Faculty of Computer Science and Information Technology

INDIGENOUS KNOWLEDGE GOVERNANCE FRAMEWORK: A HOLISTIC MODEL FOR INDIGENOUS KNOWLEDGE MANAGEMENT

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INDIGENOUS KNOWLEDGE GOVERNANCE FRAMEWORK: A HOLISTIC MODEL FOR INDIGENOUS KNOWLEDGE MANAGEMENT

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CERTIFICATE

This is to certify that the thesis entitled, **"Indigenous Knowledge Governance Framework: A Holistic Model For Indigenous Knowledge Management"** submitted by **Mr. Tariq Zaman** for the award of **Doctor of Philosophy (PhD)** Degree at the Universiti Malaysia Sarawak (UNIMAS), Sarawak, Malaysia is an authentic work carried by him under my supervision and guidance.

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AUTHOR'S DECLARATION

I declare that the work in this thesis was carried out in accordance with the regulations of Universiti Malaysia Sarawak. It is original and is the result of my work, unless otherwise indicated or acknowledged as referenced work. This thesis has not been submitted at Universiti Malaysia Sarawak or to any other academic institution or non-academic institution for any other degree or qualification.

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ABSTRACT

Development organisations acknowledge and recognise the role of Indigenous Knowledge (IK) in solutions to local problems. It is a resource that can help produce more and better food, maintain healthy lives, share wealth, prevent conflict, manage local affairs, and thus contribute to global solutions. As a wide range of digital tools have been developed, researchers and development experts are focusing on how to use information and communication technologies (ICTs) to manage this highly-valued resource. Indigenous knowledge mainly relies on tacit and implicit knowledge forms, which are deeply rooted in the social and cultural context of indigenous communities. However, ICTs for Indigenous Knowledge Management (IKM) have been designed using the conventional approach of creating and manipulating databases of knowledge. This typical approach of IKM generates the issues of indigenous knowledge governance, de-contextualisation and data manipulation. Hence, the main research question of the study is "*How can we introduce indigenous knowledge governance into ICT-based Indigenous Knowledge Management System (IKMS)?"*

The investigation was done in three phases: first, we explored the theoretical gaps and the inherent structure of indigenous knowledge management system in communities. Second, we addressed the gaps by modelling IKMS in communities and proposing a structured Indigenous Knowledge Governance Framework (IKGF). Third, we used the framework to model an existing IKMS and then validated the framework by using it as a base for design, development and implementation of ICT-based IKMS.

The thesis argues that *in order to design appropriate ICT tools for indigenous knowledge management, 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.*

ABSTRAK

Organisasi pembangunan mengiktiraf peranan Ilmu Peribumi (IK) dalam menyelesaikan pelbagai masalah tempatan, sebagai suatu sumber yang boleh membantu menghasilkan makanan yang lebih baik dengan kuantiti yang tinggi, mengekalkan kehidupan yang sihat, berkongsi kekayaan, mengelakkan konflik, menguruskan hal ehwal tempatan, dan seterusnya menyumbang kepada penyelesaian global. Manakala pelbagai alat digital telah dibangunkan, perhatian khusus telah diberikan kepada penggunaan ICT dalam menguruskan sumber yang sangat berharga ini. Pengetahuan Ilmu Peribumi sangat bergantung kepada bentuk pengetahuan tersirat dan berakar umbi dalam konteks sosial dan budaya masyarakat peribumi. Walau bagaimanapun, ICT untuk Pengurusan Ilmu Peribumi telah direka dengan mencontohi pendekatan konvensional dalam mencipta dan memanipulasi pangkalan data. Pendekatan biasa IKM menjana pelbagai isu tadbir urus ilmu peribumi, di nyah-kontekstualisasi dan manipulasi data. Oleh itu, soalan utama yang menggalakkan kajian ini adalah "Bagaimana kita boleh menggabungkan tadbir urus pengetahuan peribumi ke dalam Sistem Pengurusan Ilmu Peribumi berasaskan ICT (SPIPI)?" Kajian telah dijalankan dalam tiga fasa: pertama, kami telah meneroka jurang teori dan struktur yang ada pada sistem pengurusan ilmu peribumi dalam masyarakat. Kedua, kami mengenal pasti jurang-jurang ini melalui pemodelan IKMS dalam masyarakat dan mencadangkan Rangka Kerja Tadbir Urus Ilmu Peribumi (IKGF) yang berstruktur. Ketiga, kami menggunakan rangka kerja tersebut untuk pemodelan IKMS sedia ada dan kemudiannya merasmikan rangka kerja tersebut dengan menggunakannya sebagai asas untuk merekabentuk, membangun dan melaksanakan IKMS berasaskan ICT. Tesis ini berpendapat bahawa *untuk merekabentuk alat ICT yang sesuai untuk pengurusan pengetahuan asli, tenaga kerja ahli teknologi maklumat yang profesional*

memahami, sistem pengurusan ilmu peribumi yang holistik dan kemudian menggunakan kefahaman ini sebagai asas bagi mrekabentuk teknologi dan pendekatan.

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LIST OF ABBREVIATIONS

Abbreviation	Word
APQC	American Productivity & Quality Center
CSCCP	Culturally Sensitive Collections Care Program
DGI	Data Governance Institute
FP&IC	Free, Prior and Informed Consent
IBK	Indigenous Botanical Knowledge
iCMS	indigenous Content Management System
ICT	Information and communication Technology
IK	Indigenous Knowledge
IKG	Indigenous Knowledge Governance
IKGF	Indigenous Knowledge Governance Framework
IKM	Indigenous Knowledge Management
IKMS	Indigenous Knowledge Management System
IP	Intellectual Property
IPR	Intellectual Property Rights
ISITI-CoERI	Institute of Social Informatics and Technological Innovations-Centre of Excellence for Rural Informatics
IT	Information Technology
JDBC	Java Database Connectivity
JKKK	*Jawatankuasa Kemajuan dan Keselamatan Kampung* (Village's Development and Safety Committee)
KGA	Knowledge Governance Approach
KM	Knowledge Management

KMAT	Knowledge Management Assessment Tool
KMD	Knowledge Management Diagnostic
NMAI	National Museum of the American Indian
OCAP	Ownership, Control, Access and Possession
ODK	Open Data Kit
SDLC	System Development Life Cycle
SECI	Socialization, Externalization, Combination and Internalization
TEK	Traditional Ecological Knowledge
TIE	Tacit, Implicit and Explicit
TKDL	Traditional Knowledge Digital Library
TKRC	Traditional Knowledge Resource Classification
UNESCO	United Nations Educational, Scientific and Cultural Organization
UNIMAS	Universiti Malaysia Sarawak
XML	eXtensible Markup Language

LIST OF JOURNAL PUBLICATIONS, CONFERENCE PROCEEDINGS, PRESENTATIONS AND AWARDS

Journal Papers

- **Zaman, T.,** Kulathuramaiyer, N., & Yeo, A.W. (2013). Knowledge Management in Nonprofit Settings: A case study of indigenous knowledge management. *International Journal of Public Administration in the Digital Age (IJPADA) (accepted)*
- Yeo, A. W., **Zaman, T.**, & Kulathuramaiyer, N. (2013). Indigenous Knowledge Management in the Kelabit community in Eastern Malaysia: insights and reflections for contemporary KM design. *International Journal of Sociotechnology and Knowledge Development (IJSKD), 5*(1), 23-36. doi: 10.4018/jskd.2013010103
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- **Zaman, T.,** Yeo, A. W., & Kulathuramaiyer, N. (2013). Tacit-Implicit and Explicit Model of Knowledge Creation. In N. J. Bidwell & H. Winschiers-Theophilus (Eds.), *Indigenous Knowledge Technology Dialogues: Embracing Indigenous Knowledge in a New Technology Design Paradigm* (editing stage)
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Conference Papers (Equivalent of Journal): Refereed Full Paper

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- **Zaman, T.**, Yeo, A.W., & Kulathuramaiyer, N., (2011). *Indigenous Knowledge Governance Framework: A holistic model for indigenous knowledge management,* First Computer Human interaction, Culture and Design (CHICD) Workshop 13-14 February 2012, Universiti Malaysia Sarawak.

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- **Zaman, T.**, Yeo, A.W., & Kulathuramaiyer, N., (2011). *Indigenous Knowledge Governance Framework (IKGF): A holistic model for indigenous knowledge management.* In Conference on IT in Asia 2011. Kuching: Faculty of Computer Sciences and Information Technology, Universiti Malaysia Sarawak.

Other Publications

- **Zaman, T.**, Yeo, A.W., & Kulathuramaiyer, N., (2012). eToro: Tools and Strategies for Managing Penans' Indigenous Botanical Knowledge. Outreach: UNIMAS research bulletin, 8 (1) pp. 22.

Awards

- **2013 Information Society Innovation Fund (ISIF) Asia Award** under the category "Innovation on access provision" in the Internet Governance Forum 2013, Bali Indonesia 22-25 October 2013
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- **Best Telecentre Innovation Award** for eBario Innovation Village in the Spark13 Conference in Granada, Spain on May 29, 2013.
- **Gold Medal** in UNIMAS R&D Expo (2013) for the project "eTORO: Formalising Indigenous Knowledge Governance Framework".
- **Silver Medal** in UNIMAS R&D Expo (2012) for the project "Indigenous Technological Innovation in Malaysia: Reducing vulnerability and marginalisation among Malaysia's indigenous peoples".

CHAPTER 1 INTRODUCTION

In the last two decades, development organisations and researchers made a major shift towards the recognition of the role of Indigenous Knowledge (IK) in solutions to local problems. Indigenous Knowledge is a resource that can help to produce more and better food, maintain healthy lives, to share wealth, prevent conflict, manage local affairs, and thus contribute to global solutions (Mkapa, 2004). A wide range of digital tools have been developed and cultural heritage institutions are exploring the use of Information and Communications Technologies (ICTs) for preservation and improving access to IK. The inherent structure of IK is different from organisations' knowledge management. However, ICTs for Indigenous Knowledge Management (IKM) have been designed using the conventional approach of creating and manipulating databases of knowledge (Velden, 2010). This typical approach of IK databases design thus fails to a large extent in serving the needs of indigenous communities, as it tends to alienate IK from the essential context (Velden, 2010; Winschiers-Theophilus, Jensen, & Rodil, 2012).

IK is often said to be practical (it is determined by immediate need and utility), local (only applicable in the setting in which it was developed) and contingent (context dependent) (Nakashima & Roué, 2002). Unlike the organisation's KM systems, Indigenous Knowledge Management System (IKMS) is unique, as it mainly relies on tacit and implicit knowledge forms, which are deeply rooted in the social and cultural context of indigenous communities (Hagar, 2003). Early efforts in IKM focused on developing technologies to store, capture, and distribute knowledge (Agrawal, 2002). The focus at present has shifted, however, to make explicit the tacit knowledge of individuals and to identify the specific features that can be applied more widely for effective development and environmental conservation. The current

epistemological approach of IK tends to de-emphasise the comprehensive "processual perspective" of IKM (for details on "processual perspective" of IKM see Section 2.4) and mainly focuses on the processes of "capturing" and "distribution". These 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.

Another problem with the existing approaches is the focus that is mainly on technology development rather than exploring and building upon the inherent structure of the existing system of IKM and addressing the challenges. The community's collective activities need to be treated as the essential part of IKMS, which then provide the context and enabling environment for knowledge processes. In addition, the control of activities is subjected to and governed by an integrated governance system based on local cultural and spiritual belief systems. The separation of IK from its context and enabling environment creates the problem of knowledge de-contextualisation: that is, the storage of IK as cultural fossils.

Hence, the main research question driving the study is "*How can we introduce indigenous knowledge governance into ICT-based IKMS?"* 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 (IKGF). Thirdly, we used the framework to model an existing IKMS and then validated the framework by using it as a base for designing, developing and implementation of ICT-based IKMS.

1.1 Background

IKM systems are different from modern organisational knowledge systems in many ways; therefore, they need to be managed differently (Stevens, 2008). Current technological trends

and developments have hardly been informed by indigenous and rural knowledge systems (Kapuire & Blake, 2011). Lack of understanding indigenous community's system, their knowledge perspectives and priorities lead to failures of IKM initiatives (Reo, 2011).

The unique features of IKMS are based on two basic system perspectives: "holistic" and "living" (Aikenhead & Ogawa, 2007; Berkes, 2008; Kargbo, 2006; McGregor, 2004).

1.1.1 Holistic Systems

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 locations, situations and cultural, social and historical contexts. The 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. Researchers have underscored the need for a holistic approach while dealing with IKMS; for example, Kargbo (2006) argues that in an IKMS, all elements of matter are interconnected and cannot be understood in isolation. Berkes (2008) presents IKMS as an integration of complex components such as local ecosystems, beliefs and spiritual insights as well as the social organisation of the community. Winschiers-Theophilus et al. (2012) accept "interconnectedness" and a "holistic view" as the key values in designing ICT tools for the African IKMS.

1.1.2 Living Systems

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. Another characteristic of this "living system" relates to knowledge creation and adaptation processes in IKMS. Indigenous communities position themselves in the context of the surrounding environment where they live (UNFPII, 2009). They rely on their knowledge system for solutions to survive in changing environments by inventing new practices and innovations (Macchi & Oviedo, 2008).

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 (Christie, 2004). In these approaches, the alien conceptualisation of data modelling has led to widening of the data divide and resulted in increased vulnerability of marginalised indigenous groups (Gurstein, 2011). For example, Benjamin et al. in their case study of *Bhoomi* program highlight adverse effects brought by the "Open Data Movement" (Benjamin, Bhuvaneswari, Rajan, & Manjunatha, 2007). The *Bhoomi* program created a computerised database of 20 million land records belonging to 6.7 million farmers at Karnataka through the gathering of the entire history of cropping patterns for the last twelve seasons. The study showed that open access to land records of the indigenous farmers communities could be misused by the upper-class, high-income groups and corporations who want to gain ownership of these land from the marginalised communities.

1.2 Research Problems

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.*

1.3 Research Objectives

Due to the constraints of IK de-contextualisation, current IKM software solutions either take a product-oriented view of information management or partial "processual perspective" based on a static model. According to Agrawal (2002), IKM efforts often develop technologies to store, capture, and distribute knowledge, while the social and cultural framework in which IKM processes occur is overlooked.

The prime objective of this research is to develop a holistic framework for IKM. The framework will help researchers and ICT professionals to understand the unique structure of IKM and accommodate it in the design and development of ICT-based IKMS.

The specific research objectives are as follows:

- To study indigenous knowledge management practices and to identify the unique features that influence IKM in communities
- To examine existing and related frameworks of KM, IKM and ICT tools in order to evaluate their relative strengths and weaknesses
- To explore the current structure of IK management and governance in communities
- To design a holistic framework for IKM
- To devise a methodology and validate the Indigenous Knowledge Governance Framework in supporting ICT-based IKMS

1.4 Research Questions

The research questions posed in this study are:

- How can we introduce indigenous knowledge governance into ICT-based IKMS?
- What are the unique features that need to be considered to design ICT-based IKMS?
- Do existing frameworks and ICT tools satisfy the unique structure of IKMS in indigenous communities?
- How can we model indigenous communities' knowledge management system?
- How can we design indigenous knowledge governance framework to better understand the holistic IKMS?

1.5 Research Operationalisation

The research operationalisation process (as shown in Fig. 1.1) is divided into three phases. In Phase 1, we conducted a literature review to discover existing theoretical gaps among studies of IKMS. Data from field work confirmed these theoretical gaps and enriched our understanding of the inherent IKM structure in indigenous communities. Issues discovered in Phase 1 include the epistemological problems arising from definitions of IKM, the lack of an integrated approach to assimilate community governance structures into ICT-based IKMS, and the lack of holistic framework that supports the community's view of digital content enabled with Intellectual Property Rights (IPR), protocols and the relationships between the existing IKMS and ICTs.

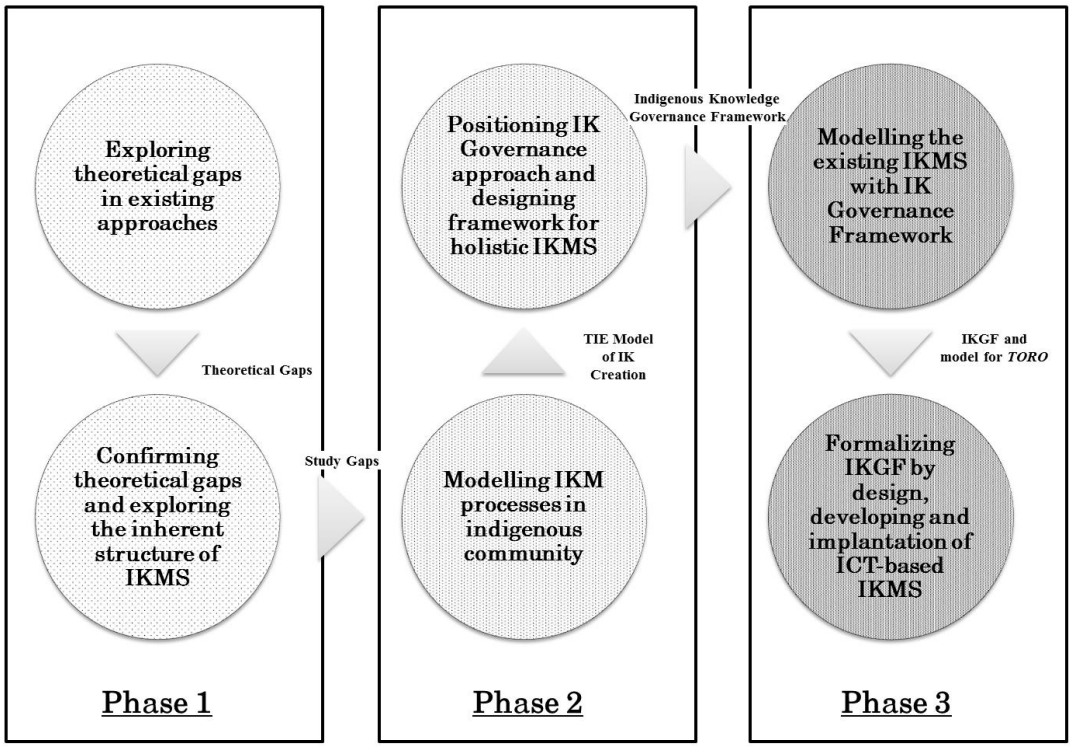

Figure 1.1: Research operationalisation

In Phase 2, we addressed the gaps by designing and modelling the indigenous knowledge management processes and the indigenous knowledge governance system. In the first part of

the phase, we presented the Tacit, Implicit and Explicit (TIE) model of knowledge creation process to address the epistemological problem with the definition of IKM, where the IK creation process is overlooked.

We also discovered that the IKM processes are highly influenced by the governance structure of indigenous communities; in the second part, we presented the indigenous knowledge governance approach and indigenous knowledge governance framework.

In Phase 3, we used the framework to model an existing community IKMS and then validated the framework by using it as a base for the design, development and implementation of ICT-based IKMS. The focus of this phase is to verify and evaluate the functionalities of the proposed framework by operationalising it in ICT-based IKMS.

