Human Factors in Software Development and Design

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Chapter 12
From Knowledge Management to Knowledge Governance:
A System-Centred Methodology for Designing Indigenous Knowledge Management System

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ABSTRACT

The existing frameworks and methodologies for software designing encompass technological aspects and needs of the urban settings. In software development, getting sufficient and correct requirements from the users is most important, because these requirements will determine the functionality of the system. In indigenous communities identifying the user needs and understanding the local context are always difficult tasks. This typical approach of designing indigenous knowledge management system generates the issues of indigenous knowledge governance, de-contextualisation, and data manipulation. Hence, the main research question this chapter addresses is, How can we introduce indigenous knowledge governance into ICT-based Indigenous Knowledge Management System (IKMS)? The study has been conducted in three phases with collaboration of two indigenous communities, Long Lamai and Bario of Sarawak, East Malaysia. The main outcome of the study is the methodology of conducting a multidisciplinary research and designing the Indigenous Knowledge Governance Framework (IKGF). The framework works as an analytical tool that can help in understanding the essential context in which indigenous knowledge management processes occur. The chapter argues that in order to design appropriate software tools for indigenous knowledge management, information technology professionals need to understand, model, and formalise the holistic indigenous knowledge management system and then use this understanding as a basis for technology design and approaches.

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INTRODUCTION

Understanding user requirements is a critical step in the development of usable software systems. In conventional software development methodologies, the end-users and beneficiaries of the system are considered well aware, skilled and motivated to adopt the software solutions. Normally, the end-users define its need in an abstract written form to help software engineers in understanding their requirements. But this may not be the case for designing software for rural and indigenous communities. The end-users in these communities may never have used technologies, have less or no skills of information and communication technologies (ICT) and may never thought about having an ICT solution for their problem. Hence, understanding the user requirement in these communities and for indigenous knowledge management systems, which fundamentally differ so far from technology supported systems represent particular challenges.

A wide range of digital tools have been developed and cultural heritage institutions are exploring the use of ICTs for preservation and improving access to Indigenous Knowledge (IK). However, ICTs for indigenous knowledge management (IKM) have been designed using the conventional approach of creating and manipulating databases of knowledge (Velden, 2010). Early efforts in IKM focused on developing digital technologies to store, capture, and distribute knowledge (Agrawal, 2002). The focus at present has shifted, however, to make explicit the tacit and implicit knowledge. The current approaches tend to overlook the community's creative expressions, practices of innovation and instead consider IK to be a static resource frozen in time and place. These typical approaches of IK databases design thus fail to a large extent in serving the needs of indigenous communities, as it tend to alienate IK from the essential context such as social, cultural and governance framework (Velden, 2010; Winschiers-Theophilus, Jensen, & Rodil, 2012).

The prime objective of this research is to develop a holistic framework for IKM that projects the ontological structure of the wider social cultural and governance system in which IKM processes occur. The investigation was done in three phases; firstly, we explored the theoretical gaps and the inherent structure of IKMS in communities. Secondly, we addressed the gaps by modelling IKMS in communities and designing a structured indigenous knowledge governance framework. Thirdly, we used the framework to model an existing IKMS and for designing, developing and implementation of ICT-based IKMS. The designed framework helps researchers and ICT professionals to understand the unique structure of IKM and accommodate it in the design and development of ICT-based IKMS.

The remainder of this chapter is structured as follows. The first part of the paper presents background of the research field and introduction of the sites and communities where research has been conducted. Second part illustrates the research framework and each phase of the study in detail. The last part, concluding section, presents reflection of the study.

BACKGROUND

Unique Features of IKMS

Current technological trends and developments have hardly been informed by indigenous and rural knowledge systems (Kapuire & Blake, 2011), which is different from non-indigenous knowledge systems in many ways. The unique features of IKMS are based on two basic system perspectives: "holistic" and "living".

Holistic System

We define "holistic" as a "whole" system where all aspects of life – both tangible (such as oral traditions and activities) and intangible (such as

governance systems and spiritual values) – are assimilated and interconnected and cannot be separated from one another. According to Velden (2002), IK is a highly contextualised body of knowledge that is linked to location, situation and cultural, social and historical context. IKMS is a complex structure that cannot be understood by only examining the parts (processes, technology, people, economic, social and ideological aspects). It must also take into account how the parts interact to make a whole system.

