of Ibadan-Academic and Administrations

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Abstract. Knowledge can be attributed to human and s/he possesses some level of tacit knowledge which is unstructured and hidden in performing tasks. Thus, tacit knowledge is implicit and difficult to express, extract and to manage. It has to be converted to explicit knowledge which can be easily documented for organizations to exploit this asset through Knowledge Management (KM) initiative. KM process involves identification of types and sources of knowledge, its organization, codification and sharing for reuse in order to facilitate efficient communication among organizational stakeholder including University setting. However, in some universities, especially in developing nations, there are usually disparate sources of information due to the semi-automated system being in use, inefficient management of resources as statutory meeting is often time consuming, requires paper documentation and less economical in addition to lack of means of preservation of expertise knowledge. Consequently, these overheads result to under-utilized resources, delays in communication, unresolved administrative issues, and/or student unrest. Thus, this work focuses on building a Knowledge Management System (KMS) adaptable to University System to revolutionize the approach of academic and administrative operations by relevant stakeholders and to support cost-effective and timely decision making process. Identified knowledge related to academic and administration are captured and structured. Hierarchical Clustering and Tokenization techniques are applied to knowledge exploitation to facilitate timely retrieval and reuse of relevant knowledge by the right stakeholders. Using University of Ibadan (UI) undergraduate program as a case study, UIKMS integrates academic resources, lodging and student disciplinary administration and facilitates collaboration among students and academic staff.

Keywords: Knowledge Management System, UIKMS, Data Mining, Hierarchical Clustering, Tokenization Algorithm, Machine Learning.

1. Introduction

In an organization, acquisition of knowledge vital to its vision and operation is very imperative due to the accrued benefits of time gain and less cost. Also, it provides content for organizational repository and its efficient retrieval. The traditional manual method of knowledge preservation in form of paper-based documents is prone to tasking, inefficient, less secure storage (susceptible to natural disaster) medium, indexing, retrieval and application to new problem. (Abdel, Waseem, Basaam, Majd, and Muhamad, 2015). The revolution from industrialization to knowledge economy has necessitated organizations that aspire to meet up with the competitive and globalization challenge of 21st century, to incline to the paradigm shift through the platform of Knowledge Management (KM). The limitations of traditional and conventional information systems have been adequately catered for by the advent of KM. It is an enabler with which organization's intangible but economic assets of both animate and inanimate sources could be identified, captured, retained and transferred for reuse and continual revision for creation of new innovative knowledge assets.

In order to capitalize on the benefits of KM, certain factors must be put into consideration. These factors are organizational vision and mission, culture, personnel expertise, business process model, and technology adoption. For an organization to leverage on its knowledge asset and optimally adopt KM initiatives, it is imperative to have a clear definition of its goals, and identification of its people, norms, policy, product/service procedure, communication channels, and Information Technology infrastructure needs. A realization of these antecedents aids to establish the factors for a successful adoption of KM System (KMS) and the consequent productivity and retention of invaluable knowledge asset for improved service delivery and increased competitive edge (Oladejo et al., 2010). Heretofore, most university in developing countries have been limited to archival process of literary knowledge resources rather than adopting and capitalizing on KM initiatives for optimized administration and academic operations.

Thus, this work aims at the development of a KMS adaptable to University systems generally and specifically, to a case study – "University of Ibadan - academic and administrations". The rest of this paper entails review of the theoretical background and related works with respect to KMS in Section 2. Section 3 discusses the methodology for the modelling and implementation of UIKMS. Section 4 reports the testing and evaluation of UIKMS and the paper is concluded in section 5.

2. Theoretical Background

This section reviews basic concepts related to Knowledge Management System (KMS), and machine learning techniques for knowledge discovery as well as existing related works.

2.1. Knowledge

There has been no universal definition of the concept - 'knowledge'. It is better described in terms of its relationship with information and data. The philosophical approach based on epistemology, that is, the study of knowledge, contemplated the meaning of knowledge as justified true belief (Pardi, 2011). It is perceived as an existence of absolute and permanent fact which is related to organization of perceptual data with respect to space, time, objects and causality (Serban and Luan, 2002). Thus, the assertion that the starting point of knowledge is data.