1.6 The Research Sites

Research 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. The following section provides basic information about the selected research sites.

1.6.1 Bario

Bario is located at the interior parts of Baram basin and administratively is part of Miri Division. It is the regional centre and home of the Kelabit community, roughly 1,000

individuals. Bario can be reached by a one-hour Twin Otter plane flight from Miri. The majority of the community members are Christians with ages between 31 - 60 years old (Gnaniah, Yeo, Songan, Zen, & Hamid, 2004). The majority of community members are rice farmers living in multi-family longhouses. There are several shops, lodges, schools, a clinic and government offices such as Immigration, Agriculture, Forestry, Army and Police Post, built in Bario. Public utilities, such as 24-hour electricity supply and treated water are not available in Bario; the community relies on generator set and solar power to generate electricity for their basic needs. In 1999, UNIMAS initiated the multi-award winning eBario project with the aim to bridge the digital divide in order to stimulate socio-economic development in community.

Even though the Kelabits of Bario have gone through rapid social and economic change within a short span of 50 years, they have managed to maintain certain aspects of their indigenous lifestyle and culture, which are still unique, particularly their handicrafts, music and dance. Bario is famous for eco-tourism and Bario rice, "Bera Adan", which is regarded as one of the finest types of rice in Sarawak (Harris, Bala, Songan, Lien, & Trang, 2001). Bario was selected for this research study because the community is still practising their indigenous lifestyles (Harris & Harris, 2011), but are also adaptive to new practices and knowledge.

1.6.2 Long Lamai

Long Lamai is one of the biggest and oldest settlements of Penan in upper Baram, Miri Sarawak. Long Lamai is only reachable by flying from Miri to Long Banga and taking a one-and-half hour boat ride to Long Lamai. Alternately, one can drive eight hours along logging roads and hike an hour through dense forest. There are approximately 450 Penans living in Long Lamai. All of them are Christians. Most of the community (92%) are farmers. With

exception of *Irau Ajaú,* or the harvesting festival, the community does not presently celebrate other cultural or social festivals. The community is egalitarian in nature and strong community bonding is reflected in their daily activities and interactions. The community has very limited communication with the outside world and lacks basic health facilities. The village is a true picture of remoteness: it has no road access, no electricity, no proper water supply and no telephone connectivity. The available infrastructures at Long Lamai consist of a Penan school, a church and a Telecentre, *Ngerabit eLamai*. Ngerabit eLamai is one of the eBario replication sites under the UNIMAS research partnership. The only source of telecommunication at the village is the telecentre. It is equipped with three networked PCs, three laptops, a printer and a scanner. The telecentre also provides other facilities such as telephone connection, the Internet, printing and photocopying services.

1.7 Thesis Organisation

The thesis is structured as follows:

Chapter 1 presents the introduction to the research.

Chapter 2 covers the literature review and presents an overview of the previous research in the domain of IK and IKM and the initiatives and tools being developed for IKM. The chapter also highlights the factors of appropriate IKMS development and summarises the comparison of current approaches. The theoretical gaps are also identified, which include overlooking the knowledge "creation" process in the definition of IKM and the absence of a holistic framework to integrate community governance structure, collective activities, and knowledge resources with ICT-based IKMS.

Chapter 3 presents the assessment results of Bario community indigenous knowledge management system. The study employs a methodological approach to assess and uncover the

inherent structure of IKMS in communities and to initiate a dialogue between community members and researchers, so that researchers can develop an understanding of indigenous community's structures, communication patterns and the factors of appropriate IKMS development. The chapter also provides empirical evidence of strong knowledge creation processes and highlights the "living" characteristic of Kelabit community's IKMS.

To address the theoretical and study gaps, **Chapter 4** delineates in detail the knowledge creation process in indigenous communities and presents the conceptual tacit, implicit and explicit model of IK creation. The model is elaborated with the case study of Bario and Long Lamai communities' information exchange and knowledge creation.

Both Chapter 3 and 4 highlight the role of the governance structures in relation to IKM in indigenous communities. **Chapter 5** analyses the concepts of governance and data, information and knowledge governance and presents an indigenous knowledge governance approach and indigenous knowledge governance framework as a holistic model for IKM.

Chapter 6 elaborates on the components of IKGF and uses it as an analytical framework for understanding the Penan Toro activity from an IKM perspective.

Chapter 7 describes in detail the methodology to apply and validate IKGF in the design, development and implementation of ICT-based IKMS. The chapter also presents a case study of using IKGF for the development of eToro, a Penan ICT-based indigenous botanical knowledge management system.

Finally, **Chapter 8** summarises the conclusions and provides recommendations for future research.

1.8 Summary

Table 1.1 presents a structured overview of the thesis and depicts the relationship between the problem statement, research questions, objectives, methodology and results.

Table 1.1: Structured overview of the thesis

Research Problems	Research Objectives	Research Questions	Chapters	Outcomes
ICT professionals need to elicit, determine and analyse the unique features and structure of IKMS.	To study the indigenous knowledge management practices and to identify the unique features that influence IKM in communities.	What are the unique features that need to be considered to design ICT-based IKMS?	Chapter 2. Literature review.	Unique features identified.
			Chapter 3. Assessment of IKMS: case study of Bario.	Unique features of IKMS are confirmed by conducting field study.
Conventional approaches of IK storage in databases or online tends to erase the essential context in which IK is rooted.	To study and evaluate the existing and related frameworks of KM and IKM and ICT tools and determine the strength and weaknesses.	Do existing frameworks and ICT tools satisfy the unique structure of IKMS in indigenous communities?	Chapter 2. Literature review.	Theoretical gaps identified from literature.
			Chapter 3. Assessment of IKMS: case study of Bario.	Theoretical gaps confirmed by collecting and analysing the results of field study.
Formulate a holistic indigenous knowledge management framework that better reflects the system of IK governance.	To explore the current structure of IK management and governance in communities. To design a holistic framework for IKM.	How can we model an indigenous knowledge management system of communities?	Chapter 4. Modelling knowledge creation process in indigenous communities.	Tacit, Implicit and Explicit IK creation model.
		How can we design indigenous knowledge governance framework to better understand the holistic IKMS?	Chapter 5. Expending IKM framework with notion of indigenous knowledge governance.	Indigenous Knowledge Governance Framework.
			Chapter 6. Indigenous Knowledge Governance Framework: Case study of the Penan Toro.	Indigenous Knowledge Governance Framework for Toro activity.
Devise a methodology to validate the framework in the ICT-based IKMS that supports the IK governance in community.	To devise a methodology and validate IKGF in ICT-based IKMS.	How can we introduce indigenous knowledge governance into ICT-based IKMS?	Chapter 7. Validating IKGF: Case study of design, development and implementation of eToro.	eToro: Platform for managing Indigenous Botanical Knowledge of Penan.

CHAPTER 2 LITERATURE REVIEW

A need for a holistic approach to develop an Indigenous Knowledge Management System (IKMS) that addresses the unique aspects of Indigenous Knowledge (IK) has been identified. This chapter explores the theoretical gaps in this field of research and practice. The first part of the chapter describes the indigenous and non-indigenous researchers' viewpoints on IK and the differences between the domains of IK and organisational knowledge. The first part of the study focuses on to the need of Indigenous Knowledge Management (IKM), the use of Information and Communication Technologies (ICT) for IKM and highlights the "processual perspective" of IKM. The second part of the chapter explains two approaches: *knowledge-centric approach* and *knower-centric approach* by analysing the existing ICT tools developed for IKM. Based on the literature review, the final part of the chapter explores the factors of appropriate IKMS development, summarises the comparison of current approaches, and reveals the gaps in existing approaches.

2.1 Definitions of Indigenous Knowledge

Based on the existing literature, the term IK, Indigenous Technical Knowledge, Traditional Knowledge, Local Knowledge, and Traditional Ecological Knowledge (TEK), are used interchangeably (Mathias, 1996). "Indigenous knowledge" recently became a popular research topic in academic and development circles. However, defining and describing IK or establishing the research boundaries for studying the subject was not always an easy task (Hall, Dei, & Rosenberg, 2000). Different researchers have different definitions of IK. An interesting classification of these definitions is from the perspectives of Non-Indigenous vs. Indigenous

researchers (Mazzocchi, 2009). Indigenous researchers belong to indigenous or aboriginal communities. They actively use the strength of inherited indigenous wisdom along Western research frameworks and ideologies to position their indigenous concepts (Martin & Mirraboopa, 2003).

2.1.1 Non-Indigenous Viewpoint

Non-indigenous or Western researchers devised many terms to confine the concepts of indigenous people's knowledge. The most common term is Traditional Ecological Knowledge, which was frequently used in 1980s. However, a universally-agreed definition is still not available. Therefore, it is important to consider the implications carried by each of these different terms.

For example, the word "traditional" is normally misapprehend; "traditional" knowledge is regarded as static and archaic forms of knowledge (Hawley, Sherry, & Johnson, 2004).

The term "indigenous" narrows the scope of TEK to the knowledge of "indigenous" dwellers of a locality: it excludes extensive environmental knowledge of other community groups, such as (non-indigenous) farmers, fishermen and health practitioners. The classification of "indigenous" itself is often problematic, as exemplified by the work of Nakashima and Roué (2002), which raises questions concerning the use of the term "indigenous" such as "who is indigenous?" and "who is non-indigenous?"

Some researchers prefer the term "local"; however, this term is weak because it lacks specificity. "Local" is a general term. Most knowledge could be labelled "local" (Nakashima & Roué, 2002).

Finally, the term "ecological" itself seems to limit the scope of IK especially when "ecology" is defined within a Western perspective with a lesser emphasis on relatedness between the social,

cultural and environmental dimensions (Berkes, 2008). IK cannot be separated from certain spiritual, social, cultural and linguistic frameworks.

2.1.2 Indigenous Viewpoint

Indigenous researchers consider IK as a way of life rather than just "knowledge". According to Deborah McGregor, an *Anishinaabe* scholar from First Nation in Canada:

> *"This knowledge I call Indigenous Knowledge...is not just "knowledge" per se. It is the lives lived by peoples and their particular relationship with Creation. In conventional Eurocentric definitions of Indigenous Knowledge, it is presented as a noun, a thing, knowledge; but to Indigenous people, it is much more than knowledge. Indigenous Knowledge cannot be separated from the people who hold and practice it, nor can it be separated from the land/environment/Creation…We have to remember who we are. We have to invest in learning all aspects of our knowledge, including processes (how we come to know, through stories and experiences), places (in our communities, on the land), products (the knowledge itself), and people (our own personal development for fulfilling our vision/responsibilities): We have to tell our version of this story"* (McGregor, 2004).

For this research we adapted Berkes (2008) definition of TEK (or IK) as;

> *"a cumulative body of knowledge, practices and beliefs of specific group of people, evolving by adaptive processes and handed down through generations by cultural transmission, about the relationships of living beings (including humans) with one another and with their environment".*

The definition highlights two important aspects of IK: first the social and cultural system where the knowledge resides, and second, the adaptive nature of IK. Detailed discussions on these aspects are presented in the subsequent chapters.

2.2 Distinguishing Indigenous Knowledge from Non-Indigenous Knowledge

Currently, no simple or common criterion exist to separate IK from non-indigenous knowledge (Agrawal, 2002). Western science defines knowledge as experimental (deductions from hypotheses are tested), systematic (results can be replicated) and universal (results are independent from context, as variables are isolated and controlled) while IK is often said to be practical (determined by immediate need and utility), local (only applicable in the setting in which it was developed) and contingent (context dependent) (Nakashima & Roué, 2002). Table 2.1 illustrates the different orientations between IK and modern organisational knowledge.

Table 2.1: Indigenous knowledge compared with modern organisational knowledge (Addom, 2010)

Features	**Indigenous Knowledge**	**Organisational Knowledge**
Relationship	Subordinate	Dominant
Communication	Oral	Literate
	Teaching through doing	Didactic
Dominant Mode of thought	Intuitive	Analytical
Characteristics	Holistic	Reductionist
	Subjective	Objective
	Implicit/Tacit	Explicit/Codified
	Experiential	Positivist

2.3 Why Study Indigenous Knowledge?

In the last two decades, indigenous knowledge has been recognised as a key element of social and economic development (Yokakul, Zawdie, & Booth, 2011) and a valuable science (Kapoor, 2011). We conclude three major reasons for this shift.

The first is the failure of Western science in providing solutions for environmental degradation. Hall et al. (2000) argued that the recognition of modern scientific knowledge does not always provide the best solution of the environmental problems. People consider the wisdom of IK as an alternative to Western science in addressing ecological concerns.

The second is the role of indigenous communities in the discovery of new drugs and medicinal plants. Schultes (1979) proclaimed that the Amazon forest constitutes "an untapped emporium of germplasm" and proposed that indigenous people should be considered as a kind of rapid-assessment team that could help to locate the most promising plants for scientific evaluation. For example, Sarawak Biodiversity Centre engaged local communities in performing biological standardisation on collected plants. They found that more than 35% of the collected species showed good activity against cancer cell lines (The Star, 2006).

The third reason indigenous knowledge has been valued recently is due to the rapid extinction of indigenous cultures and the threats to IK itself. Stevens (2008) argues for the urgent need to document the disappearing IK in order to avert a "serious economic and scientific loss for mankind". IK is also an important part of humankind's cultural heritage (Mazzocchi, 2006), hence many initiatives of IKM have been started by development practitioners, governments, non-government organisations, researchers and even by the local indigenous communities themselves.

The efforts of the development community and researchers for recognition, documentation and preservation of IK have been largely fruitful, but encountered challenges such as the issues of knowledge governance and biopiracy. The commodification and exploitation of IK by pharmaceutical companies have challenged indigenous people's perceptions of "IK as collective goods and for the benefit of all". For examples, according to Posey et al. (1990) these companies make $85 billion profit annually from the medicinal plants first known to indigenous peoples for their healing properties, and returned only a minuscule proportion (less than 0.001%) of profits to the indigenous peoples.

2.4 Indigenous Knowledge Management: The Processual Perspective

In last two decades, several IK documentation practices regarded IK as a "cultural fossil" that could simply be archived. Hence, many researchers suggested to emphasise holistic structures of IKMS instead of considering IK as a static resource seized in time and place (Christie, 2005; Verran, 2005). One of the interesting concepts is Zent's (2009) "processual perspectives on indigenous knowledge" that mainly deals with the aspects of - creation, transmission, transformation, conservation, and loss - of IK. We performed a systematic review of the literature to elucidate the definition of IKM that highlights the holistic processual perspective. The only related definition that we found is Mearns and Du Toit's (2008) definition;

> *"Indigenous knowledge management is the process of **capturing** a community's collective experience, whether it resides in customs, traditions or in individual's head and subsequently **distributing** it to wherever it has the biggest payoff for the benefit of the community and society at large".*

The definition covers the two processes of IKM ("capturing" and "distributing") and overlooks community creative expressions and practices of innovation. Knowledge creation is arguably the

most important step in knowledge management processes, as the management (control) of knowledge is impossible without first creating it (Puga & Trefler, 2003). Indigenous communities rely on their knowledge system for solutions, and by inventing new practices and innovations their knowledge system survives in a changing environment (Macchi & Oviedo, 2008). According to Hammersmith (2009) the IK systems are innovated from within and they also internalise, use and adapt external knowledge to suit the local situation. Hence we enhance the scope of Mearns and Du Toit's (2008) definition by accommodating the processes of "creation" and "adaptation" and present IKM as "*a living model that describes the processes of accumulation, adaptation, creation, and utilisation of the community's collective or individual's IK"*.

2.5 The Use of Information and Communication Technologies for Indigenous Knowledge Management

Velden (2010) discusses the direct relationship between the term "Indigenous Knowledge Management" and the digitisation efforts of IK. Over the past two decades and with the evolving concepts of IKM, researchers, development organisations and even indigenous communities are exploring digital technology and techniques to codify and improve access to IK (Dyson, Hendriks, & Grant, 2007; Holland & Smith, 2000). ICTs provide many opportunities to codify and make explicit non-codified tacit knowledge and then disseminate it through various forms of expression such as pictures, audio and videos. There are many examples of using ICTs for revitalization of indigenous languages and preservation of cultures and knowledge (Edwin, Yeo, Juan, & Chin, 2010; Keegan, Keegan, & Laws, 2011; Martín & Cortés, 2010; Nickerson & Kaufman, 2005). ICTs address the physical and communication constraints as well as facilitate

the emergence of global networks. For example, UNESCO has identified indigenous people's networks collaborating on the Internet across the globe. These networks use ICTs to strengthen and reinforce IK and provide more culturally-responsive learning resources and environments for their children (Resta, 2011).

Researchers also highlighted the challenges that technology can bring; instead of a silver bullet solution to cultural preservation, ICTs can be a double-edged sword for indigenous communities. Velden (2010) highlights how the expectations from digital tools such as database software for IKM are very high. Oppenneer (2010) warns that the use of ICTs for IKM can bring in a "computer-mediated colonialism". He also argues that Western cultural values, which are embedded within the technology, can dominate the values, social and cultural systems, and communicative preferences of indigenous peoples. According to Winschiers-Theophilus et al. (2012), for a major shift in the traditional Western conceptual framework of technology design for IKMS. The Western science paradigm should move beyond the approach of validating and integrating IK and towards embracing knowledge co-design and co-production in bringing researchers, scientists and indigenous knowledge holders together on an equitable and mutually-respectful basis.

We will keep these issues in mind – the potential role of ICTs for IKM as well as possible embedded social and cultural values of technology designs – as we review IKM initiatives and relevant literature in the following sections. In Sections 2.6 and 2.7, we will present a brief introduction and will discuss the structure of digital IKM initiatives. In Section 2.8 we will analyse the initiatives based on the factors of appropriate IKMS development that are extracted from Velden (2010), Burtis (2009) and Ngulube (2002).

We applied three conditions in the selection of case studies to be evaluated:

1. The research should be applied research. It should focus on impacts in the indigenous community where it is conducted.
2. The research should be replicated in different communities or tested in different knowledge domains in order to indicate the strength of the research methodology.
3. The selected case study should be applied ICT research with development and application of software tool as proof of concept to demonstrate the feasibility of proposed theoretical model.

The case studies are classified as knower-centric approach (product oriented view) or knowledge-centric approach (partial process oriented view). According to Velden (2002) knowledge-centric initiatives focus on the contents while knower-centric initiatives focus more on enabling environment in which knowledge can be shared in more informal ways.

2.6 Indigenous Knowledge Management with Knowledge-Centric Approach

Early initiators of IK initiatives took a knowledge-centred approach (partial process oriented view) where they collected and codified IK as digital data. These practices were designed and implemented in the same way organisations' knowledge management initiatives and traditional database approaches were designed. In the following sections we will review several representative case studies of the knowledge-centric approach.