Living System

In Western epistemologies, IK is generally interpreted as a static and archaic form of knowledge while the indigenous researchers interpret IK as;

- A way of life (McGregor, 2004)
- A way of knowing (Aikenhead & Ogawa, 2007) and
- Adaptable and creative system (Macchi & Oviedo, 2008).

The indigenous perspective is not just "knowledge" per se (a thing, an object) but also a way of life that includes dynamic practices such as oral traditions, listening to stories, singing songs, reciting prayers, dancing at celebrations, and participating in ceremonies; all of which are passed on from generation to generation.

In the conventional approaches of IKM, knowledge is de-contextualised by extracting it from the living and holistic system of IK and storing it as data in databases. IKM is a long process and complex system of activities that deals with the multidimensional challenges such as digital technologies, intellectual property rights and the complex social, cultural and belief system of the communities. The current ICT-based IKMS and the frameworks provide a product-view of IKM and mainly satisfy the Western conception of knowledge management, in which knowledge is stored as abstract entities in digital forms. Hence, a well-formulated holistic framework is needed to provide real-time modelling of the living IKMS assimilated with the structure and use of ICT tools.

Data and Information Governance Frameworks

In this section, we present an analysis on selected frameworks of data, information and knowledge governance.

Khatri and Brown's Data Governance Framework

Khatri and Brown presented a data governance framework that includes five interrelated decision domains: Data principles; Data quality; Metadata; Data access; and Data lifecycle (Khatri & Brown, 2010).

The framework is designed for practitioners to help them develop a data governance strategy for managing data as an organisational asset. The scope of the framework is limited to knowledge assets and related control mechanisms concerning mainly explicit forms of data representation.

Data Governance Institute's Framework for Data Governance

Another framework by DGI, focuses on one or more related data-areas describing 10 inter-related components: mission, goals, governance metrics, data rules, decision rights, accountabilities, controls, data stakeholders, data governance office and data stewards (Thomas, 2006). The framework recommends establishing "universal objectives" to enable better decision-making and to ensure transparency of the data management process.

The framework is useful for data protection and managing data capture, storage and usage in the right context. However, the framework considers the role of management and organisational structure as outside components in the data governance lifecycle.

IBM's Information Governance Framework

IBM's framework for information governance assesses the current state of information system and the desired future state of maturity (Soares, Deutsch, Hanna, & Malik, 2012). The framework relates information governance to high-level business processes where data is considered one part of the business system. The framework is composed of 11 disciplines of governance across four distinct focus layers.

The review of the literature has shown that no framework exists that addresses shortcomings listed above; that is, no available framework to model IKM processes and structure within the context of indigenous knowledge governance. Existing organisational KM frameworks mainly address the issue of managing explicit knowledge (data and information) while overlooking the unique features of IKMS that are based on implicit and tacit knowledge. In addition, we note that previous knowledge management research has focused on the design and development of conceptual models, and not implementation of these models.

Limited attention has been directed at how the frameworks and models are implemented and validated, such as in the case of World Bank's Framework for Action and Virtual Repatriation programme. The same has been reported by Zent (2009).

Research Problem

Development organisations acknowledge and recognise the role of IK as a solution to local problems. A wide range of ICT tools has been developed for management of this highly valued resource. However, several researchers highlighted the challenges that the technology can raise in managing IK (Oppenneer, 2008). IK takes predominantly tacit and implicit forms, locked in the community's activities and governed by social and cultural frameworks. The use of ICTs for IKM can cause problems when IK is de-contextualised, extracted from living and holistic local systems, and stored as data.

In addition, Western cultural values, which tend to be embedded within the technology, can dominate the values, social and cultural systems and communicative preferences of indigenous peoples (Winschiers-Theophilus et al., 2012). Hence, technology and database management should only be seen as supportive elements or mechanisms in a wider system of IK governance that includes the application of customary laws, institutional authority and structures, and collaborative activity mechanisms in the community where technology is deployed. In order to design appropriate ICT tools for IKM, ICT professionals need to understand the holistic indigenous knowledge management system and then use this understanding as a basis for ICT-based IKMS' design and approaches.