Data can be referred to as a fact or figure for representing a unitary element of interest in a world domain, which independently connotes no meaning, unless a relationship is established among the data to express a particular information. Hence, related data with a defined purpose culminates to information. In the long run, information combined with individual or organizational expertise and judgment within a *context* at a *period of time* for *decision making purpose* or guiding *action* to be taken, could be referred to as knowledge, (Oladejo and Odetoye, 2018; Drucker, 2001; Serban and Luan, 2002; Alan, 2010). In the context of a University setting, data is the atomic unit of a fact or record which is of importance to its academic or administration procedures. For instance, student's *Matriculation Number, Name, Age, Gender*... constitute data which when related to an entity or a student,

form a specific information, say, bio-data. The report that a University administration generates for, say, *Gender Mainstreaming Unit*, could be the inference that is, knowledge on *students' gender ration* over a *period of sessions* for respective *programmes of study*, which could guide *decision making or action* to be expedited. The relationship among data, information and knowledge as well as wisdom is illustrated by Fig. 1.

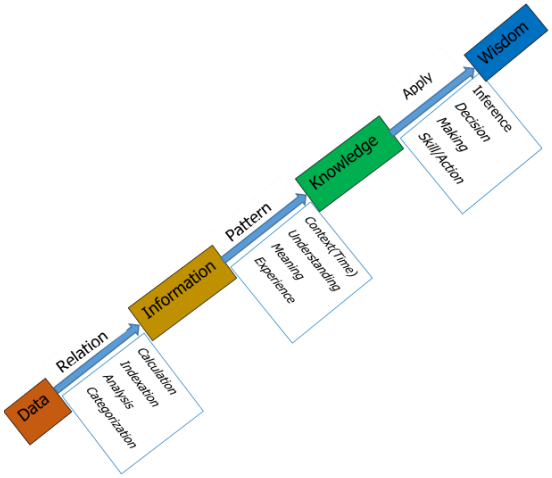

Figure 1: Relationship among Data, Information, Knowledge and Wisdom

Knowledge is classified into explicit and tacit knowledge. The former is referred to as 'knows' while tacit as 'know-how' and 'know-why'. Tacit knowledge is implicit and subjective, and thus difficult to express, share and to manage. It needs to be converted into explicit knowledge which is easily articulated and accessed in form of documents, books, or videos among others, in order for organizations to effectively leverage on Knowledge Management.

2.2. Knowledge Management

Knowledge Management (KM) is a vast and pervasive initiative which is invaluable to virtually every walk of life, of which higher institutions are not excluded. As opined by Baptisa Nunes et al., (2006), the means by which institutions could optimize their roles of teaching, research and administrations in order to promote the use and sharing of

information for decision making is through the principles and practices of KM. It suffices to mention that various definitions of KM have evolved over the decades (Oladejo and Apantaku, 2019), but this work opines that KM is a conscious and systematic approach to identify, capture, organize, preserve, share, and reuse vital organizational knowledge resource from the right sources and transferred within the right stakeholders as informed by the organizational goals and culture in order to sustain competitive edge and productivity.

2.3. Artificial Intelligence and Knowledge Management

Artificial Intelligence (AI) is a branch of Computer Science which focuses on creation of intelligent computer programs such that machines can think and act intelligently. Application of AI techniques to KM is very vital especially, to knowledge representation and exploitation phases of KM. Among diverse techniques of AI is Machine learning (ML) which dwells on the ability of intelligent agents to learn from experience in order to improve its performance or behavior (Poole and Mackworth, 2010). ML is classified into supervised and unsupervised learning. The former depicts intelligent agents that learn by example, usually a training example of input-output pairs, in order to induce a hypothesis or general rule from the observed instances for prediction of output of a new input. Examples are Classification models such as Artificial Neural networks, Deep Learning, Bayesian Networks, Decision Trees, Support Vector machine; and regression models. Unsupervised ML algorithms for example clustering, creates a natural classification scheme to form clusters of training examples in order to predict feature values of each class without the target features from an input training set. Thus, ML explores the study and conduction of algorithms that can learn from and make prediction on data/explicit knowledge (Arthur, 2017).