2.6.1 World Bank's Indigenous Knowledge for Development Program

The Indigenous Knowledge for Development Program, started in 1998, was the response by the World Bank and partners (CIRAN/Nuffic, CISDA, ECA, IDRC, ITU, SANGONet, UNDP, UNESCO, WHO and WIPO) to clients and civil society who called for a more systematic

integration of IK in the development process. The program institutionalized a number of activities on IK, integrated this knowledge into Bank-supported programs and into national policies in more than 50 countries (Srikantaiah, 2008). The IK Program has developed a "Framework for Action" addresses the challenge of integrating IK into the development process. The Framework for Action comprises of four pillars:

a) Dissemination of knowledge and community-based practices;
b) Facilitating learning and knowledge exchange among communities;
c) Mainstreaming IK in national development policies and projects; and,
d) Building partnerships between local practitioners, community-based organisations, governments, donors, the global scientific community and other international organisations.

The Program has also developed a number of tools and services to record and disseminate IK practices including the creation of a web database of over 300 indigenous practices and the compilation of 60 IK Notes in a published book entitled Local Pathways to Global Development.

2.6.2 Best Practices on Indigenous Knowledge-UNESCO Program

UNESCO developed a database of 50 best practices from around the world on IK use in developing cost-effective and sustainable survival strategies for poverty alleviation and income generation in indigenous communities (Boven & Morohashi, 2002). Authors of the articles in the journal "Indigenous Knowledge and Development Monitor" were requested to convert their data into the format of a best practice to serve as case studies in the publication. We designed the flowchart (Fig. 2.1) to depict the process of selecting the best practices of IK for the UNESCO database.

A questionnaire was used to gather information in such a way that is compatible with the selection criteria of the case study as a best practice. In order to qualify as a best practice, the activity in question had to be evaluated both by independent experts and by the people directly concerned. If the evaluator needed more information about a proposed best practice, the contact person was requested to provide further information.

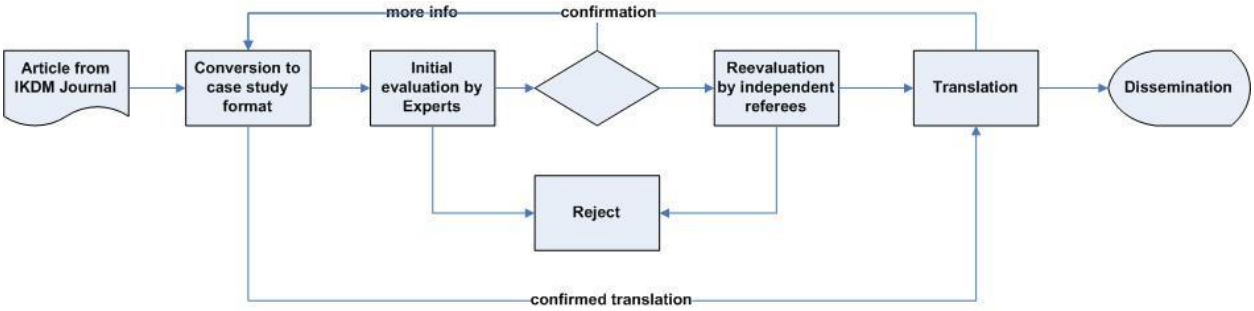

Figure 2.1: Flowchart for selection of the best practices

The description of the activity was then sent to one or more independent referees who are experts in a field relevant to the proposed best practice. Finally the practice went to a language editor. The translated version was then sent back to the contact person to make sure that the original intent had been lost in this process.

The case studies are disseminated by the publication Boven and Morohashi (2002), the journal "Indigenous Knowledge and Development Monitor" and available from the URL http://www.unesco.org/most/bpindi.htm. The publication notes that in the preparation of the questionnaire, their team was confronted with methodological constraints such as the conversion of IK practices into Western concepts of data classification (Boven & Morohashi, 2002). From the review of UNESCO program for the Best Practices on Indigenous Knowledge, we conclude that a systematic approach is needed even to highlight, evaluate and publish case studies of IK practices.

2.6.3 The Traditional Knowledge Digital Library India

The Traditional Knowledge Digital Library (TKDL) aims to digitise traditional Indian knowledge and facilitate the patent examiners in searching for relevant prior art. The project has been initiated by the National Institute of Science Communication and Information Resources (NISCAIR) and Department of Indian Systems of Medicine and Homeopathy India. The TKDL project has conducted the following major activities (Williams, Marburra, Guenther, Conatus, & Arnott, 2011);

- Created TKDL hardware and software platform for data entry.
- Digitised the text and image documents.
- Built a directory of Traditional Knowledge Resource Classification.
- Populated the database and hosted the database in the web portal.

The project uncovered numerous patented scientific discoveries connected to IK in some way that lacked attribution of sources. This effort uncovers mappings between so-called prior-art and their rightful source of origin.

The Traditional Knowledge Resource Classification (TKRC) of TKDL software (Fig. 2.2) converts the available documents of *Siddha, Unani, Yoga,* and *Ayurvedic* into multiple languages such as English, German, French, Spanish and Japanese.

The software developed does not perform transliteration but can complete smart translations and convert abstracted data into several languages by using Unicode, XML and Metadata methodology. The TKDL software also converts traditional terminologies into scientific terminologies: for example, *Jwar* to fever and *Mussorika* to small pox (Gupta 2005). At least 36 cases had been identified by the European Patent Office and 40 cases by United States Patent and Trademark Office utilising TKDL.

Figure 2.2: Screenshot of Traditional Knowledge Digital Library (Source: http://www.new.dli.ernet.in)

In the knowledge-centric approach, the main objectives of the projects are to share and preserve IK by disseminating the best practices and enabling the communities to have a say in how much information they want to share.

2.7 Indigenous Knowledge Management with Knower-Centric Approach

The knower-centric approach focuses on building networks to create an enabling environment for archiving, protecting, sharing and preserving IK. These initiatives deploy participatory multimedia technologies such as Web 2.0 applications to undertake collaborative efforts of digitising IK. In the following section we will review the selected initiatives and tools used in knower-centric IKM.

2.7.1 Virtual Repatriation - The Spiral of Knowledge Project

The virtual repatriation project is part of Culturally Sensitive Collections Care Program (CSCCP) program of National Museum of the American Indian (NMAI). This program was initiated in response to the demands by Native Americans to create a secure way to deal with culturally sensitive material and information in museum collections. NMAI maintains the catalogue of 800,000 cultural objects and 125,000 photographs; more than 2,000 items have been repatriated to Native Communities in the Western (Smithsonian Institution, 2012).

The technologies used in the virtual repatriation project facilitated the information communication and knowledge sharing between geographically dispersed indigenous groups. The project uses innovative high quality 2D and 3D scanners, collaborative interactive software tools, high-speed networks and emerging grid technologies.

Figure 2.3 depicts the IT workflow model of "spiral of knowledge project" that is a sub-component of the NMAI's project. The project helps the communities to access digital copies of the objects online and request access to and /or repatriation of the physical object.

To facilitate the process of communication between stakeholders, the NMAI project established indigenous knowledge centres with high-speed Internet facility. The numbers (1 to 7) in Figure 2.3 represent the stages within the NMAI's spiral of knowledge workflow.

The community members can request digital objects and associated information using XML (eXtensible Markup Language) packages. The packages contain structured data, which can be understood and uploaded to the databases within the local indigenous knowledge centres and further communicated to the NMAI.

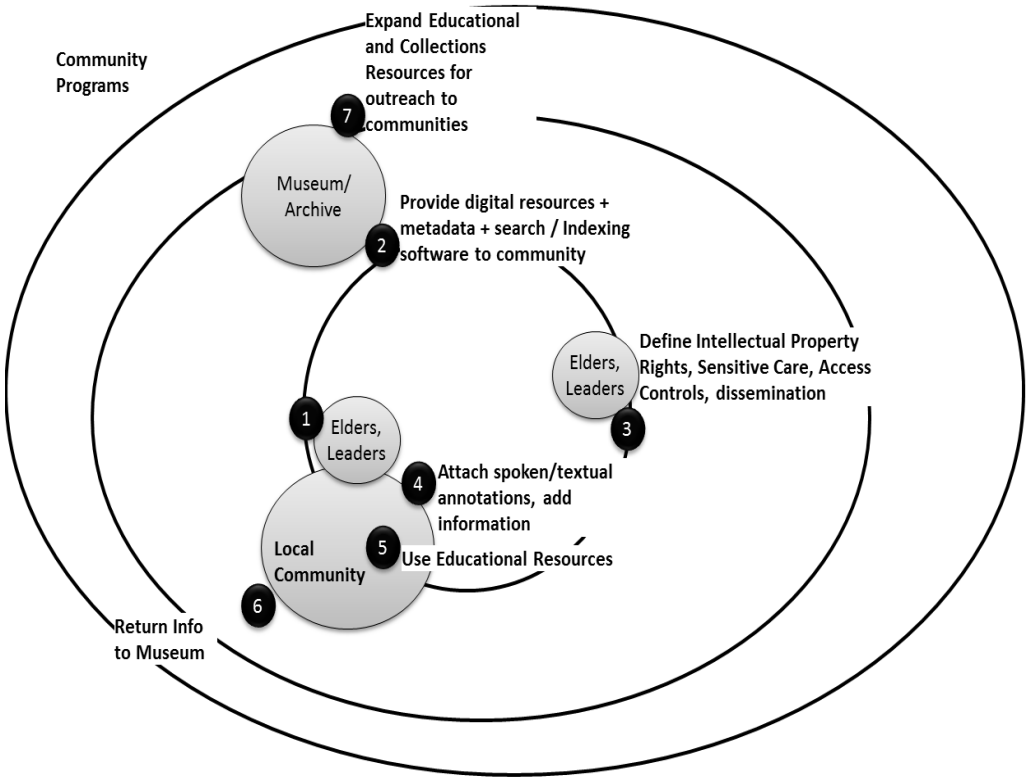

Figure 2.3: Information workflow for NMAI's Spiral of Knowledge project (Hunter, 2005)

After scanning the request, the digital objects that are available in the project database will be transferred over the networks to the local knowledge base in the indigenous knowledge centre. A further request of access to, and /or repatriation of the physical object can also be forwarded with the help of online system.

2.7.2 The IKM Software System

The IKM software system was developed by the School of Information Technology and Electrical Engineering, University of Queensland, Australia. The software is an open-source system that enables indigenous communities to develop and maintain their community knowledge base and define access controls and rights management according to their indigenous norms (Hunter, Koopman, & Sledge, 2003). In earlier stages, the software was developed and

tested in Virtual Repatriation projects and later replicated in other case studies such as biological and chemical sciences, eHealth and ethnography. The main objectives of the system are to preserve indigenous culture and to provide solutions for viewing digitised content and artefacts in alignment with indigenous customs and practices. The system contains three major components:

1. The Metadata Editor/Generator;
2. The Database;
3. The Search, Retrieval and Presentation Interface.

Figure 2.4 illustrates the interfaces of the above stated three components and tools used to build and integrate them into a single coherent system.

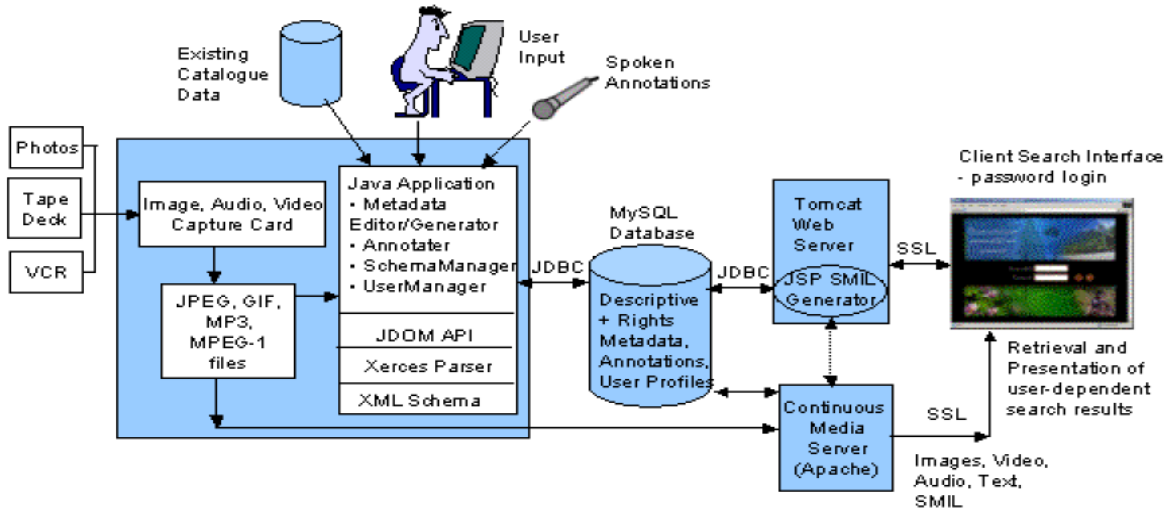

Figure 2.4: IKM system architecture and workflow (Hunter et al., 2003)

Users of the system require a login ID and password to run the software and the rights to use certain functionalities depending on privileges associated with their user profile. The Metadata Editor/Generator of the system enables users to input the descriptive, rights and tribal care

metadata associated with objects (either physical or digital) and to attach spoken or written annotations to specific objects.

The metadata is stored in relational tables in a MySQL database, which is connected through a Java Database Connectivity (JDBC) API. The software also features a search, browse and retrieval interface built using standard Web Browser technologies (Internet Explorer, Netscape). The IKM software system is mainly a secured web-based IKMS for searching, annotating, and storing multimedia collection of indigenous resources. The system provides user-directed content creation and metadata management. However, the technology is not adapted to cohere with indigenous governance system and control of the technology lies outside the community (though sensitivities are considered).

2.7.3 Ara Irititja Archival Project

The Ara Irititja Archival project was developed in 1994 by archival consultant John Dallwitz along with anthropologist Ushma Scales and *Anangu* school teacher Ron Lister (Ara Irititja, 2011). The main concern and motivation for the project was the preservation and repatriation of important historical records such as photographs, film videos, sound recordings, documents and artefacts that were removed from *Anangu* lands in north-western South Australia over many decades.

Ara Irititja is a multimedia cultural database of the visitors to the *Anangu* lands as well as an expanding database for local community to access and contribute their own records (Higgins, 2005). The interface design fulfils the requirements of users who may not be literate in English, have vision disabilities or command little familiarity with computing tools. The software created various classes of secure and restricted access to sensitive materials such as images of people recently deceased (Fig. 2.5).

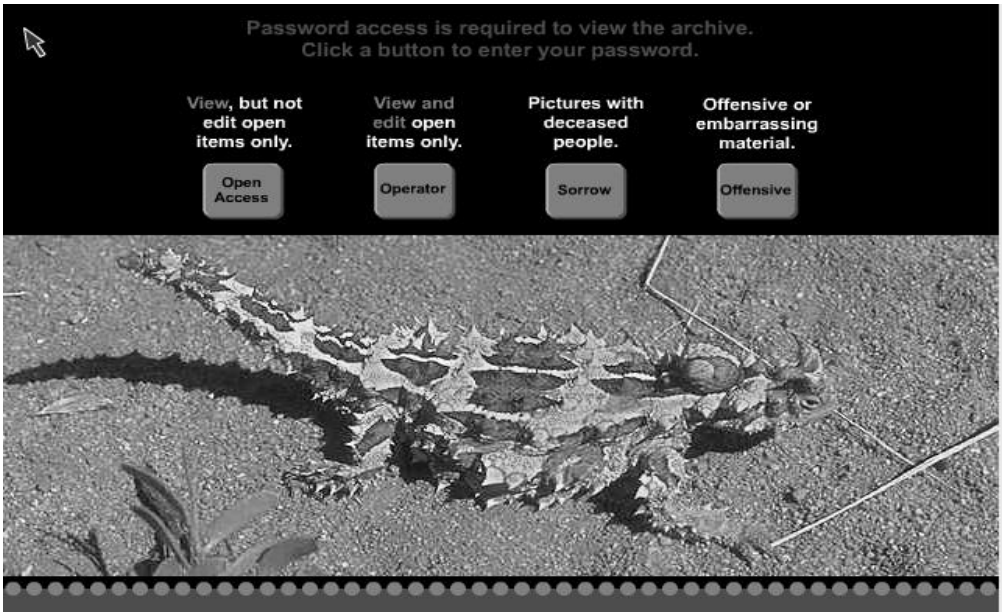

Figure 2.5: Front screen depicting restricted access to Ara Irititja database (Source: http://www.irititja.com/the_archive/demo/demo.html

In late 2010, the Ara Irititja software underwent a significant transition, migrating the large database record into a browser-based, cross-platform, multimedia KM system now known as Ara Irititja KMS (Ara Irititja, 2011)

The Ara Irititja project provides a proprietary solution to local IKM needs; however, the software license and training fee become an impediment for local communities to use it as IKM solution. The technical solution must be affordable, secure, easy to use and customizable.

2.7.4 The Mukurtu Wumpurrarni-Kari Archive

The Mukurtu Wumpurrarni-Kari Archive is an open source, cultural heritage, content management and archive software tool that has been developed out of a lengthy collaboration between Washington State University, USA and the *Warumungu* community of Tenant Creek, Northern Territory, Australia (Christian, 2005). The need for the archive and the software tools were first discussed in 2003, when a cultural centre was opened in Warumungu community and

the community members expressed concerns about repatriation of historical items for inclusion in the centre. The Mukurtu system allows storing digital copies of indigenous contents such as pictures, documents and artefacts. Artefacts have particularly deep social and cultural significance, so there is a need to deal with care and according to the cultural protocols that are associated with the artefacts. To respond the culturally-based protocol requirement, the Mukurtu system provides a login-based profile for the users and allows any community to define and redefine their own access and circulation protocols based on their own cultural norms and priorities. The access control of the users can be defined by community leaders and based on the community-driven narratives defined as "users stories" (Table 2.2).

Table 2.2: User story narratives for community Agile development of Mukurtu CMS (Christian, 2012)

As a . . .	**I want to . . .**	**So that . . .**
Tribal administrator	Define my own cultural protocols for the content uploaded into the archive	The content I upload is linked to parameters for access by members of the community, such as gender, clan, family group, elder, etc.
Tribal administrator	Link cultural protocols to groups in the community	Content that I upload is accessible by only the tribal members who have the matching user profile tags
Tribal administrator	Set up parameters for access to content in the archive	When individuals enter information about themselves, it matches with cultural protocols
Tribal administrator	Define access parameters for various types of users and groups	When I assign someone a status such as "tribal member," it is clear what permissions they have
Tribal administrator	Set up pages for individual tribal member in each of the families of the tribe	Each person can have a genealogical page where they can upload information about themselves and link content
Tribal administrator	Set up "collections"	Individual content can be grouped and viewed
Tribal administrator	Set licensing options	Each piece of content or collection is licensed either with traditional copyright, Creative Commons license, or a traditional license we define

In their profile, the users identify culturally-significant details about themselves, such as their family and country, which also determine their access right in the archive. When a new record is uploaded into the system, the community members decide on which restrictions should apply to that content and community leaders set the access rights for each new record.

Although the approach takes an administrative perspective, it is sensitive to tribal members' needs and allows the community to mobilize for collaborative user-directed and user-driven content development.