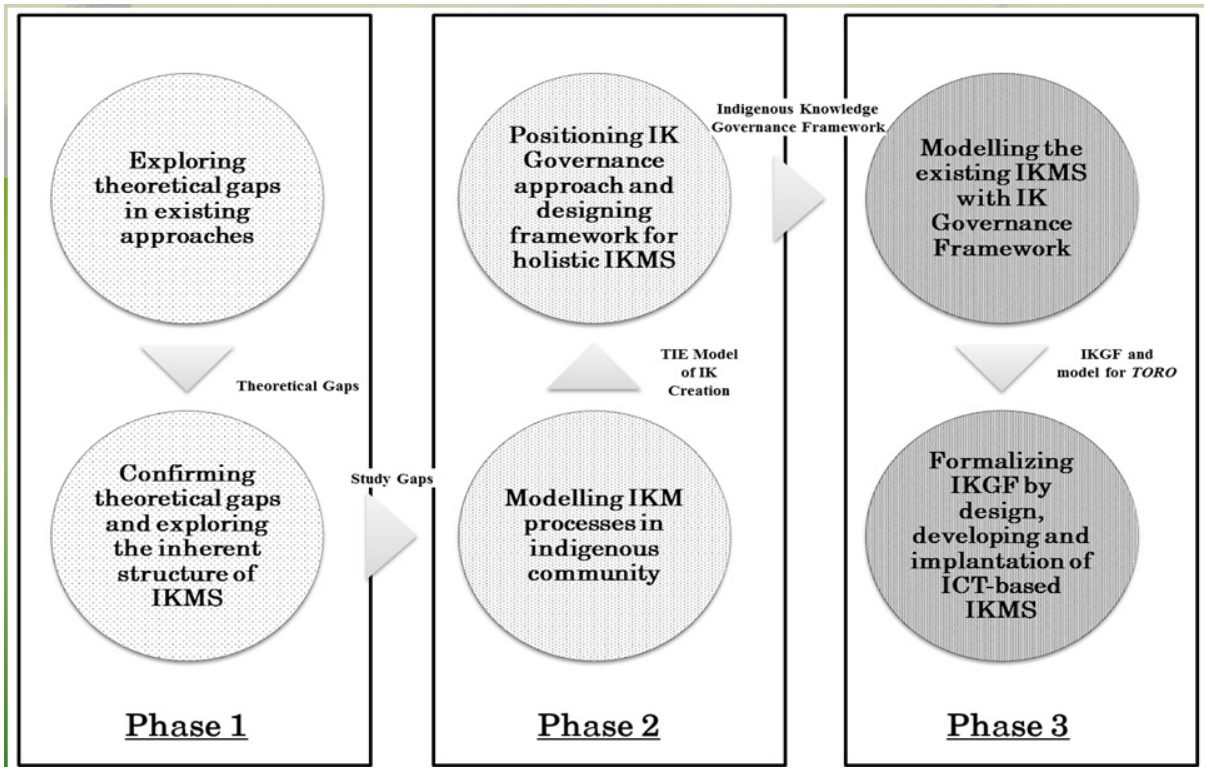
The Research Sites

The study was conducted in two remote sites of Sarawak in East Malaysia: Long Lamai, a Penan settlement, and Bario, a Kelabit settlement. Sarawak is situated on the northwest of the island of Borneo. Indigenous peoples – collectively known a *Dayaks* - comprise two-thirds of Sarawak's population (Ngidang, 2005). Many, distinct ethnic groups exist in Sarawak, including the Penan and Kelabits. These two sites were chosen largely because Universiti Malaysia Sarawak (UNIMAS) maintains a research collaboration and development partnership with Bario and Long Lamai communities.

Research Methodology

The research methodology and operationalisation process (Figure 1) is divided into three phases. In Phase 1, we conducted a literature review and collected the empirical data to discover exist-

Figure 1. Research operationalization



ing theoretical gaps among studies of IKMS. In Phase 2, we addressed the gaps by designing and modelling the indigenous knowledge management processes and the indigenous knowledge governance system. In Phase 3, we used the framework to model an existing community IKMS and then formalised the framework by using it as a base for the design, development and implementation of ICT-based IKMS.