Natural Language Processing (NLP) is another branch of AI which supports generation and understanding of natural language. Examples include text-to speech systems, speech recognition, Machine translation, information retrieval among others. In NLP system, tokenization algorithm is widely used for analyzing the structure of sentences. Tokenization is a process of identification of a stream of

textual content and its decomposition into words, terms, symbols, or some other meaningful elements called tokens, within an input documents (Vikram and Balwinder, 2014 ; Vijayarani and Janani, 2016).

AI techniques have proactively impacted KM initiatives in the sense that organizations thrive better in terms of productivity and competitiveness. Since ML techniques do learn and improve their performance, their application to KM reduces complexity while efficiency is gained in performance of tasks by organizational stakeholders. ML facilitates learning – efficient knowledge holders, as new insights are generated automatically. Also, a key success indicator of KM is having access to right knowledge at the right time. NLP supports faster retrieval of explicit knowledge. Clustering algorithm and tokenization are applied in this work to support knowledge exploitation of academic resources and reuse of related cases of student disciplinary cases.

Knowledge discovery techniques include ML algorithms and are indispensable for supporting capitalization of knowledge asset of an organization.

2.4. Review of Related Works

A research on Academics was carried out by Barpujary (2011) to identifying user requirements for designing a KMS for academic institutes and to gather information on students and researchers regarding their job requirements using Survey method and questionnaires. This facilitates knowledge storage and dissemination and ultimately contributes to enhancement of capabilities of academicians and students of an academic institute, resulting in organizational effectiveness.

A KMS for administration of students' disciplinary cases in university setting was developed using ontology for structuring explicit knowledge on identified allegation and its sub-classes (Oladejo and Apantaku, 2019). Case based reasoning technique was applied to knowledge exploitation of related past cases and collaboration platform

was created for sharing of knowledge among stakeholders. The KMS is limited to retrieval of past cases which requires further analysis for comprehension by the stakeholders and the duration of decision making may be delayed as no real-time tracking of the administration process exists in the system.

3. Methodology

The developmental phases of and techniques for the KMS in this work for University of Ibadan, termed as UIKMS is depicted in Table 1.

Table 1: Development Phases of UIKMS Process

S/N	TASK	METHOD
1	Knowledge Identification	Interview of stakeholders and observation of existing system
2	Explicit knowledge Acquisition	Uploading of information via online portal
3	Knowledge Representation/Storage	Repository building based on Conceptual and Relational Models
4	Knowledge Exploitation through Sharing and Reuse	Hierarchical Clustering and Tokenization Algorithm
5	Knowledge Creation	Feedback

The existing system study of the case study reveals that the general approach to managing academic and administration knowledge assets is basically semi-automated. The use of portal for organizing these assets is limited to content for basic administration, such as admission, registration (students) and documentation on different sectors, activities and literary resources of the University. Moreover, existing e-learning platform for some courses facilitates knowledge sharing among students and lecturers. However, there is no existing operational KMS which capitalizes on representation of externalized tacit knowledge of students, researchers and administrators. Also, student disciplinary administration is impeded due to communication overheads and prolonged decision making process. Thus, the development of a KMS to manage these vital knowledge assets is indispensable.

3.1 Design of Knowledge Architecture for University Systems

Fig. 2 shows the architecture of UIKMS, adaptable to university setting, and the various components are explained as follows.