2.8 Factors of Appropriate Indigenous Knowledge Management System Development

We have identified eight factors (Table 2.3), which we consider to be crucial for development of appropriate IKMS and have been partially suggested in a variety of theoretical consideration (e.g. Burtis, 2009; Ngulube, 2002; Velden, 2010).

These factors should be considered and addressed by the researchers and ICT professionals while developing a digital solution for IKM. Mere software alone is not an adequate solution to IKM needs; the focus should be extended to incorporate complex issues of IK ownership, IPR legislation, cultural protocols and technical issues in the form of choice of media and access.

In addition, IKM systems are complex structures that cannot be understood by only examining the factors in isolation; these factors are closely interrelated and interdependent, so it is also important to examine how these factors interact and combine to make a whole system.

Table 2.3: Factors of appropriate indigenous knowledge management system development

Initiatives / Factors	Velden, (2010)	Burtis (2009)	Ngulube (2002)
Cultural protocols to protect • Customary rules • Spiritual values and • Belief	Yes	Yes	Yes
Community Ownership rights of • IK resources (IPRs) • Control external intervention	Yes	Yes	No
Community capacity building for • Understanding the basic ICT concepts as co-designers • Skills of ICT use for effective use of tools	Yes	Yes	No
Storage of IK resources • Web-based • Local repository	No	No	Yes
Data protection by addressing • Data vulnerability • Logical access mechanism • Physical control	Yes	No	Yes
Community Engagement • In all stages of system development lifecycle • By Free, Prior and Informed Consent agreement	Yes	Yes	No
Framework for conceptual modelling • Enabling community directed content management • Process management built into the community's knowledge management workflows	Yes		
Methodology to • Ensure technical solution with assimilative technologies align with community's governance structure			Yes

For example, community ownership rights can be protected by explicitly describing it in the cultural protocols whereby the community cultural protocols cannot be designed without the active participation and engagement of community members. Capacity building program will help community members to understand the potential role of ICTs for IKM and to take part as co-designers in the software development processes that deal with the issues of storage and data protection of IK.

In the next sections, Table 2.4 provides a summary of the comparison between the current approaches (discussed in Sections 2.6 and 2.7) based on the identified factors and we will briefly discuss each factor and the gaps in the existing solutions.

Table 2.4: The gaps that need to be addressed given current state-of-the art solutions for indigenous knowledge management

Initiatives / Factors	World Bank IK	UNESCO Best practices of IK	TKDL	Virtual Repatriation	The IKM Software System	Ara Irititja	Mukurtu
Cultural protocols to protect • Customary rules • Spiritual values and • Belief.	No	No	No	Yes	Yes	Yes	Yes
Community Ownership rights of • IK resources (IPRs) • Control external intervention.	No	No	No	No	Yes	Yes	Yes
Community capacity building for • Understanding the basic ICT concepts as co-designers • Skills of ICT use for effective use of tools.	Limited	Yes	No	Yes	No	Yes	Yes
Storage of IK resources • Web-based. • Local repository.	Web	Web	Web	Web	Web	Web	Web
Data protection by addressing • Data vulnerability. • Logical access mechanism. • Physical control.	No	No	No	Yes	Yes	Yes	No
Community Engagement • In all stages of system development lifecycle. • By Free, Prior and Informed Consent agreement.	No	No	No	No	No	No	No
Framework for conceptual modelling and • Enabling community directed content management. • Process management built into the community's knowledge management workflows.	No	No	No	No	No	No	No
Methodology to • Ensure technical solution with assimilative technologies align with community's governance structure.	No	No	No	No	No	No	No

Cultural Protocols

Cultural protocols are customary worldviews, principles or values, rules and codes of conduct, and established practices (Swiderska et al., 2009). However, external actors often do not understand the meanings of social context, customary protocols and governance systems of indigenous communities because they are codified in ways specific to each community, culture, and location. Failing to respect community protocols, whether intentional or not, can lead to conflict and negative impacts on the association between the external actors and community. To address this issue, indigenous peoples and local communities have begun to document and develop their protocols into forms that can also be understood by others. They are using these new forms to ensure that external actors respect their customary laws, values, and decision-making processes, particularly those concerning stewardship (Shrumm & Jonas, 2012).

The current approaches World Bank IK, UNESCO Best practices of IK and TKDL do not address the requirements of cultural protocols. Virtual Repatriation, IKM Software system, Ara Irititja and Mukurtu address it at the level of software system functionalities only (to restrict the access rights, for example).

Community Ownership Rights

Indigenous communities always face the threats of exploitation if they have no or passive participation in decision making process related to IK governance issues such as ownership of IK resources and research processes. In indigenous communities, the rights' regime and knowledge domain is divided into three groups: individual knowledge, community knowledge and public knowledge (Fig. 2.6) (Gupta, 2004).

The current IP regime established internationally by World Intellectual Property Organization is based on Western notions of individual property ownership and only recognises rights that

belong to individuals (a person or company as legal entity) who wrote, taped, painted, drew or filmed the IK (Janke & Dawson, 2012). Hence other kinds of resource regimes and knowledge domains (such as community knowledge) have not been formally recognized by modern IP regimes.

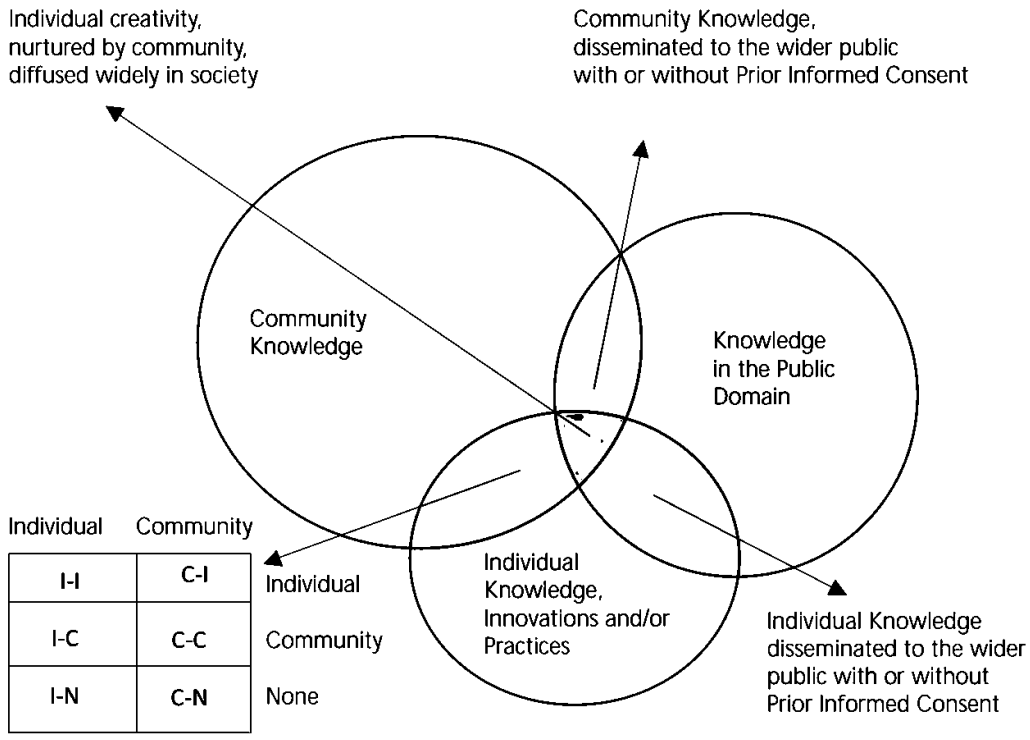

Figure 2.6: Contested domains of local knowledge (Gupta, 2004)

The second issue of IK ownership is related to the structure of IKMS. The existing IPR system is not appropriate for the protection of IK in its original undocumented tacit and implicit form (Nordin, Hassan, & Zainol, 2012). For example, the Pitjantjatjara Council took legal action against the author of the book "Nomads of the Australian Desert", which is based on anthropological data that they believe belongs to their community (Wyburn, 2010). They successfully restrained the publication although failed to secure the copyright, as none of the community members is author or co-authors of the book. To address these concerns, the National

Science Foundation (NSF) has emphasised the need to honour IPR of indigenous communities in all digital projects (Holland, 2002).

In terms of community ownership rights, the World Bank IK, UNESCO Best practices of IK, TKDL and Virtual Repatriation do not provide procedures for enforcement or exercise of these rights. The IKM Software, Ara Irititja and Mukurtu software systems provide access rights privileges and controls for exercising ownership rights, which help in cases when rights exist in explicit form.

Community Capacity Building

Community capacity-building needs to be developed in two stages: first, to address basic ICT concepts and the structures of the digital tools so the community can provide information and make informed decisions; second, to build the skills for using the IK system after the implementation. Previously, the IK digitisation process was conducted principally by outsiders, who often disseminated culturally sensitive materials. This exposure could lead to abuse of culturally-sensitive information by parties not intended to access it. Effective community capacity building is a key enabler of good IKM practices, in which community members can collect, record, and disseminate their own IK. The advent of new digital technologies helped democratize data collection, with individual users assuming the role of knowledge producers. This transformed the traditional system of division between those who produce knowledge (authors and editors) and those who use it (reader). However, studies still argue that indigenous communities must have trained IT human resource in their communities (Holland, 2002) so they can produce and contribute to ICT-based IKMS as well as become authors/collectors (copyrights holder) and active users of the digital collection.

The UNESCO Best practices of IK, Virtual Repatriation, Ara Irititja and Mukurtu stress community capacity building for IKM while World Bank IK only supports capacity building for knowledge exchange in partner communities. The TKDL and IKM Software system does not provide any capacity building training for the local community.

Storage

IK is embedded in the lives and daily activities of indigenous communities (Pettersen, 2011). Traditional approaches to IKMS focus on the codification and storage of IK as objects in databases and overlook communities' collective activity system. Communities' collective activities are the essential part of IKMS. They provide the context and enabling environment for knowledge processes. In addition, communities have an integrated governance system of cultural and spiritual beliefs that controls these collective activities. For example, some Aboriginal and Torres Strait Islander groups in Australia have songs for every occasion - hunting songs, funeral songs, gossip songs and songs of ancestors, landscapes, animals, seasons, myths and Dreamtime legends. But some music and songs can only be performed in special ceremonies, by special age groups or by gender (The Queensland Government, 2008). Hence, the separation process of IK from these communities' collective activities creates the threat of de-contextualisation and storage of IK as a cultural fossil.

Another issue is the physical storage of IK resources after documentation. Many international, regional and national archives apply web-based storage (*ex-situ*) solutions. Few researchers advocate for the storage of collected resources in local repositories and the placement in community centres where collections can be easily accessible and integrated into the existing KM systems (Goswami & Basu, 2011).

The projects World Bank IK, UNESCO Best practices of IK, TKDL, Virtual Repatriation, IKM Software System, Ara Irititja, and Mukurtu are using Web-based storage mechanisms where the data is physically stored on the servers placed outside the community.

Data Protection

The community's collective activities (such as ceremonies) provide the time and place where all people in an indigenous community work together to protect, maintain, and practice traditional customs to ensure the survival of IKMS. Cultural and spiritual beliefs often establish inherent security protocol systems, in which particular IK resources are individually owned or kept secure by specific members of a community. In Australian indigenous communities some individuals and families protect particular knowledge and have the responsibility of ensuring that those stories and knowledge are correctly remembered and passed on, and that rituals and ceremonies are correctly performed (The Queensland Government, 2008).

According to Dyson and Leggett (2006), the ICTs' design for IKMS should be based on indigenous community protocols, security concerns over who has access to secret or sacred knowledge, and IPR issues. Researchers should work together with community members to explore how local needs, communication norms, access and security concerns can be addressed with the appropriate digital tools.

Data presented in the World Bank IK and UNESCO Best practice of IK and TKDL projects is freely accessible and creates the risk of exploitation (Pettersen, 2011). The Virtual Repatriation, IKM Software System, Ara Irititja and Mukurtu provide various classes of secure and restricted access to sensitive materials.

Community Engagement

According to Holland (2002), the Digital Collectives in Indigenous Cultures and Communities meeting in Hawaii brought together cultural leaders, digital library researchers and builders, and representatives from institutions of cultural memory and funding agencies, to discuss the way digital technology might be used so that the cultures of indigenous communities could be preserved and public perception of these communities improved. The recommendations from the meeting include the participation of community leadership and elders, respect of their cultural values and their right to decide the degree of their participation in information technology plans related to digital collectives (Holland, 2002). The ideal situation in the case of ICT-based IKMS would be a process in which the indigenous community actively participates in each step of system development lifecycle. In Figure 2.7 we show four possible levels of community engagement in system development, which range from "User" (least engaged) to "Co-Designer" (most engaged).

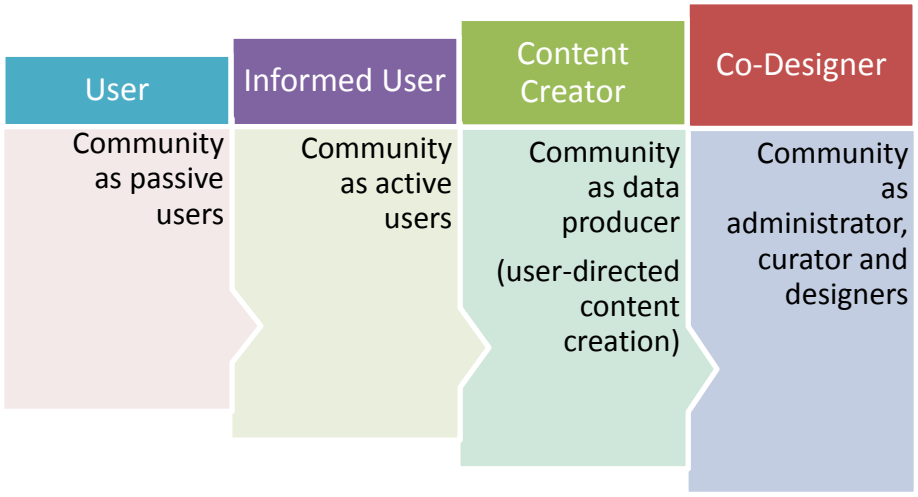

Figure 2.7: Levels of community engagement in the system development

At the “User” level, the community has most limited role and merely receive access to the ICT-based IKMS. They have no participation before, during or after system design and development. Hence they become passive users of the system, which may be designed upon concepts foreign to their culture. At the “Informed User” level, the community is not involved in the system design and development but they are “informed as users” at the implementation stage of project and trained as users of the ICT-based IKMS. At the “Contents Creator” level, the community participate in collecting and producing data to populate the ICT-based IKMS. Hence their role is limited to the level of making their tacit knowledge explicit with the help of technology and digital tools. In this case, modern Intellectual Property (IP) laws do not consider them to be “writers” of the produced content. As such, they cannot claim the copyrights of their knowledge. At the “Co-Designer” level, the community is involved as “co-designers” in the system development and implementation phases and has a role in every decision related to their knowledge resources. In addition, members of the community are considered both curators and designers of the system, they can proclaim legal rights to intellectual property within the IKMS.

Free, Prior and Informed Consent (FP&IC) is an internationally- recognised tool to ensure active community participation and engagement in any project related to indigenous communities. The main intention behind FP&IC is that the knowledge bearers (the local community) agree to be active partners in any activities related to their resources including IK (Shrumm & Jonas, 2012). FP&IC principles comprise four conditions, all of which must be met before the consent of indigenous peoples can be regarded as free, prior and informed (Porsanger, Guttorm, & Árbediehtu, 2011). Under FP&IC, consent must (1) be granted freely; (2) be granted in advance (prior to initiation); (3) be granted on an informed basis; and (4) be regarded as consent, not an agreement or contract (unless mentioned explicitly). The research agreements should base on

FP&IC principle and should cover the details related to the project such as implementation plan, benefits and the roles and rights of each partners of the project.

As outlined, community capacity building and engagement is critical to the success of ICT-based IKM. However, while literature on existing approaches discusses outcomes or technical solutions to IKM, it does not describe the procedure for how the community engagement processes has been or should be conducted.

Framework

IKMS are the complex arrays of knowledge, skill, practices and beliefs, social, cultural and cognitive systems that guide the members of indigenous community in their interactions with one another and with the strategies for coping with changing environments. According to Nakashima and Roué (2002), it would be self-defeating to consider farmers' knowledge of rain patterns, soil types and crop varieties apart from the ways in which this information is put into practice in their fields. However, Western scientific epistemologies consider knowledge as an abstract entity independent from practice. These differences between Western and indigenous knowledge domains become more clear and challenging when they interact with each other. For example, using ICTs for IKM is an integration of IK and technologies (mainly based on Western ways of knowing). A basic understanding of these different knowledge domains is considered as a prerequisite for designing an integrated knowledge management system (Bohensky & Maru, 2011). It is a long process and complex system of activities that deals with the multidimensional challenges such as digital technologies, IPRs, 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 alienated from the living and holistic system and 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. The framework can help in making a clear picture of an environment in which IK is created and located, such as, "who can have access to the knowledge?", "where it is stored or archived?", "how knowledge is shared?" and, "how knowledge evolves over time?" (Velden, 2010)

James D. Wolfensohn, former World Bank President, also stressed the need of a framework that deals with indigenous people and their knowledge (Woytek & Gorjestani, 1998). He highlighted the importance of the contents of such a framework and methodological approach for the application of this framework in these words;

> *"We must learn from the past - how a framework is developed and applied is as important as the contents of the framework"* (Wolfensohn, 1998).

The World Bank IK, Virtual Repatriation and IKM Software System provide some workflow models that either cover the internal flow of data in the technology system or the structure of project management although none of them provides the holistic structure of the complex IKMS.

Methodology

The traditional approaches in KM research are essentially limited to designing the framework for developing ICT tools or connecting with the community, as in the case of Virtual Repatriation or IKM Software system, for example. After designing the framework, one of the main challenges is the methodology or validation process of the framework. Zent (2009) discusses the potential of processual perspective of IK but emphasises the lack of standardised methodologies in this domain. He argues that some authors have developed potentially useful theoretical frameworks centred around concepts of processes, interactivity and contextuality, but it is presently unclear how these may be applied. James D. Wolfensohn, stressed the framework and methodology for

the validation of the framework equally (Wolfensohn, 1998). Ngulube (2002) indicated methodology as a challenge to IK preservation and management.

As mentioned earlier in the list of our review projects, only World Bank IK has developed "Framework for Action," but even in this case the methodology to validation the framework and the lesson learned of the validation process is not well documented and shared.

The review of the current approaches, based on the factors of appropriate IKMS development indicates the following:

- There is no framework available that incorporates and depicts the relationship between ICT tools, IKMS, community partnership and rights and the social, cultural and governance system.
- The focus of the current approaches deals with explicit knowledge bases. There is no mechanism available that incorporates the non-persistent data as dominant data source.
- None of the current approaches assimilate community activities in the design, development and implementation of ICT-based IKMS; therefore, the approaches miss the essential features of the "holistic" and "living" systems central to contextualizing IK.
- The current approaches do not provide guidelines for validation of the proposed workflows and frameworks.