Phase 1: Exploring Theoretical Gaps

The Phase 1 comprises of through literature review and field study to explore the research and study gaps. In this phase, literature review has been conducted to explore the theoretical gaps in existing literature. The review found a gap at epistemological level in defining IKM. The current definitions tends to de-emphasise the comprehensive process oriented IKM and mainly focuses on the processes of "capturing" and "distribution" while undermining IK creation process (Yeo, Zaman, & Kulathuramaiyer, 2013). The approaches also reflected in the digital technology designs. As noted by Agrawal (2002) the main aim of the IKM databases is to "collect" and "distribute" available information.

Based on the Burtis (2009); Ngulube (2002) and Velden (2010), we identified the influencing factors that's should be considered and addressed by the researchers and softwareware engineers while developing a digital solution for IKM. The focus of software system for IKM should be extended to incorporate complex issues of IK ownership, intellectual property rights legislation, cultural protocols and technical issues in the form of choice of media and access at the project planning level.

The second part of the first phase explores the study gaps by observing a case study from the field and to develop a methodological approach to reveal the inherent structure of IKMS

in indigenous community of Bario (Yeo, et al., 2013). The study confirms that the knowledge creation process is arguably the most important step in IKM processes. It is highly rated by the respondents from the Bario community. The study also reveals that the organisation's KM tools and frameworks cannot be used in the existing shape for IKM because of the differences between indigenous and non-indigenous knowledge domains. The study highlights the important role of community's governance structure in information dissemination, resources allocation and coordinating community's collective activities. The results reveal that in Bario community, the information communication and access is closely linked with the relationship and role of information seeker in the local governance institutions. The results of the study also argue that there is a need to incorporate the knowledge of modern legal system with access to expertise of indigenous customary, statutory and religious systems of governance. The study highlights the features that are not taken into account in the conventional approaches of designing ICT tools and frameworks for IKM. These features include the indigenous governance system, organisational structure, the protection of IK and resource management, and collective community activities.

Phase 2: Positioning Indigenous Knowledge Governance

As explored in Phase 1 of the study, the recent wave of research undermines the knowledge creation process in indigenous communities which is an important and well established area of research and development in organisations. The ultimate effect is that software engineers focus on the "dissemination" and "storage" processes while neglecting the "living" characteristic of IK. In this phase first, we delineate in more detail the knowledge creation process in indigenous communities and present it as a "living system". A living system is one that constantly creates new knowledge, closely connected to day-to-day activities and social systems and is reflected upon before acceptance and assimilation. Furthermore, we outlined the community's engagement process with new information and know-how and present Tacit, Implicit and Explicit (TIE) model of knowledge creation in indigenous communities (Zaman, Yeo, & Kulathuramaiyer, 2011a). The TIE model emphasises on community's activities as part of IKMS process and highlights the need to address it in ICT-based IKMS project design. The concept of embedding ICT-based IKMS as part of the existing IKMS will enhance the relationship between knowledge forms (tacit, implicit and explicit) and community activities and ultimately will address the problems related to IK de-contextualisation and storage of IK as a cultural fossil.

In second part of the Phase 2, we expanded the scope of indigenous knowledge management with notion of indigenous knowledge governance. In indigenous way of life, communities govern their knowledge by coordinating activities that are influenced and controlled by social and cultural systems. In this context, IK represents a critical resource that needs to be focused towards specific processes and governance activities. From our literature review, we found the definition of indigenous data and information governance and we explored the lack of definition for indigenous knowledge governance. To address this gap, we presented the definition of indigenous knowledge governance (IKG) as the system of governance comprises of people, processes and technology used to formally manage and protect structured and unstructured indigenous knowledge assets to guarantee commonly understood, correct, complete, trusted, secure and findable information throughout the indigenous community.