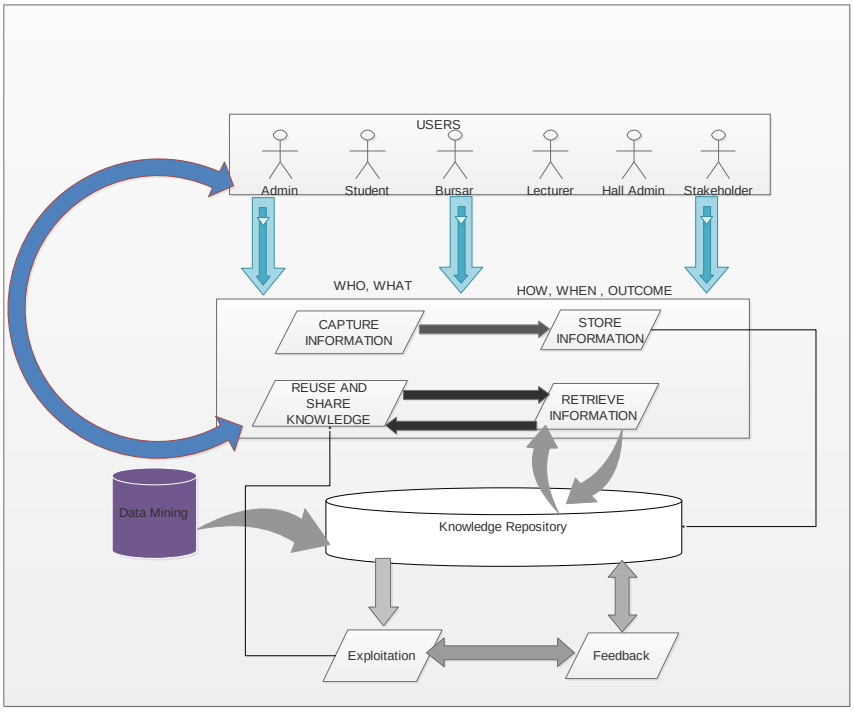

Figure 2: Architecture for University KMS Portal (Adapted from Oladejo, Odumuyiwa and David, 2010)

i. **Knowledge Representation:** In order to preserve the captured explicit knowledge of "who, what, when, how and outcome", from stakeholders on academic and administration tasks, conceptual and Relational Models are used for the representation of the knowledge asset for *storage* in the *Knowledge Repository***.** Figure 3 depicts the structure of the repository for learning resources, lodging, financial and student disciplinary administration.

ii. **Knowledge Exploitation:** Hierarchical Clustering Technique and Tokenization Algorithm are used for capitalizing

knowledge from the repository such that users have faster access to and easy comprehension of retrieved relevant knowledge for the purpose of *sharing and reuse*.

iii. **Feedback:** It is a dynamic process which involves users' assessment of the relevance of exploited knowledge processes and in form of feedback. The feedback leads to creation of new knowledge for subsequent storage in the repository.

iv. **Users:** Represent the various university stakeholders who serve as sources of knowledge on how activities and student disciplinary cases are performed and resolved respectively.

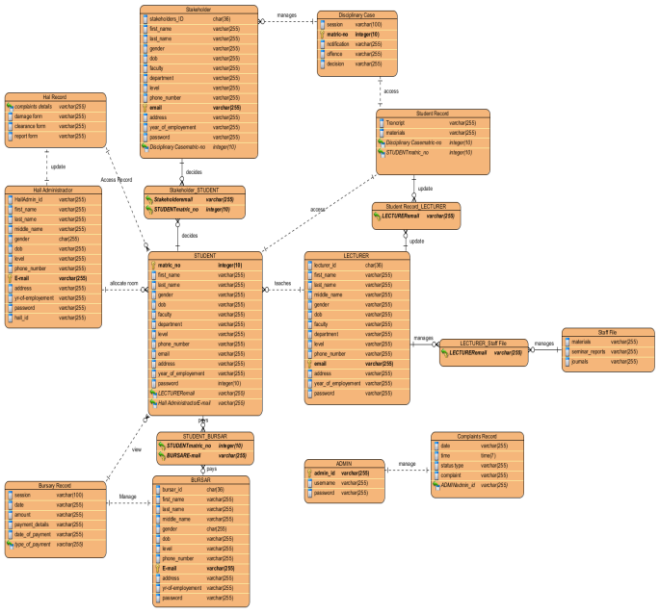

Figure 3: Relational Model for University KMS Portal

3.2 Logic Model of Knowledge Exploitation of UIKMS

The captured information from students and staff of the university were pre-processed through cleaning, filtering and re-labeling for the purpose of efficient exploitation. This information are extracted hierarchically through clustering analysis for quick overview. Identical clusters are identified and then the most similar clusters are merged iteratively until all clusters are merged together.