2.9 Summary

The literature review indicates three main issues and theoretical gaps that need to be addressed.

The first issue is the epistemological problem and the lack of consensus and clarity in defining the terms "indigenous knowledge" (Section 2.1) and "indigenous knowledge management" (Section 2.4). The review highlights the different viewpoints (indigenous and non-indigenous)

and the need of a balanced approach for defining IK. The gap in IKM definition and processual perspective is also highlighted where the focus is on the storage and dissemination processes, overlooking communities' innovation and creativity.

The second issue is the lack of an integrated approach to assimilate the community governance structure, collective activities, and knowledge resources within ICT-based IKMS. The focus of the current approaches is on developing software tools and databases that create archives of IK, ultimately resulting in decontextualized "cultural fossils" (Sections 2.6 and 2.7). The community governs knowledge resources by controlling the collective activities and the alienation of knowledge resources from community collective activities brings adverse effects to IKMS.

The third issue is the lack of holistic framework and validation methodology that support the community's view of digital content enabled with IPR, illustrates the relationships between essential components of the existing IKMS and the designed system and the conceptual modelling of community's participation in the system development lifecycle of the ICT-based IKMS (Section 2.8).

CHAPTER 3 ASSESSMENT OF INDIGENOUS KNOWLEDGE MANAGEMENT: CASE STUDY OF BARIO

The literature review in the previous chapter uncovered the theoretical gaps and influencing factors that need to be considered and addressed by researchers and Information and communication Technologies (ICT) professionals while developing ICT-based Indigenous Knowledge Management Systems (IKMS). The objectives of this chapter are to explore 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 communities. The study initiated a dialogue between community members and researchers that helped the researchers to better understand the indigenous community's structures, communication patterns and the influencing factors of IKMS.

The scope of the exploratory study is the assessment of IKMS in the community of Bario. The first part of the chapter discuses the structure of IKMS in communities, its conceptualisation in ICT-based IKMS and the review of the related work. The theoretical framework, methodology and data collection process employed in this study are discussed in the second part of the chapter. We summarize the results and discussion in the final part of the chapter.

3.1 The Structure of Indigenous Knowledge Management System in Community and Alien Conceptualisation

Indigenous communities have inherent system for managing their knowledge resources, which has withstood and proven sustainable over thousands of years of dramatic events (Sveiby, 2007). These communities have unique ways and processes to manage, preserve and transfer this knowledge from generations on the basis of relationships (intergenerational) and power structures (Williams et al., 2011). Unlike the organisation's Knowledge Management (KM) structures where technology and databases are the essential parts of the system, IK lives in the memory, oral literature, collective intelligence and activities of the community. For example, the World Oral Literature Project describes a variety of Indigenous Knowledge (IK) forms of oral literature, which includes ritual texts, curative chants, epic poems, musical genres, songs, spells, legends, recitations, life histories and historical narratives (University of Cambridge, 2012).

However, according to Kapuire and Blake (2011) current technology trends and developments have hardly been informed by rural and indigenous community's inherent structures of information communication and Indigenous Knowledge Management (IKM). The literature has a sufficient number of examples about the failures or short term successes in adapting existing technologies, which are mainly designed for urban settings but then implemented in rural community (Howard, 2008; Thirumavalavan & Garforth, 2009). One of the factors in the failure of technology appropriation is the absence of input from local culture in the design of the system (Winschiers-Theophilus, 2009). Indigenous communities have the right to develop culturally appropriate ICT applications with content and access controls on their own terms and respecting their modes of communication and knowledge sharing (Håkansson & Deer, 2006). To prevent alien conceptualisations from being carried forward into the development, design and

implementation process of ICT tools for IKM, it is essential for knowledge engineers and researchers to have working knowledge of the community, community's structure, communication patterns and factors that influence the system development lifecycle of the ICT-based IKMS.

To develop an understanding of the inherent structure of indigenous knowledge management system in Bario community, we used the process of IKMS assessment as a tool. The tool helped researchers to systematically analyse the social, cultural and governance system from the IKM perspective in the community of Bario. The following portion of this chapter discusses the assessment tools of knowledge management and IKM from existing literature and then analyses the appropriateness of these tools in our case study.

3.2 Related Work: Assessment Tools

In the current section, we discuss four broad approaches that have been applied in the auditing and mapping of KM systems in indigenous community and organisations. The first two approaches are the mapping and auditing of IK (Mearns & Du Toit, 2008), and IKM (Joseph & Rotich, 2008), while the third and fourth approaches are the Knowledge Management Diagnostic (KMD) tool (Bukowitz & Williams, 2000) and the Knowledge Management Assessment Tool (KMAT) (Jager, 1999).

The aim behind these approaches is to understand and sometimes benchmark the KM processes in community or organisation, although the tools tend to vary greatly. In the first approach, Mearns and Du Toit (2008) audited the use of IK as a commodity for tourists at cultural villages in South Africa. The researchers used the knowledge audit tools designed for organisations to investigate the extent to which IK is being conserved at the cultural villages. The research

findings rated the extent of IK conservation fairly “poor”. Researchers conclude this was due to a village focus on promoting tourism enterprises. The research findings also outline the scope of knowledge audits tools beyond those used for business organisations and in IKM.

The second approach mainly focuses on mapping and auditing the processes of IKM by studying the application of IK in particular domains. Joseph and Rotich (2008) examine the application of IK in framing practices in rural villages of Kenya. The researcher did not use any specific tool and mainly collected the data by survey and face-to-face interviews. The study presents recommendation to the farmers and agriculture researchers for improving the preservation, capturing and dissemination of IK.

The third approach is the Bukowitz and Williams (2000) KMD tool to gauge and rate the KM efforts of ordinary business and research organisations according to the knowledge management process framework (Fig. 3.1).

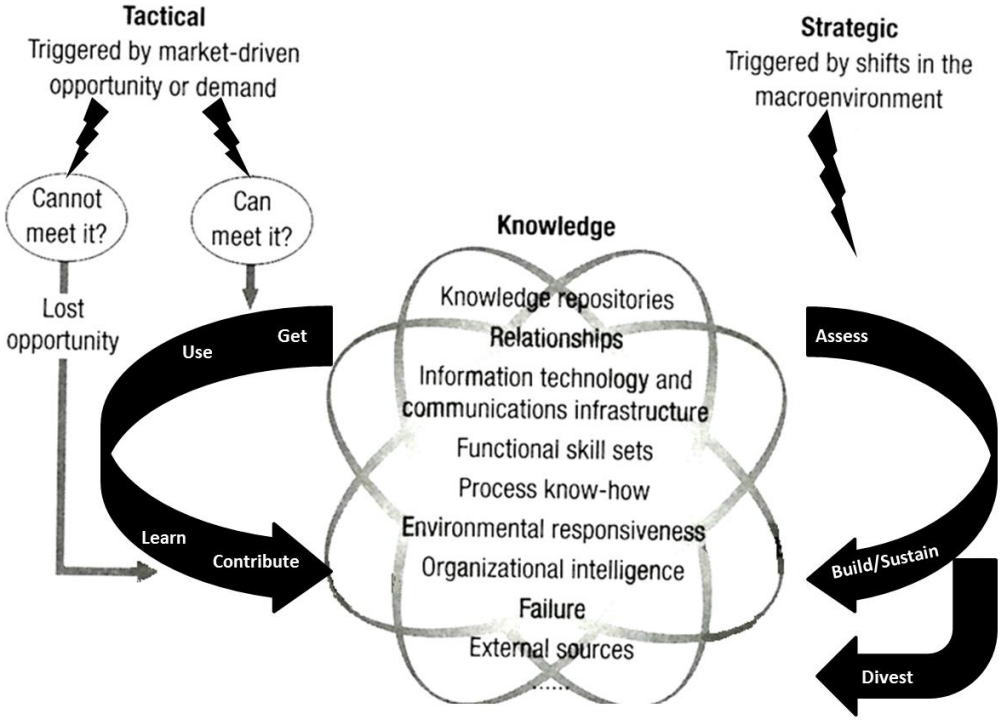

Figure 3.1: Knowledge management process framework (Bukowitz & Williams, 2000)

The fourth approach, KMAT, is a collaborative and qualitative benchmarking tool, designed to help organisations make an initial high-level assessment of how well they manage knowledge. KMAT was developed by APQC (American Productivity & Quality Center) and Arthur Andersen. It is mainly used in industry. The model (Fig. 3.2) places major KM activities and enablers together in a dynamic system (Jager, 1999).

Each of the five sections of the tool encompasses a set of 24 KM practices (leadership=4 sets, culture=5 sets, technology=6 sets, measurement=4 sets and process=5 sets). Organisations can have their performance rated and benchmarked with those of the other organisations for each of 24 practices (O'Dell, Grayson, & Essaides, 1998).

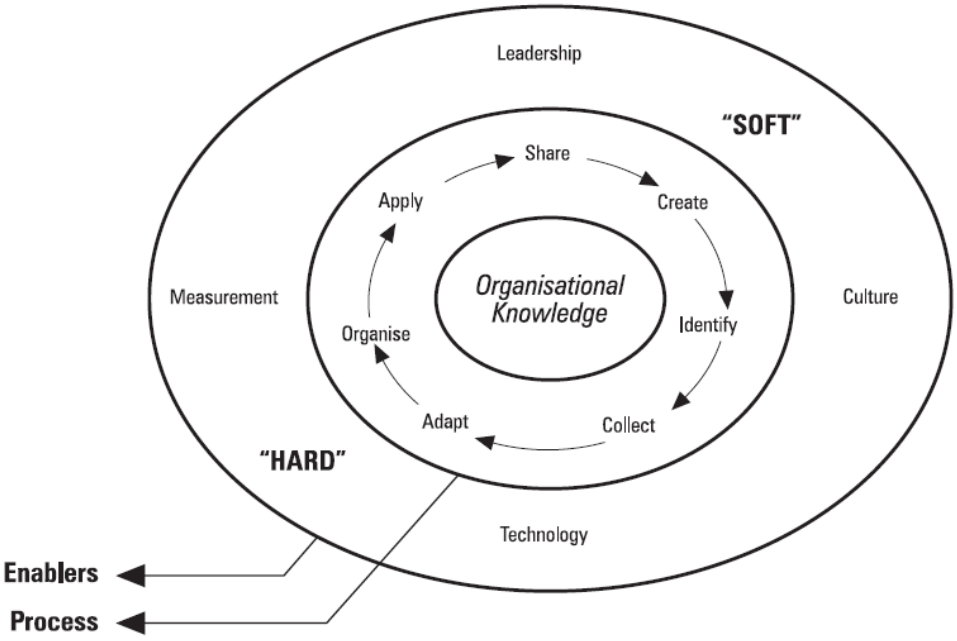

Figure 3.2: Organisation's knowledge management model (Jager, 1999)

The concept "IK as commodity" used in the first approach is a very narrow conception, and thus is widely criticised by indigenous researchers (McGregor, 2004). This could be one of the reasons for the IKM audit results (poor in this case) in Mearns and Du Toit (2008) study. The

second approach presented in Joseph and Rotich (2008) is relatively better where researchers focus on the processual perspective of IKM, although at limited level. The study only measures the processes of IK preservation, capturing and dissemination in the agricultural practices of the community; however, they do not consider the processes of IK creation and adaptation. The third and fourth approaches provide well-established frameworks and methodologies to audit and evaluate KM processes. Although these frameworks and tools are not particularly designed for indigenous setting, they are widely used in research and rural development organisations (Okunoye et al., 2002). Both of the tools, KMAT and KMD use a quantitative approach (questionnaires), best suited to explore the strength and weakness of KM processes. Respondents complete the questionnaires, but there is no direct interaction between researcher and respondent for follow-up questions. These limited tools are not able to capture qualitative data to elaborate the context in which the KM processes occurs. This shortcoming limits the scope of the research design. Hence these approaches, in their currents structure, cannot be used in our case study to develop an understanding of the inherent IKMS of Bario community. The review of the existing tools, however, helps us in designing the theoretical framework, selecting questions for survey and developing the methodology for our case study, which will be discussed in the following sections.

3.3 Theoretical Framework

A preliminary study has been conducted using KMD tool based on seven KM processes framework. The original KMD diagnostic contains 140 questions, 20 questions for each of the seven knowledge management processes. We used this questionnaire (in standard structure and change the wordings) in the preliminary study with the Kelabit community of Bario (see

Appendix I). Many questions were left unanswered by the respondents, especially in the processes of assess, build and sustain, and divest and we discovered several assumptions in KMD tool that might not necessarily be relevant to the rural communities. Our enquiry revealed the reason being the irrelevance of these questions to the nature of their knowledge organisation or the fundamental difference in the domains of modern organisational knowledge management and indigenous knowledge management. Many of the unanswered questions were related to the data organisation with ICT which off course is an alien concept in traditional way of knowledge management in community.

After this, we decided to modify the original KMD using the response rates to each of the questions and to base it on the structure of knowledge management system in indigenous community. Hence, we first modelled indigenous knowledge management in communities (Fig. 3.3) to depict how communities utilise, transfer, accumulate and create knowledge. The model (Fig 3.3) is based on the definition of IKM provided in Section 2.4.

The model highlights four basic steps of knowledge management; to perform daily work the successors learn from their ancestors, adapt and utilise their knowledge to create value, learn from what they create and, ultimately, accumulate or feed this new knowledge back into the system for others to use as they tackle problems of their own. One or more of the processes occur simultaneously and contribute to each other. In this study, we focus on the main processes of utilisation, creation, adaption and accumulation.

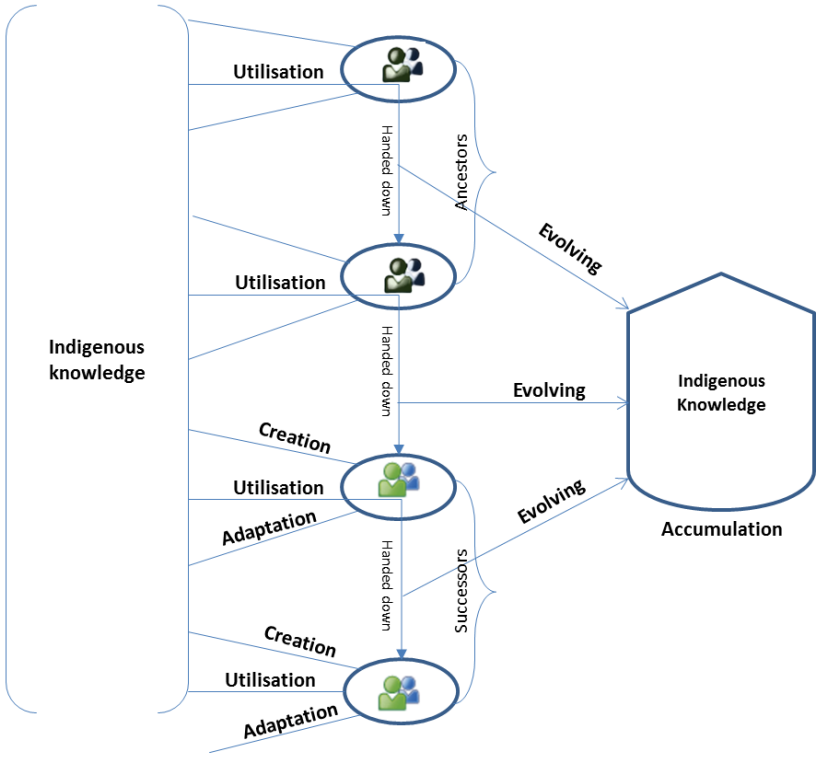

Figure 3.3: Indigenous knowledge management processes model

The following section presents a short description on each of the process.

Accumulation

Knowledge accumulation is the process where the community members contribute new knowledge back into the communal knowledge base so others can access and use it when they tackle the problem on their own. Community knowledge bases can be considered the memory of the community in the form of oral literature, practices, ceremonies, and even institutional structures.

Adaptation

When the indigenous community faces new challenges they respond by relying on the best available knowledge base and the urgent need arises from challenges. The adaptation process is different from utilisation, as adaptation is not just "utilising" knowledge but creating innovative

solutions that are based in some way on indigenous understanding. McLean (2010) illustrates over 400 case studies on climate change, its effects and indigenous people's adaptive responses. The Honey Bee Network of India is another example of IK adaptation; the Honey Bee Network developed databases of about 10,000 green grassroots innovations, including the outstanding traditional, ecological and technological, knowledge of farmers, artisans, pastoralists, fishermen and women; scouted from more than 75 countries (Rao, 2006).

Creation

"Creation" refers to generating new knowledge, not merely learning from ancestors or acquiring knowledge from outside sources (Takeuchi & Umemoto, 1996). Knowledge creation in indigenous community occurs via two main processes: "interaction" and "action". Interaction refers to exchange and communication of existing knowledge. Action is associated with the production of new knowledge during execution of existing acquired knowledge.

Utilisation

IK is mainly shared orally, transferred from ancestors to successors by word of mouth. Once knowledge has been located and obtained, community faces a challenge of applying it rapidly to their specific situations. Indigenous practices in agriculture, forest, biodiversity, water and fisheries management are examples of IK utilisation.

3.4 Methodology

Research findings are based on data collected in the first eight months of the research (November 2009 – June 2010). This study methodology deployed a mixed (qualitative and quantitative) approach. After preliminary study and in second round, we rearranged the questions that are highly rated by the respondents in four main categories: knowledge accumulation, adaptation,

creation and utilisation. This reduced the total number of questions in the survey instrument to twenty. The standard KMD tool uses a single survey questionnaire to assess KM processes, which might be easy to understand for management and senior staff members of a modern organisation. In preliminary study, we revealed that our respondents from indigenous community need examples and clarification of many terms used in the questionnaire. Hence, we added in-depth semi-structured interview to support the survey instruments and if the respondents need any clarification and to better understand the statements in the instrument. Where necessary, we also changed the wordings of the questionnaire and added some phrases to others based on the feedback from respondents. Thus the main purpose of the amendment exercise was to reduce ambiguity and to avoid low response rate by including only relevant questions.

There are no catalogued knowledge experts in Bario community so it was also challenging to locate knowledgeable respondents. Hence, we used snowball sampling technique to recruit subjects for this study. Snowball sampling is an approach for locating information-rich key informants. Using this approach, a few potential respondents were contacted and interviewed. They were then asked to refer researchers to other potential respondents. We recruited the first two respondents, John Tarawe and Stanley Apoi based on their vast experiences with development projects and their positions in local governance structure of Bario community. To reduce the biases of snowball sampling, next we recruited only those respondents who were referred by two people. We limit our sample size to 15 respondents (Appendix II); as the standard number of respondents for qualitative research is 12-20 (Tuckett, 2004). All the respondents are fluent speakers of English language in addition to local Kelabit language and Bhasa Malay. The respondents included local farmers, handicraft makers, teachers, community council members, and tourism operators (lodge owners and tour guides).

3.5 Data Collection

The research was conducted primarily through a survey questionnaire (Appendix III) and interviews. The survey questionnaire contained three statements that corresponded to each IKM process. In response to a statement, the respondents chose whether they agreed with the statement strongly (select S), moderately (select M) or weakly (select W).