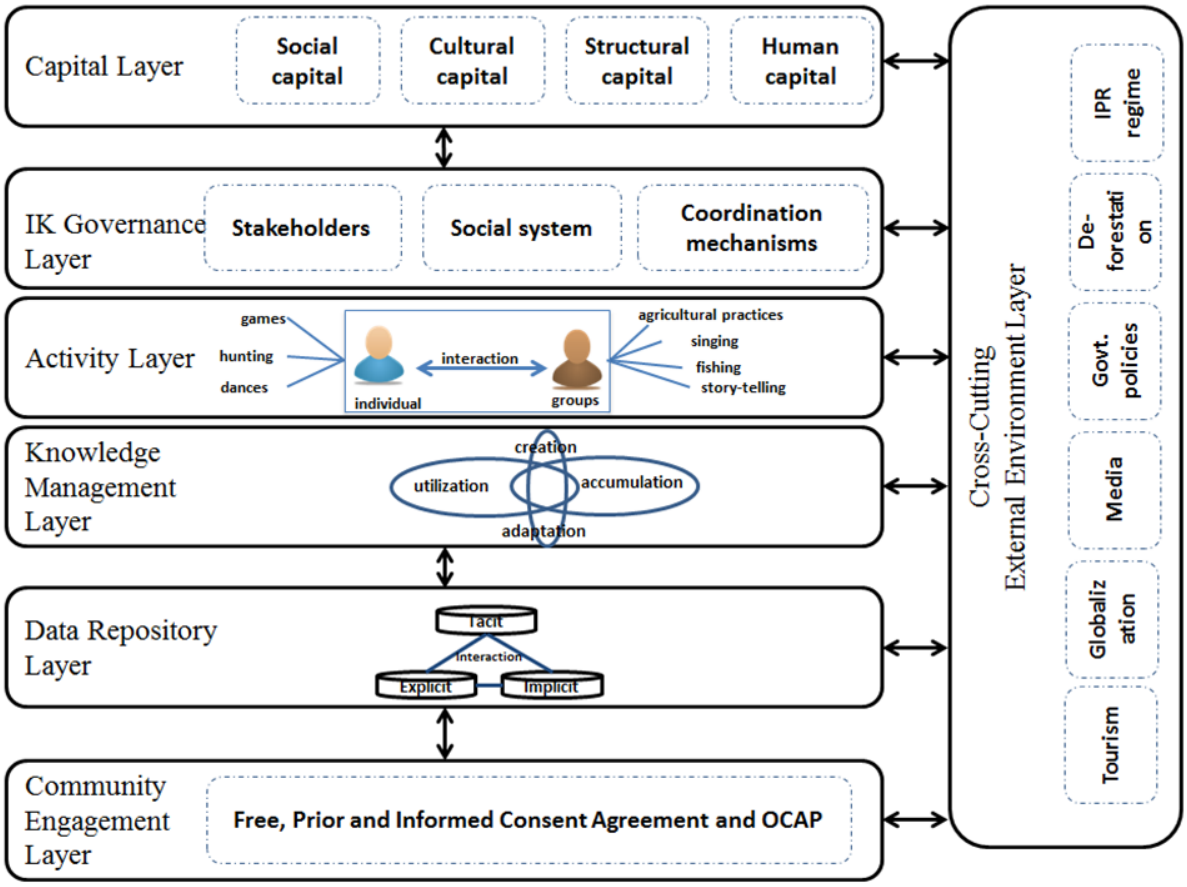
IKG concept covers the governance of both structured and unstructured knowledge assets simultaneously. The structured assets include data and information while unstructured assets include activities and the social and cultural context. After

defining IKG, we modelled the IKM processes and structure within the context of indigenous knowledge governance and presented indigenous knowledge governance framework as a holistic model of indigenous knowledge management (Zaman, Yeo, & Kulathuramaiyer, 2011b).

The standard IKGF (Figure 2) is an abstract model of IKM system contains the set of cooperating components that are grouped into seven layers Capital Layer; IK Governance Layer; Activity Layer; KM Layer; Data Repository Layer; Community Engagement Layer; and Cross-Cutting External Environment Layer.

The holistic nature of the framework is reflected in inter-linked and inter-dependent connection of the various layers of the model. Main layer of the framework is governance layer which comprises of three components; stakeholders, social system and coordination mechanism. The second layer is activity layer. The activities on communal and family level are the key drivers of indigenous knowledge management in these communities. While performing these activities the community exercises different knowledge management processes i.e. singing songs or telling stories are the normal activities of the community celebrations. While singing song or telling stories they do exercise the knowledge management processes (knowledge management layer). The data repository layer represents the community repository of experiences, poems, stories, folklores and songs. The community engagement layer indicates the

Figure 2. The logical architecture view of a layered IKGF (Zaman, et al., 2011b)



principles of data and information governance i.e ownership, control, access and possession (OCAP) (First Nations Centre, 2007) and free, prior and informed consent (FP&IC) (HREOC, 2009). The capital layer in the framework represents the outcome of the indigenous knowledge management system. The external environment layers highlights the external factors that effects on all or many components of the indigenous knowledge management system.