Tokenization algorithm is applied for iterative decomposition of words within the input documents or search query into tokens for faster access to relevant knowledge that have any of the tokens in its description from the repository. Figure 4 depicts the Pseudo-code on how the Tokenizer works for the extraction of Student Disciplinary (SD) past cases.

```
 // find the cases being searched for

public function find_cases(Request $request)

  {

//tokenize through every first 10 disciplinary cases with the searched word

     $data['cases'] = DisciplinaryCase::where('description', 'LIKE', '%'.$request-
>term.'%')->paginate(10);

//return the searched result

     return view('stakeholder.pages.search-results')->with($data);

  }
```

Figure 4: Pseudo-code for Tokenization Process

UIKMS enhances the conventional method of resolving SD cases by integrating aging tracking technique. The system sends a reminder to the Stakeholders (SD Units) and a notification to the Reporter (Lecturer or Hall Administrator) reminding them of the case that is yet unattended to.

4. Implementation and Evaluation of UIKMS

UIKMS is developed on a web-based platform. Figures 5 and 6 present the snapshots of interfaces for repository of all SD cases and stakeholders notification platform respectively. For instance, the stakeholders access each case with details. When the “All” button is clicked, it shows all cases, either closed or opened. When the “open” button is clicked, it shows all cases that are yet to be attended to and the “closed” button shows cases that have been finalized.

Other sub-systems of UIKMS include platform for learning resources with chat box for collaboration among students and lecturers as depicted in Figure 7; as well as lodging and finance management.