In addition to the survey questionnaire, in-depth semi-structured interviews were conducted with the same respondents. In interviews, the respondent explained his or her rating of each statement with an exemplar practice of KM in their community. This research technique was advantageous in two ways: firstly it initiated a dialogue between the researchers and respondent and developed the respondent's understanding of the underlying theme behind each statement. Secondly it helped in develop the researcher's understanding of IKM practices, related factors and the depth of the processes within the indigenous community of Bario.

3.6 Results

The results are presented in three parts; part one presents demographic data. Part two presents quantitative results of the survey. The third part illustrates the qualitative results of the semi-structured interview.

3.6.1 Demographics

Of the fifteen respondents interviewed, 10 of them were male and five female (Table 3.1). The majority (six respondents) was aged more than 60 and none of the respondents were less than 31 year old. The majority (six respondents) are farmers and lodge owners (four respondents).

Table 3.1: Demographic Table-Gender, Age and Occupation of the respondents

Gender Composition:		*n*=15
	Male	10
	Female	5
Age:		
	31-40	3
	41-50	5
	51-60	1
	60+	6
Occupation:		
	Farmer	6
	Councillor	1
	Tour Guide	2
	Lodge Owner	4
	Handicraft maker	1
	Teacher	1

3.6.2 Survey Questionnaire

For assessment of each IKM process we used three statements and the corresponding response of 15 respondents (Appendix IV). We obtained a total of 45 votes for each IKM process. We then compiled each set of values against the corresponding IKM process, producing the following scores in Table 3.2. In order to compare the results of processes, the survey responses were assigned values; “Weak” was assigned a value of 1, “Moderate” was assigned a value of 2 and “Strong” was assigned a value of 3. Each set of values was then compiled against corresponding

IKM processes, producing the following scores in Table 3.3, which are depicted graphically in Figure 3.4.

Table 3.2: Comparing indigenous knowledge management processes

IK Processes	Strong	Moderate	Weak	Total Votes	Max. Score
Section 1- Knowledge Accumulation	9	11	**25**	45	135
Section 2- Knowledge Adaptation	9	**18**	**18**	45	135
Section 3- Knowledge Creation	17	**15**	**13**	45	135
Section 4- Knowledge Utilisation	13	**21**	**11**	45	135

The survey results indicate the gaps in the sub domains of Bario community's IKMS. The results presented above show that knowledge utilisation and creation processes achieved higher scores in comparison to knowledge accumulation and adaptation, probably due to the nature of the Bario community.

Table 3.3: Indigenous knowledge management processes and assigned scores

IK Processes	Strong	Moderate	Weak	Obtained Score	% Score
Section 1- Knowledge Accumulation	27	22	25	74	55.81%
Section 2- Knowledge Adaptation	27	36	18	81	60.00%
Section 3- Knowledge Creation	51	30	13	94	69.63%
Section 4- Knowledge Utilisation	39	42	11	92	68.15%

The Bario community is famous for learning from experiences, creating new practices, and exercising indigenous practice in their daily routine work, so they are able to do these processes well. An interesting example is how Bario community revived the failed 17 million Ringgit

Bario micro hydro project that was abandoned for more than a decade when it met its premature demise in 1997 (Banie, 2012).

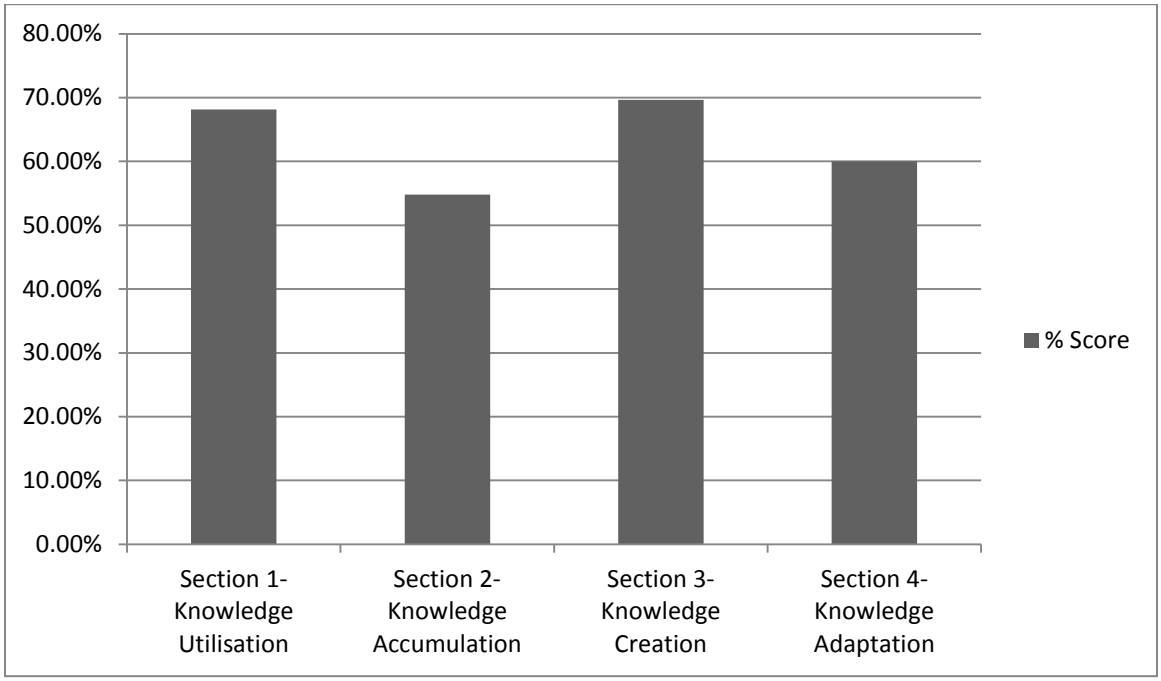

Figure 3.4: Result of indigenous knowledge management processes comparisons

The results show that knowledge accumulation process needed more focus, followed by a focus on knowledge adaptation processes. In response to the knowledge sharing mechanisms in community, male respondents (76%) reported *Jawatankuasa Kemajuan dan Keselamatan Kampung* (JKKK) and the female respondents (90%) mentioned church as their main source of information because they as individuals play a role in these institutions.

All the representative of longhouses in JKKK are male, whereas the church has an active women's group, which helps coordinate and conduct different social and religious activities. Irrespective of age, occupation and gender, all the respondents have interest and basic information about the plantation of paddy as well as farming. All female respondents rated community sense for protection of knowledge assets as "Weak"; and recognised that Bario

community has collective decision-making system(s) by rating the corresponding statement strong or moderate (3 out of 5 females rated it as “Strong” and 2 as ‘’Moderate”).

The male respondents gave a high rating to the community support for introducing new technologies and practices; out of 10 male participants 8 rated this practice as “Strong” and two as “Moderate”. The majority of female respondents rated the same practice as “Moderate” (four out of five as “Moderate” and one as “Weak”). The majority of the respondents from the age group of 50 year or less reported the practice of community support to acquire knowledge from external sources as “Weak” (7 out of 8 respondents) while the respondents from the 60+ age group reported it as “Moderate” (five out of seven respondents).

3.6.3 Semi-structured Interviews

The aim of semi-structured interviews is to understand the structure and the context of IKM processes from the community’s perspective. The study discovered three main factors influencing IKM: the governance structure, the system of protection for IK and resource management, and the community collective activities’ support for IKM. In the following section, we present a discussion on each of the factors.

The Governance Structure

IKM practices do not exist in a vacuum but are embedded in and linked with local institutions and governance systems (Berkes, Colding, & Folkean, 2002). The Bario community has interconnected customary, statutory and religious governance systems and institutional structure (Fig. 3.5), which influences community decision-making and communication patterns. The JKKK or The Village’s Development and Safety Committee, Council of Elders and Church are considered the most influential and effective sources of information in Bario. The JKKK is the main local agent for managing and coordinating village development, empowered and

recognised under modern government structures. The committee has representatives from each longhouse in Bario. The Council of Elders is the custodian to uphold the *adat*. *Adats* are largely unwritten and oral traditions that are handed down from generation to generation and continue to evolve to meet the changing needs of the community. The church in Bario is a spiritual religious institution and also an important local institution that organises community economic and social life. To exercise any of the IKM processes, first the community receives information from different sources. These sources of information can be internal as well as external. According to the respondent Lian Tarawe, Bario community members refer to JKKK if they require any information or knowledge about village development or government plans, while the Council of Elders is the main source of information and decisions about customary laws, organising traditional ceremonies and resolving disputes. The church also has great influence on communication patterns and indigenous culture of Bario community as reported by Harris and Harris (2011). The respondent of the survey confirmed this finding. Figure 3.6 shows the general structure of social network and relationship model of Bario community.

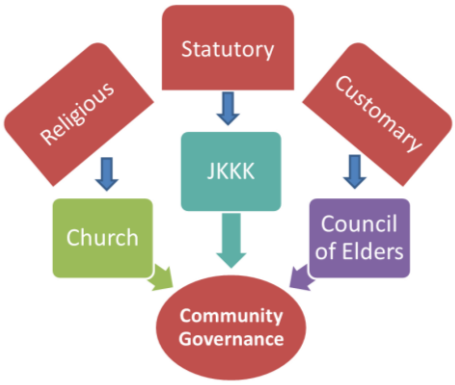

Figure 3.5: Bario community governance systems

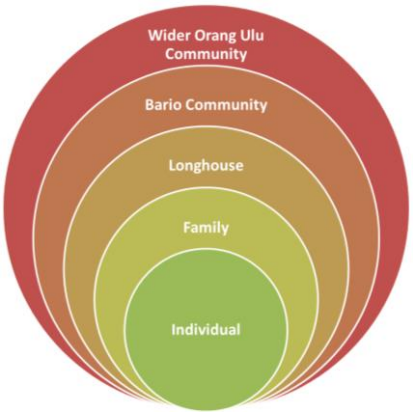

Figure 3.6: Community structure of social network in Bario

The Protection of IK and Resource Management

The Bario community governs their resources and regulates the whole native way of life with customary rules, *adat*, which are promulgated and enforced by JKKK and Councils of Elders. According to the respondent Gerawat Nulun, the JKKK and Council of Elders deal with two fundamental management problems related to resources: how to control access to the resource, and how to institute rules among community members to solve the conflict of individual vs. communal interests.

The following example depicts the community's concerns about the protection and uses of their cultural heritage, indigenous practices and sacred sites. According to respondent Jaman Riboh Tekapan, in 2008 the Bario community and the collaborators have started initiatives to protect the heritage sites in Kelabit's highland. The project is funded by the US Embassy for Malaysia in Kuala Lumpur through the Ambassador's Fund for Cultural Preservation. More than 700 sites have been identified and documented with detail information, pictures, GPS coordinates and mapping 250 square meter boundaries around each site. The cultural sites include stone megaliths (which were carried to the locations by Kelabit warriors to prove their strength and mark sacred areas), funeral jars (intricately carved pots jars containing the ashes and heirlooms of deceased Kelabits) and animal salt licks. The exercise was prompted by the need to protect these important cultural sites from destruction by logging after part of the Kelabit Highlands was licensed out for logging in the 1990s. This was also the reason why the focus of the exercise was within areas covered by the logging license instead of the whole of the Kelabit Highlands.

Janowski and Kerlogue (2007) illustrated another example of relationship between social and cultural system and IK assets. They reported in detail about the individuals' status issue in Kelabits and Penan of Bario, which is connected with the use and planting of Bario rice.

Community Collective Activities

Bulan (2011) illustrates the examples of *adat* and ceremonial practices that govern the relationship of the community and land in Sarawak. In addition, she defines the role of indigenous oral literature stories, songs and ballads as the evidence of indigenous occupation and the proprietary rights related to the land in litigations. Indigenous community has inherent learning system based on the processes of apprenticeship, the practice of the oral tradition, direct observation, and instruction. The learning system has support from IK base songs, skills and stories, which are controlled by social and cultural norms, beliefs and taboos. Organising community collective activities and ceremonies is one of the traditional ways of utilising and transferring knowledge to new generations. Traditional forms of passing knowledge from an older generation to a younger one always involve young and old being in the same place at the same time doing things together and sharing about it. Based on the findings of the study, the designed illustration (Fig 3.7) depicts the integrated IK learning system and the relationship between skills, experience, activities, community practices and culture, such as community values, beliefs, rituals and traditional songs and stories.

To verify the model in Figure 3.7, we present an example of the Kelabit's *irau mekaa ngadan* – or name changing ceremony. According to the respondent Jeanette Nulun, the ceremony is a celebration at which new names are taken by grandparents (who host the feast or *irau*), parents and children. Hosting an *irau* is seen as positive way for Kelabit to participate in and reaffirm traditional culture.

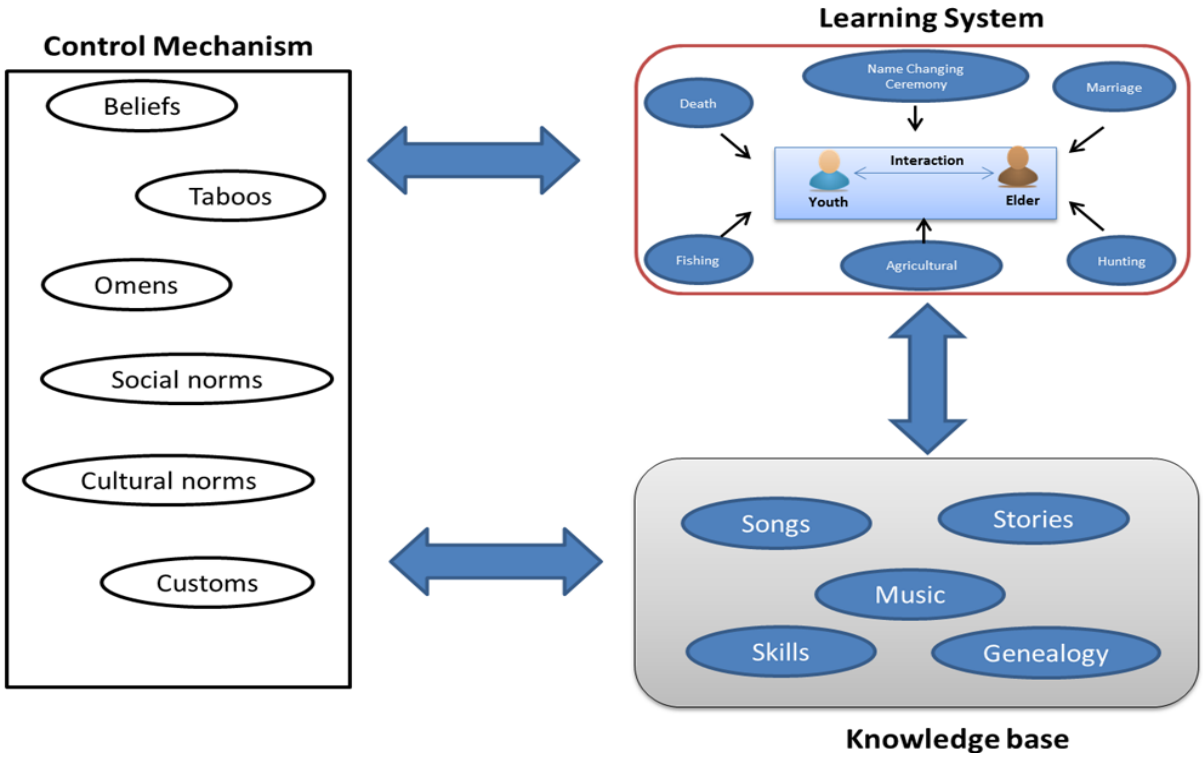

Figure 3.7: Integrated indigenous knowledge learning system

Common activities in the ceremony include changing names, speeches, meal and various forms of entertainment songs, dances and games. While performing these activities the community exercises different KM processes. For example, when the parents and grandparents change their name they recall (adapt) the names from family genealogy tree. The *irau* is also important because it stresses the positive accomplishments and affirms a person and family's place in the community (Amster, 1998).

IK is context-specific and embedded in the everyday practices of the members of a community. The case study of Bario has produced insights into the current structures and the social and cultural framework, which underlie IKM practices within the community.

3.7 Discussion

The conceptual gaps, identified in the case study, have some important implications for researchers and indigenous community concerned with IKMS. In Chapter 2, Section 2.4 highlighted that the current definitions of IKM only focus on "capturing" and "distributing" processes and the IK creation process in the community is not well pictured and documented. An interesting aspect of the case study is the empirical evidence of strong knowledge creation processes as a part of the Bario community's IKMS (stated in table 3.3, 69.63%). This also reflects the "living" characteristic of the Bario community's IKM system. A living system is one that constantly creates new knowledge that is closely connected to day-to-day activities and social systems and is reflected upon before acceptance and assimilation.

The results of the preliminary study indicated that the tools and frameworks designed for organising KM cannot be used in existing shape for IKM because of the fundamental differences that often exist between indigenous and non-indigenous knowledge domains. The study explores the inherent features of integrated IK learning system (Fig. 3.7) in Bario community, which are mainly based on the processual perspective and exercise the processes of storage, leveraging, sharing and applying knowledge. The structure of IKM is different from the organisation's KM system and based on the oral literature (knowledge base), community activities (learning system) and governance system (control mechanism) as depicted in Figure 3.7. The case study argues that unique features and influencing factors of IK need to be identified and addressed appropriately in the tools and frameworks for IKMS.

The community governance system and its role in information, resources and collective activities is another important aspect of IKMS explored in this study. 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 Church, JKKK, and Council of Elders (90% of the females reported church and 76% of male respondents mentioned JKKK as their main source of information). The results 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. For example, in the case of identified and documented heritage sites in the Kelabit's highland as discussed in Section 3.6.3.

Researchers also found the exercise useful as the interaction with the community members and the structural analysis provide them an insight into local issues, social and cultural systems, the role of indigenous organisations, and factors that influence the wider indigenous knowledge management system in the Bario community.

3.8 Summary

The study confirms that the knowledge creation process is arguably the most important step in the 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 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.

CHAPTER 4 MODELLING INDIGENOUS KNOWLEDGE CREATION AS A LIVING SYSTEM

The majority of research and development of technologies for Indigenous Knowledge (IK) still focuses on the capturing, representation and dissemination of knowledge but rarely on the Indigenous Knowledge Management Systems (IKMS) inherent processes of creation and adaptation. IKMS is sustainably addresses the needs of indigenous communities by creating and/or adapting new knowledge while responding to the external challenges. The existing models of knowledge creation are best suited to modern organisational structure. To the best of our knowledge, no such model has been found to date, which accommodates the structure of indigenous knowledge creation. Hence, this chapter is an attempt to delineate in detail the knowledge creation process in indigenous community 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. The first part of the chapter presents a review of the knowledge creation concept and models that represent this knowledge creation process. The second portion will outline the community engagement process and present Tacit, Implicit and Explicit (TIE) model of indigenous knowledge creation. In the third part, the TIE model is elaborated and examined with the case study of information exchange and knowledge creation process in the specific communities of Long Lamai and Bario, Malaysia.