The model (Figure 2) explains the relationship between different components of indigenous knowledge management system and then structures the associated components in layers so researchers can better understand the complex IKMS.

Phase 3: Validating and Formalising IKGF

In this phase of the research, first we presented an explanatory case study of using IKGF as an analytical tool. In order to illustrate how IKGF can be used to represent the holistic IKMS model, we apply it to model Toro, a complex indigenous knowledge management system of the Penan community of Long Lamai in upper Baram of Sarawak.

Toro is a joint activity of a Penan family and also works as an activity-based knowledge sharing and mentoring journey in the forest that links community elders to members of the younger generations in grooming future guardians of the rainforest. Mentoring includes lessons on livelihood combined with a notion of stewardship, incorporating concepts of conservation ethics and ownership. Depicting the complex structure of Toro in IKGF layers model helps in understanding the holistic context of Penan's IKMS.

In second part of this phase, we formalise the framework by using it for designing, developing and implementing the eToro platform (Siew, Yeo, & Zaman, 2013). The eToro platform is a combination of software (for fata collection and content management system) and community activities to support the Indigenous Botanical Knowledge (IBK) of the Penan community of Long Lamai. The proposed framework has helped in developing a common understanding of software developers and community members (end-users) for planning, designing, developing and implementing ICT-based IKMS. From the researchers' perspective, a series of formalised methodology were identified. These are: (1) Designing Process Flow Diagrams in order to understand processes, roles, actions & rights of stakeholders; (2) Developing Cultural Protocols for community, researchers and data engagement; (3) Designing Data Instruments for eliciting community needs and acquisition of eToro; (4) Developing Prototypes for digital data collection and indigenous content management and (5) Capacity Building Program for participatory digital data collection and processing (Zaman, Yeo, & Kulathuramaiyer, 2013). It is always difficult to translate social and the cultural aspects into ICT-based IKMS because of the complex context parameters and the difficulty of communicating the community perspective. To address this limitation, the IKGF can help in three important aspects: first, to identify the relation between the community coordination mechanism, governance system and activities. Second, to distinguish the parameters of social, cultural and governance context that sustains the overall IKMS. Finally, to develop the thorough understanding of community members (end-users) and researcher's perspectives of IKMS, focus on the broader outcomes and explore the relationship with external environment.

CONCLUSION

Based on the results of this research, IKM is a complex system that cannot be understood by examining individual parts (processes, data, activities, people, economic etc.) only. It is also about how these parts interact and combine to make a whole system. Whereas a wide range of

digital IKM tools have been developed, special attention has been given to use ICT for the management of this highly valuable resource. IK takes predominantly tacit and implicit forms, locked in the community's activities and governed by local social and cultural frameworks. The use of ICT for IKM, will create the problem of knowledge de-contextualisation by extracting IK from the living and holistic system and storing it as raw data. Furthermore, ICTs alone cannot provide all the answers or solutions to IKM, but it can be a part of the solution. In order to design an adequate ICT-based IKMS, a holistic approach needs to be adopted that accommodates the community communication pattern, social and cultural systems and governance mechanism.

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KEY TERMS AND DEFINITIONS

Bario: A Malaysian village located in the centre of the Kelabit Highlands in the northeast of Sarawak, very close to the international border with Indonesian Kalimantan, and 3280 feet above sea level.

Holistic: means system as a whole where all aspects of life are interconnected.

Long Lamai: A remote Penan village on the border of Kalimantan(Indonesia) and Sarawak (Malaysia).

OCAP: The principles of ownership, control, access and possession developed by First Nations to control the data collection processes in their communities.

Penan: The Penan are nomadic aboriginal people living in East Malaysia and Brunei.

TIE: Tacit, Implicit and Explicit forms of knowledge.