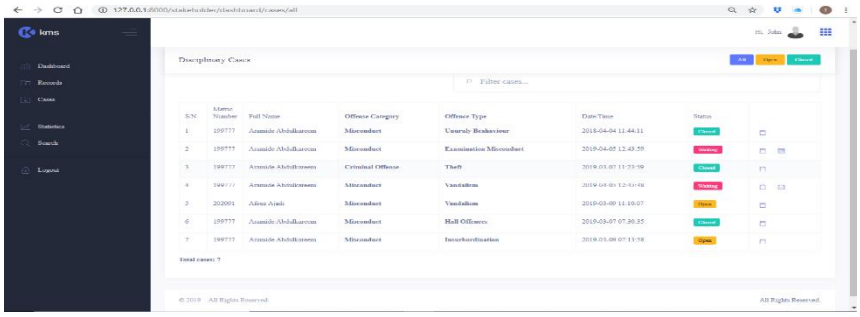

Figure 5: Disciplinary Case Repository

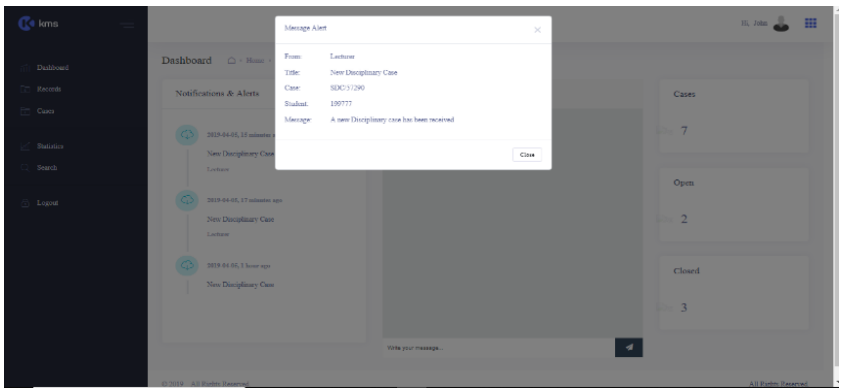

Figure 6: Stakeholder Notification Details

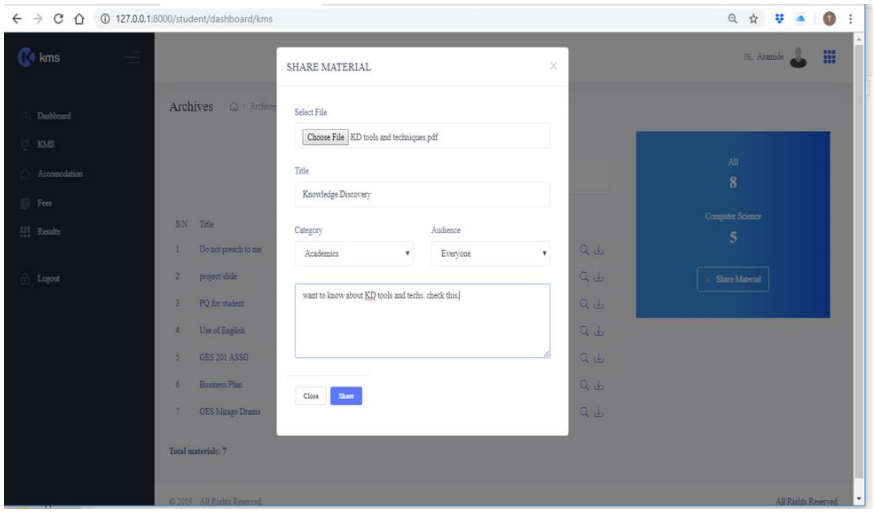

Figure 7: Students' Material Sharing Session

The developed KMS in this work is evaluated against the case study existing system, which is, University of Ibadan Online System (UIOS) and the reviewed related KMS using qualitative features Table 2 presents a summary of the comparison of these systems. Certain benchmark features for the qualitative evaluation are defined based on the best practice of KM initiative.

Table 2 Comparison of the new system, existing system and other related KMS

Benchmark	**UIKMS**	**UIOMS**	**Related Work**
Nature of Knowledge being Represented	Explicit and externalized tacit knowledge in digitalized form	Explicit knowledge	Explicit knowledge but Tacit knowledge is not comprehensive enough
Organizational Goal	Goals of the University are met	Goals are met with manual support	Goal are met
Implementation Platform	It is accessible through the web.	The online portal is web based.	It is accessible through the web.
Collaboration	Available and Reliable.	Not available	Available and Reliable
Knowledge Sharing Culture	Strongly supported by Collaborative platform	Collaboration is transcient but solely manual	Mildly driven by Collaboration
Exploitation	Users search is narrowed down to specific area through Clustering Analysis and Tokenization Algorithm	Users search through large pool of knowledge to gain access through Content Management System and manually	Users search is narrowed down to specific area based on case-based reasoning technique.
Time Consumption	Very fast irrespective of the document size	Relatively slow subject to users' understanding	Relatively fast

5. Conclusion

The motivation of this work came as a result of the stress undergone in higher institutions with paper works both for academic and administrative tasks by students and staff. Sequel to this limitation, this work developed a KMS which serves as an integrated platform for knowledge capture and sharing with respect to academic resources, lodging, financial administration and Student Disciplinary Committee. For the latter, it offers a fast track handling of cases leading to efficiency

in timely decision making and optimization of resources like memo, meeting time to mention a few. The academic part of UIKMS through knowledge sharing supports improved learning among students.

Ultimately, this work is adaptable to typical university settings with inherent benefits of reduction of redundant information, effective collaboration and efficient retrieval of knowledge for timely decision making among stakeholders. Nonetheless, it may be extended in scope and enhanced with other knowledge exploitation techniques for improved capabilities of staff and students of an academic institute.

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