4.1 Knowledge Creation

Knowledge creation can be defined as the process of the development and circulation of new knowledge within the organization (Lynch 2006). Knowledge creation is also called *knowledge*

production (Tang, Liu, & Wen 2005) or *knowledge construction* (Mora, Pérez, Garrido, Wang, & Sicilia, 2010). The creation of knowledge refers to creating and applying new knowledge in a certain context, not merely learning what another person already knows (Takeuchi & Umemoto, 1996). Knowledge creation in indigenous community occurs via two main processes: "interaction" and "action". Interaction refers to exchange and communication of existing knowledge. Action is associated with the production of new knowledge during execution of existing acquired know how/information in a certain context. Through social and collaborative processes as well as an individual's cognitive process (e.g., reflection), knowledge is created, shared, amplified, enlarged, and justified in organisational settings (Nonaka, 1994). The knowledge creation process involves steps such as sharing tacit knowledge, creating concepts, justifying concepts, building a prototype, and cross-levelling of knowledge (Krogh, Ichijo, & Nonaka, 2000). Much of the existing research on knowledge creation focuses on the sources and the domains of knowledge such as tacit or explicit knowledge. Explicit knowledge is the knowledge in written or recorded text, audio, video or graphics. It exists as a physical or virtual entity so it can be named, disseminated and measured even sometimes assigned a monetary value. In contrast, tacit knowledge refers to things we know that cannot be made explicit (cannot be expressed using language) (Wilson & Wilson, 2011). Research now needs to move beyond traditional approaches to Indigenous Knowledge Management (IKM) and consider the factors that facilitate knowledge creation such as enabling environments, culture, community capacity and process of engagement with new information and know-how.

The knowledge creation process is highly influenced by particular contexts and settings. In organisations, knowledge is alienated from its context and implicit knowledge sources, transformed in a commoditisable product and systematically transmitted between firms (Nonaka,

1994). The focus of knowledge creation models is transformation of tacit knowledge into explicit and codified forms. The conventional design approach of ICT-based IKMS is based on the same models where IK is de-contextualised, stored in databases and disseminated on the Web (Agrawal, 2002). However, IK is a highly contextualised body of knowledge where the community's collective activities are the essential part of IKMS as depicted in Figure 3.7. These activities provide the context and enabling environment for the knowledge management processes. In addition, indigenous community has integrated governance system of cultural and spiritual beliefs that control the collective activities. For example, many Aboriginal and Torres Strait Islander people in Australia have songs for every occasion - hunting songs, funeral songs, gossip songs and songs of ancestors, landscapes, animals, seasons, myths and Dreamtime legends. Some of this indigenous music and songs can only be performed in special ceremonies, by special age group and gender (The Queensland Government, 2008). Hence, the mere digitisation process of one aspect (for example, stories) will lose the essential context, cultural controls, and enabling environment in which the IK is rooted. Hence a context-specific, culturally-sensitive and holistic approach needs to be adopted for modelling IK creation process.

Considering the fundamental differences between indigenous and organisational knowledge domains, in the following section, we present a review of the classic knowledge creation conceptual models to understand the theoretical background and basic concepts related to knowledge creation processes.

4.1.1 Nonaka's SECI Model

In Nonaka's theory, knowledge conversion or interaction is the key concept for knowledge creation. In spite of those proposed conditions or enablers, Nonaka emphasised *Ba* as an enabling process. *Ba*, a Japanese word, is defined as a platform where knowledge is created, shared, and

exploited. *Ba* can be physical, virtual, mental or any combination of them. Nonaka's Socialization, Externalization, Combination and Internalisation (SECI) model (Fig. 4.1) has four modes of knowledge creation: socialization, externalization, internalisation, and combination (Nonaka, 1994).

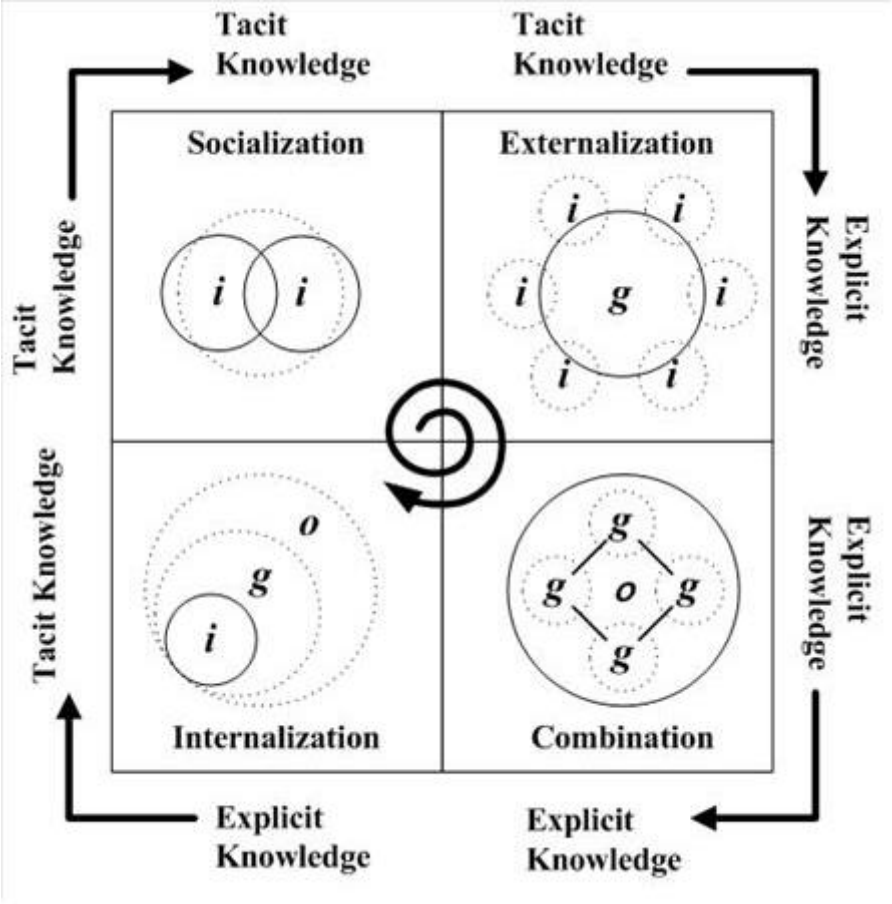

Figure 4.1: Spiral evolution of knowledge conversion and self-transcending process (Nonaka & Konno, 1998)

Fundamental to SECI model is the codification of knowledge into two basic forms: explicit knowledge (easily codified and shared asynchronously) and tacit knowledge (experiential, intuitive and communicated most effectively in face-to-face encounters).

4.1.2 Rachel Bodle's Model

Rachel Bodle combined the Nancy Dixon Dynamic Knowledge Creation Model (Dixon, 1994) and SECI (Nonaka, 1994) and created a composite diagram (Fig. 4.2) for mobilizing tacit knowledge in the area of organisational learning (Bodle, 2001).

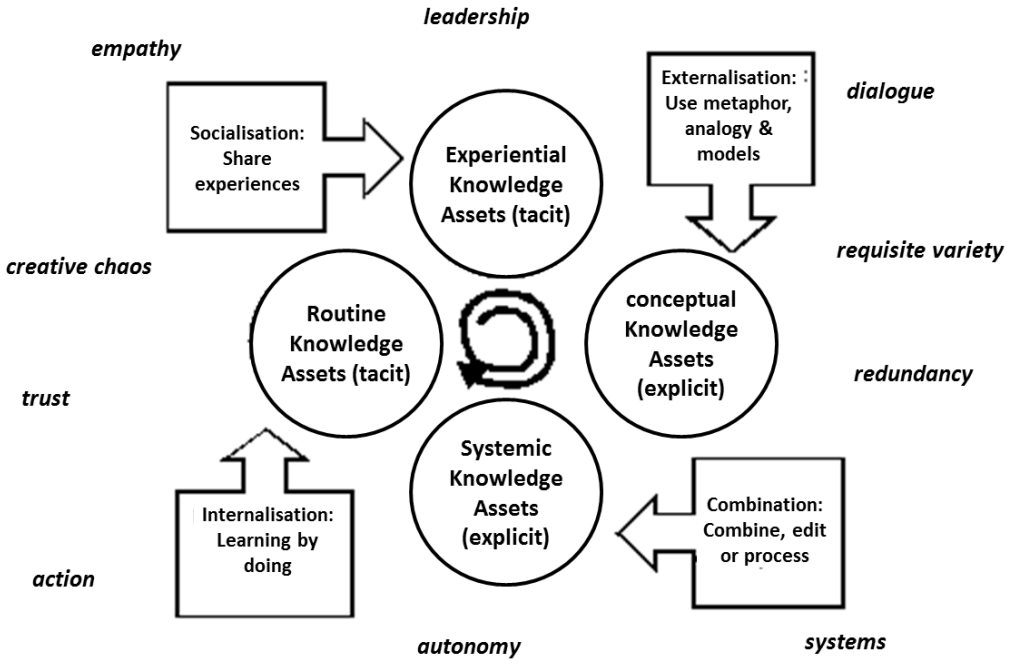

Figure 4.2: Model for mobilising tacit knowledge (Bodle, 2001)

The model suggests four categories of knowledge assets in an organisation (or individual):

- Routine knowledge (explicit to tacit) – learning by doing.
- Experiential knowledge (tacit to tacit) – judgment of individuals.
- Conceptual knowledge (tacit to explicit) – frameworks and models to utilise.
- Systemic knowledge (explicit to explicit) – editing and synthesizing multiple sources.

4.1.3 Jackson and Klobas' Model

The Jackson and Klobas model (Fig. 4.3) describes how personal knowledge is created, personal knowledge being what an individual knows (Jackson & Klobas, 2010).

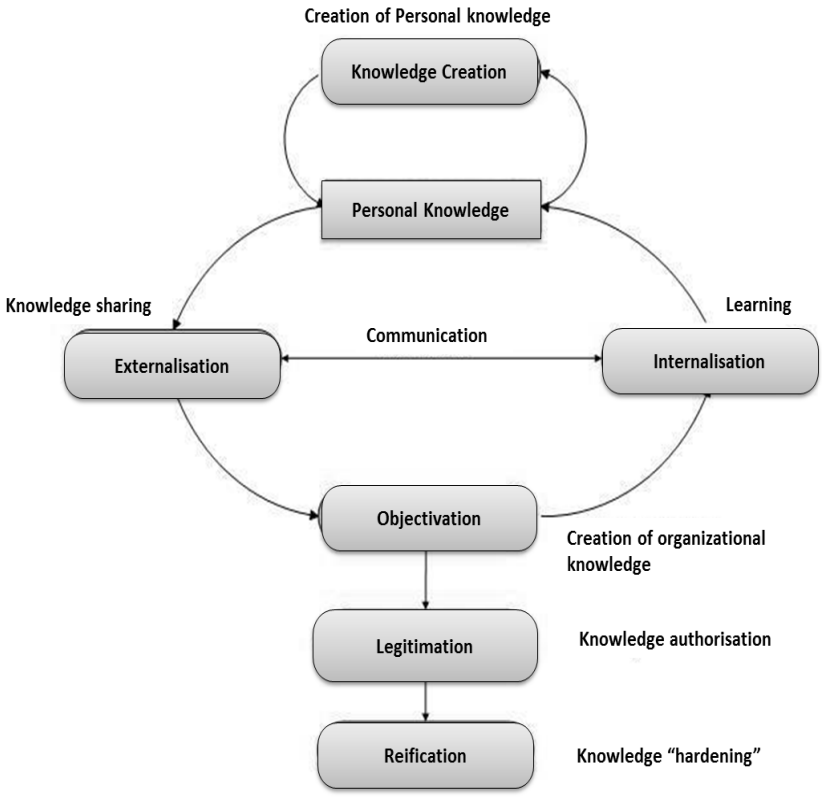

Figure 4.3: The knowledge transfer model (Jackson & Klobas, 2010)

Personal knowledge is built up using mental models of the world – these models are frameworks that individuals use to make sense of the world. According to the Jackson-Klobas process model, personal knowledge is built up through a number of processes including externalization, objectivation, legitimation, internalisation and reification.

The models are based on the two forms of knowledge (tacit and explicit). Nonaka and Takeuchi's theory of "knowledge conversion" serves as the conceptual cornerstone of these

models. The theory of knowledge conversion is based on the assumption that all types of tacit knowledge can be converted in explicit knowledge (Alkhaldi, Olaimat, & Jordan, 2006).

4.1.4 Shortcomings of the Current Knowledge Creation Models

IK is mainly tacit or implicit in nature, difficult to codify, and embedded in community practices, institutions, relationships and activities (Hagar, 2003). Existing models of knowledge creation mainly deal with the cognitive processes and overlook the relationship between community practices, activities and knowledge assets. The existing models also adequately deals with the classic distribution of tacit and explicit knowledge forms but failed to accommodate the implicit knowledge form of IK. The models are based on the theory of "knowledge conversion" that emphasises on the assumption that all types of tacit knowledge can be converted into explicit knowledge. While in indigenous communities where the knowledge is mainly in implicit and tacit form, there is always a body of knowledge that cannot be converted into explicit form (Polanyi, 2009).

In the following section, we will further explore and discuss the distinctions between the three knowledge forms (tacit, implicit and explicit). In Section 4.3, we will present TIE conceptual model, which accommodate all three forms of knowledge (tacit, implicit and explicit) and depicts information and knowledge flow in community sub-systems. We will further explain the model with a case study in Section 4.4.

4.2 Knowledge Creation in Indigenous Community

Knowledge creation occurs through practices, actions and interactions (Nonaka, Toyama, & Konno, 2000). Interactions can be initiated internally in the integrated IK learning system as

depicted in Figure 3.7 or externally within the networks or environment from where the community receives information and know-how. Two concepts are important to conceptualise the IK creation process: first, the forms of indigenous knowledge and interaction process; second community engagement with information acquired from internal or external sources and action process.

4.2.1 Interaction Process and Forms of Indigenous Knowledge

The division of knowledge into two fundamental forms, tacit and explicit, is a common practice in organisations (Nonaka, 1994; Polanyi, 2009). However, we must take into account the profound conceptual and structural differences between IK and modern organisational knowledge (established in Chapter 2). Indigenous knowledge is *tacitly* stored in people's memories and organisational structures (von Lewinski, 2008), *implicitly* embedded in people's daily lives and activities (Pettersen, 2011) and *explicitly* shared orally in stories, songs, folklores and dances (Nyota & Mapara, 2008). Hence splitting the knowledge domains in three forms – tacit, implicit and explicit – is best suited for the structure of IK. In Figure 4.4 we describe the different forms IK.

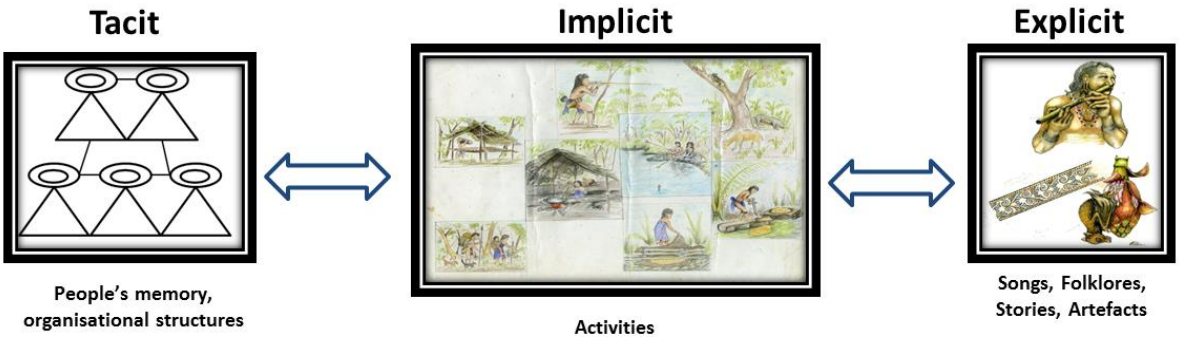

Figure 4.4: Forms of indigenous knowledge

We have discussed tacit and explicit knowledge domain. Implicit knowledge is the form of knowledge that is believed to be tacit but can be transformed into explicit knowledge (Frappaolo, 2008). The distinctions between the three domains of knowledge are usually drawn in the context of capability to be articulated (Fig. 4.5).

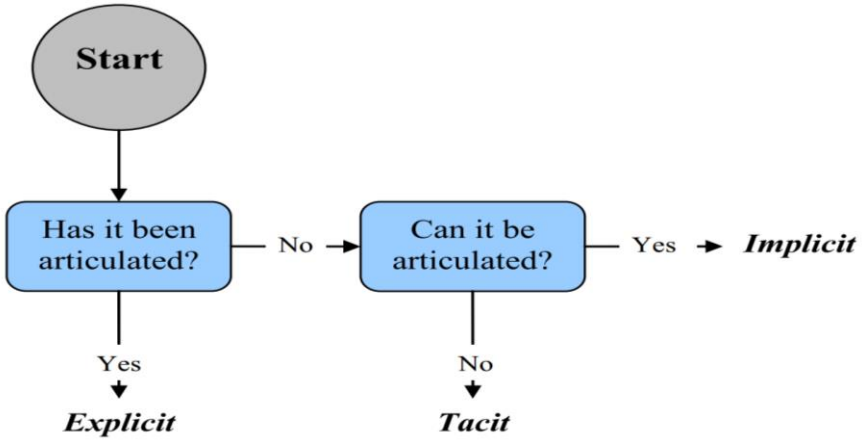

Figure 4.5: Distinctions between tacit, implicit and explicit knowledge (Alonderienơ, Pundzienơ, & Krišþinjnas, 2006)

According to Nonaka and Takeuchi (1995), human knowledge is created and expanded through social interaction between knowledge forms. Knowledge adopts alternating forms so as to mutually enhance tacit, implicit and explicit elements. Because knowledge is the capacity to act based on explicit, implicit and tacit elements, enhancing this capacity means acquiring new information and making use of existing knowledge. The indigenous knowledge interaction process between implicit and explicit knowledge forms occurs during lifecycle of information and knowledge flow within community structures. The modern organisations use different tools to enable this interaction such as community of practice and Information and Communication Technologies (ICT) while in indigenous community it occurs when community receives

information, use and contextualise it in their daily life. In the following section, we are explaining the information flow and action process in indigenous communities.

4.2.2 Action Process and Community Engagement with New Information

Researchers highlighted information acquisition from internal or external sources as the first stage of new knowledge creation (Ceptureanu & Ceptureanu, 2010; Julien & Vaghely, 2001). On the one hand, the relationship between indigenous community and external environment are becoming complex and causing the threats of globalization that have the adverse effects on the languages, economical life, environment and well-being of the indigenous community (UNFPII, 2009). On the other hand, Internet and World Wide Web are generating the opportunities for indigenous people to acquire new information, know-how and to become a part of the external networks (Resta, 2011). In a social practice of new knowledge creation based on action process, there may exists a coherent, complex, coordinated form of human activity to acquire information form external sources, process and contextualise it in daily life practices and externalise it to make value. In Figure 4.6, we illustrate the community engagement process with new information and knowledge flow within community networks.

The five stages of information acquisition and knowledge flow in Figure 4.6 include the following:

Internalisation: The acquisition of information and knowledge from networks of interaction;

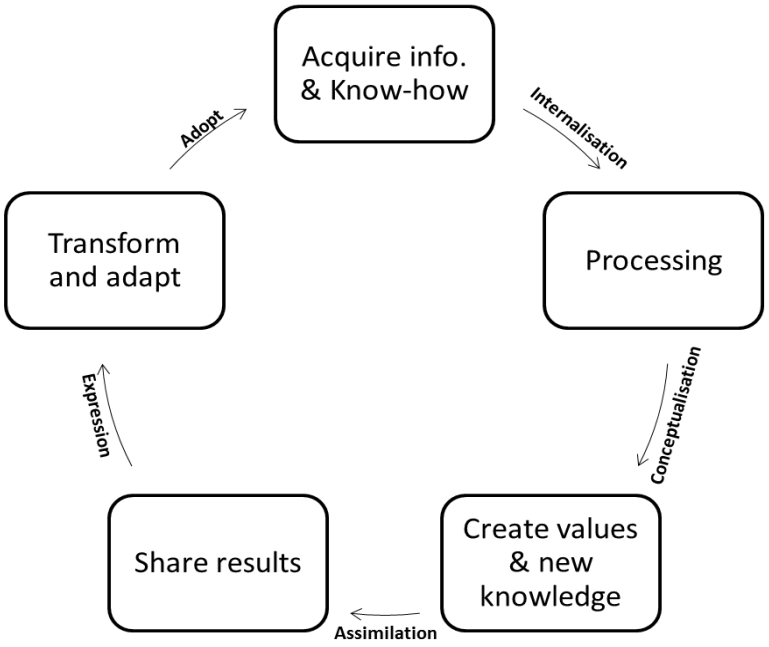

Figure 4.6: The processes of information acquisition and knowledge flow in a community

Conceptualisation: The processing of information within the community networks, which include people with different values, experiences and interest;

Assimilation: The creation of values and innovations (new knowledge) from information while exercising it inside the field and daily life;

Expression: The sharing of new experiences and results with other people, including youth, and making them skilful so they can receive benefits from produced knowledge;

Adopt: The acquisition of information and knowledge from community knowledge bases.

After discussing the basic concepts, in the next section we present TIE model, used to describe the IK creation process, which is based on six major stages (five for action process and one for interaction process).

4.3 Tacit, Implicit and Explicit Knowledge Creation Model

Figure 4.7 provides a graphical view of the TIE workflow model (a combination of interaction (Fig. 4.4) and action (Fig 4.6) processes) that explains constructs and stages of knowledge creation process in indigenous communities. The model takes into account six major stages:

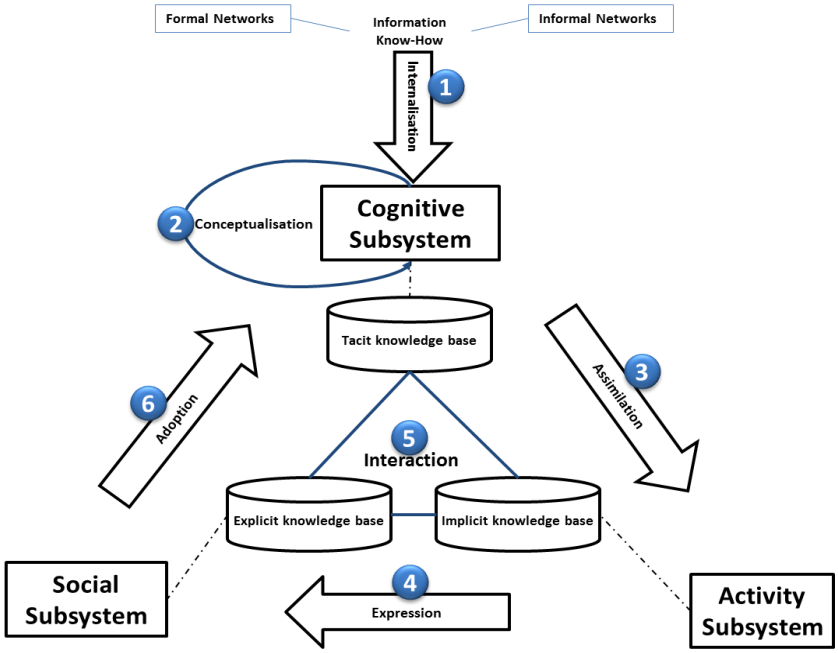

Figure 4.7: Tacit-Implicit-Explicit knowledge creation model

1) **Internalisation**: The initial sharing of knowledge or experiences and the interaction between internal actors and external environment are crucial for new knowledge creation (Nonaka, 1994). In the internalisation stage, a community continuously receives new information from formal (such as Government bodies) and informal (social networks with other communities and individuals) external networks.
2) **Conceptualisation**: The community has a cognitive subsystem that is inherent in the community members' experiences, roles, and organisational structures, such as an

Elders' council. These institutions work as a conceptualisation and information processing unit where the community systematically analyses problems and conceptualises available solutions within the local context. Solutions can be acquired from external sources (deduced from information accumulated in internalisation process) or from the tacit knowledge base that is comprised people's memories and organisational structures within the indigenous community. A critical weakness in knowledge research has been the measurement of created knowledge. Dretske (1983) defines the measurement of knowledge creation as justified belief that leads to actions. Hence, in this case, we consider that a community creates new knowledge by construing the solution of a problem from the acquired information, and performing the tasks by assimilating with the current activities.

3) **Assimilation**: The relevant acquired information and knowledge is then integrated with existing knowledge and assimilated in the community's activity system. In the assimilation stage, the community members associate the problem, acquired information with the existing knowledge and apply it in local context. The assimilation process is supported by the activity subsystem, which is inherent in the actions and collective activities of the individuals. The community's implicit knowledge base, comprised of people's actions or individual and group activities, supports the activity subsystem.

4) **Expression**: In this process, the activity subsystem validates the status of information in terms of relevance to the local context. In this stage the community share the results of the assimilation inside groups such as family, clan, or generally with the people who are concerned. The social subsystem provides the relationships and

institutions that support those relationships such as family or community of practice. The failure or success the assimilation process also becomes a part of the explicit knowledge base comprised of oral literature such as stories, songs and folklores.

5) **Interaction**: The knowledge conversion theory only accommodates the interaction between tacit and explicit forms of knowledge. In case of IKMS, we enhanced the scope of knowledge conversion to accommodate the implicit form of knowledge also. For example, as stated earlier, the Aboriginal and Torres Strait Islanders have indigenous ceremonies and other activities governed by social norms and celebrated by cultural performances (such as telling stories, and dances and playing music instruments) (The Australian Government, 2008). Another example is from the Penans community, playing music instruments called *pagang*. The *pagang* is a bamboo harp producing a melodious twanging sound (in explicit form), which needs special skills (implicit form of knowledge) to play. But *pagang* can only play by female members of the community and there is a sacred belief (tacit form) of the community that if it is played by male member, he would get attacked by the animals in the forest. The knowledge conversion from implicit to explicit and vice versa occurs in internalisation, conceptualisation, assimilation, expression and adoption stages.

6) **Adoption**: Lessons learned become parts of the community knowledge base. In the future, if any problem of the same nature occurs, the community adopts the practices from their previous experiences and decides which information or knowledge practices would be more effective in their situation. The adoption of knowledge can be classified into two types; (a) internally sourced, which refers to the adoption of

knowledge developed predominantly within the boundaries of the firm or community, or, (b) externally sourced, which refers to the adoption of knowledge developed by entities and individuals outside the boundaries of the community.

The six-stages model above presents IK creation process as an outcome of interactions between knowledge domains and assimilation of information and activities (actions). Unlike traditional organisational models, the TIE model presents community activities and subsystems as integral parts of the knowledge conversion process. To elaborate on this model, the next section will present the findings of the case study of Bario ‑ Long Lamai knowledge exchange and creation.

4.4 Case Study: Bario – Long Lamai Knowledge Creation and Exchange

The following case study of knowledge exchange and creation between the Kelabits of Bario and the Penan of Long Lamai communities will exemplify a practical application of the model.

4.4.1 Background of the Case Study

Creating new knowledge often involves combining internal and external information and knowledge in a unique way. The internal knowledge is all knowledge that a community has created within its boundaries, while external knowledge is the knowledge that other communities or modern organisations have created and is thus stored within their boundaries. To acquire external knowledge and information communities, need to scout the environment and search for appropriate information that they can use. For this purpose, communities need to create and maintain formal and informal social networks.

At the turn of the 20th century, the Brooke government in Sarawak instituted a system of government-supervised trade meetings known as *tamu* between the nomadic Penan and longhouse-dwelling agriculturalists communities. *Tamu* connected Penan with the network of global trade and provided them a formal social network with government officials and their longhouse neighbours primarily Kayan, Kenyah and Berawan (Yan, 2012). It also provides them a platform for acquiring new information and knowledge from government officials and neighbourhood communities. According to Along Sega, the iconic paramount leader of the last nomadic Penan group in the Upper Limbang region of Sarawak;

> *"The Berawan were the middle persons in our trading…At that time, we did not know how to use the blowpipe. We used bamboo to make them. We learned from Berawan how to make blowpipes from hardwood"(BMF, 2005).*

Tamu is an example of the informal networks of Penan and neighbour communities. The system of *tamu* is no longer practised but the Penans are still used to form the formal and informal networks. For this case study we are using eBario Knowledge Fair like a *tamu*, as an informal network and information exchange platform between Penan of Long Lamai and their neighbour Kelabit of Bario.

The eBario Knowledge Fair (eBKF) was instigated as a pioneering example of Development Conferencing. Once in every two years, academicians, development professionals, policy makers and activists come together in the remote village of Bario, Sarawak. The conference provides an opportunity for participants to share their experiences and knowledge against the background of the achievements of the e-Bario telecentre and community radio initiative. eBario, an award-winning project initiated in early 2000, aimed to determine the extent to which contemporary ICTs can deliver sustainable human development to remote rural communities in Sarawak.

Given its relative success, in 2007 the eBario project has been replicated in four other rural and remote sites in East Malaysia: Long Lamai, Ba'kelalan in Sarawak, and Larapan and Buayan in Sabah.

4.4.2 Community to Community Information Exchange and Knowledge Creation

During the second eBKF in 2009, a knowledge-sharing workshop was organised to encourage replicating telecentres and telecentre management committees, such as that in Bario. Members of the Penan community from Long Lamai also participated in this workshop. The Kelabit of Bario organised visits to paddy fields and Homestay programs where local experts from the community shared their experiences and information about successful tourism programs and agricultural practices. After observing how Bario community is using ICTs to promote their cultural tourism, representatives of Long Lamai community expressed interest in establishing a Nomadic Homestay program to promote Long Lamai as an eco-tourism destination. To do so, they would leverage ICT, Internet and telecentre services. eBKF provided an opportunity for Long Lamai community representatives to interact with their peers, Homestay owners and tourism operators from Bario. This interaction was the first stage for Long Lamai community representatives to acquire the information about tourism programs from their peers in Bario community. The following section will explain the case study and the knowledge creation stages based on the TIE module (Fig. 4.7):

1) **Internalisation**: eBKF, eBario, and *Ngerabit* eLamai provided a formal network of knowledge sharing to Long Lamai and Bario communities. During the field visits, peer mentors from Bario community shared their experience and practices of Bario paddy plantation, local product promotion and tourism activities' management. Value creation

can take place through the creation of new knowledge. This consists of the initial sharing of knowledge, experience, and practices among members, and the effective creation of new service and product concepts based on this shared knowledge (von Krogh, 1998). According to Garen Jengan, the eLamai Telecentre Manager and a Penan from Long Lamai, *"we identified the cool weather, organic food and historical tales of the monoliths as some of the attractions for tourists in Bario and during the visit, we also learnt how the Bario community is using ICTs for promotion and the telecentre as a hub for tourism activities"*. Another example of Internalisation process is the use of YouTube for community journalism in Long Lamai. After getting access to Internet, Gayut Lim, a local community member of Long Lamai has been selected for community journalism training by the Malaysian Citizen Journalists' group. He developed and uploaded nine videos and pictorial reports highlighting community issues such as the dilapidated state of the two long houses in Long Lamai, a long-tail boat that capsized in the Long Lamai river, traditional music instruments of Penan, a fire incidence in Long Lamai, and a documentary about the processes of picking *Buah Dabai* (a black olive look-alike fruit in Borneo's forests).

The reports are available online at

(http://cj.my/profile/205/_import_peliwa105@gmail.com)

2) **Conceptualisation**: After returning from eBKF, the representatives from Long Lamai community shared their field experience with other community members, JKKK and elders. The Long Lamai community collectively decided to establish the Homestay and eco-tourism programs to attract the outside cash income for self-sustainability of the community. The community established a Nomadic Homestay program where tourists

can experience the life of nomadic Penan, known around the world as eco-warriors, roaming through the jungle. During the conceptualisation stage, the elders of the community evaluated the benefits and potential threats related to rural tourism projects. According to Wilson, the headman of Long Lamai, *"I understand tourism can bring about changes. There are fears of negative influences, but we have faith that we can manage these changes with clearly set rules. There are many ways to make a project successful so that it benefits the community. We are keen to learn new things"* (Yoon, 2012). The Penan are egalitarian in nature so the community is developing the tourism project based on equity in benefit sharing principle.

3) **Assimilation**: As the new information and know-how was considered relevant, so the cognitive subsystem and activity subsystem supported the combination process in Long Lamai community. The community planned to use ICT, Internet and the telecentre as a hub for tourism activities, such as they did in Bario. For the initial phase, the community elected members of a newly-formed Boat and Homestay Association. They were tasked with planning the jungle tracks, standardising rates of tourism services such as rates of tourist guides, homestay, boat and cultural performances.

4) **Expression**: The externalization process has been performed based on the basis of successful tests and experiment. The Long Lamai community is developing a holistic approach towards community-based tourism projects. The community developed a 10-page guidebook for the tourists and community members. They are also using ICT for promotion of the tourism program. The telecentres are the only means of telecommunication in Long Lamai so the community is using the existing ICT and social media tools such as Facebook, Skype and blogs to foster their business activities,

communication with the outside world and marketing their traditional handicrafts and tourism products. A few young members from the community have been sent to complete trainings from professional training institutions in Kuala Lumpur and Kuching in hotel management and tourism promotion programs. After completion of their trainings, they intend to return to the community and help their families establish the tourism programs (PEMANDU, 2011).

5) **Interaction**: To establish the tourism programs, the community is leveraging the interaction of tacit, implicit and explicit knowledge bases. For example, the construction of jungle trails for the tourists. The Penan have their informal mental maps of the jungle, which are based on many sources, such as "Oro*"* their indigenous sign language or "Omen*"* the signs and directions provided by the birds as pathfinders. The cognitive maps in the Penans' minds are their tacit knowledge base while the Oro or the sign language is explicit and Omen are the implicit knowledge. The construction of jungle tracks is an exercise of interaction between these knowledge domains. According to Garen Jengan, "*constructing jungle tracks is not a normal process for the Penan as they assume that jungle has a dynamic nature and a trail cannot be permanently constructed. After we planned for the tourism program, the community decided to construct jungle trails for tourists so they can easily walk in the dense jungle"*.

   The community created partnerships in several other research projects to preserve and strengthen tacit and implicit knowledge bases. One of them is the project of developing genealogy software based on the cultural model for Penan (Mit, Shiang, Khairuddin, & Borhan, 2011). This project is working on marriage cultures of remote communities, which is very closely related to the proposed new family tree (genealogy). The proposed

new genealogy software accommodates basic information about individuals, including births, marriages, and deaths and, most importantly, the story behind these activities/events for historical records. By doing this the young generation can learn/preserve why they need to perform a particular event, and what are the consequences if they do or they do not do it? Therefore, the unique idea behind this research project is not only to preserve genealogical data, but the new architecture of genealogy software that integrates cultures of minority ethnic group of remote community in Borneo so that the culture will not be extinct.

6) **Adoption**: New practices are integrated into the community cognitive subsystems of Long Lamai. In future, when new information and know-how will reach, it will be processed in same way and judged on the base of the recently created knowledge and skills too. Although Long Lamai's experience of establishing a tourism business is in its initial stages, other Penan communities (such as Long Balai) consider it an exemplary project and have expressed formal interest to learn and replicate the same practices of tourism activities in their community.

The objective of the study is to conceptualise an integrated model of the community knowledge creation process, stages, knowledge domains and assimilated activities. While the TIE model facilitates the simplification of the community knowledge-creation process, it does not attempt to explain all the aspects of knowledge and knowledge creation. However, we expect that the model will help researchers to understand and examine different indigenous knowledge creation stages.

4.5 Summary

This chapter has two contributions: first, it presents a theoretical model of indigenous community knowledge creation process, addressing a theoretical gap in IKMS. Second, it emphasises the community's activities as part of the IKMS process and the need to address them 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. Community governing institutions such as the Council of Elders or community representative councils *Jawatankuasa Kemajuan dan Keselamatan Kampung* play an important role in the conceptualisation stage where the community analyses a problem and makes decisions. The scope of the current chapter is limited to the IK creation process. We will discuss the role of governance, and the concept of indigenous knowledge governance, in detail in the following chapters.

CHAPTER 5 EXPANDING IKM FRAMEWORK WITH THE NOTION OF INDIGENOUS KNOWLEDGE GOVERNANCE

Chapter 4 illustrates the conceptual model of the indigenous knowledge creation process and highlights the relationship between community governance systems and indigenous knowledge management.

In the indigenous way of life, community govern their knowledge by coordinating activities that are influenced and controlled by social and cultural systems. Efforts in managing Indigenous Knowledge (IK) that produce databases using information and communication technologies face a number of shortcomings (Agrawal, 2002) such as the lack of consideration of the holistic structure of Indigenous Knowledge Management (IKM), being overly reliant on persistent data and the loss of control over knowledge assets when they become stored and structured in databases. There is a need to study the relationship between knowledge governance systems and IKM. So far, we have not encountered any IKM model that fully addresses the shortcomings mentioned above.

This chapter addresses these challenges by presenting the concepts of Indigenous Knowledge Governance (IKG) and Indigenous Knowledge Governance Framework (IKGF) as a holistic and living model of Indigenous Knowledge Management Systems (IKMS). First we will analyse the concepts of governance and data, as well as information and knowledge governance. Subsequently, the chapter presents the Indigenous Knowledge Governance (IKG) approach based on the holistic nature of IKMS. To further illustrate the IKG approach, the last part of the chapter describes the indigenous knowledge governance framework and the corresponding components in detail.

5.1 The Concept of Governance

IK does not exist in a vacuum but is embedded in and linked with local institutions and governance system (Berkes et al., 2002). The term "governance" is subject to many different understandings. There have been numerous definitions and approaches to governance and different definitions that emphasise different features (Fig. 5.1).

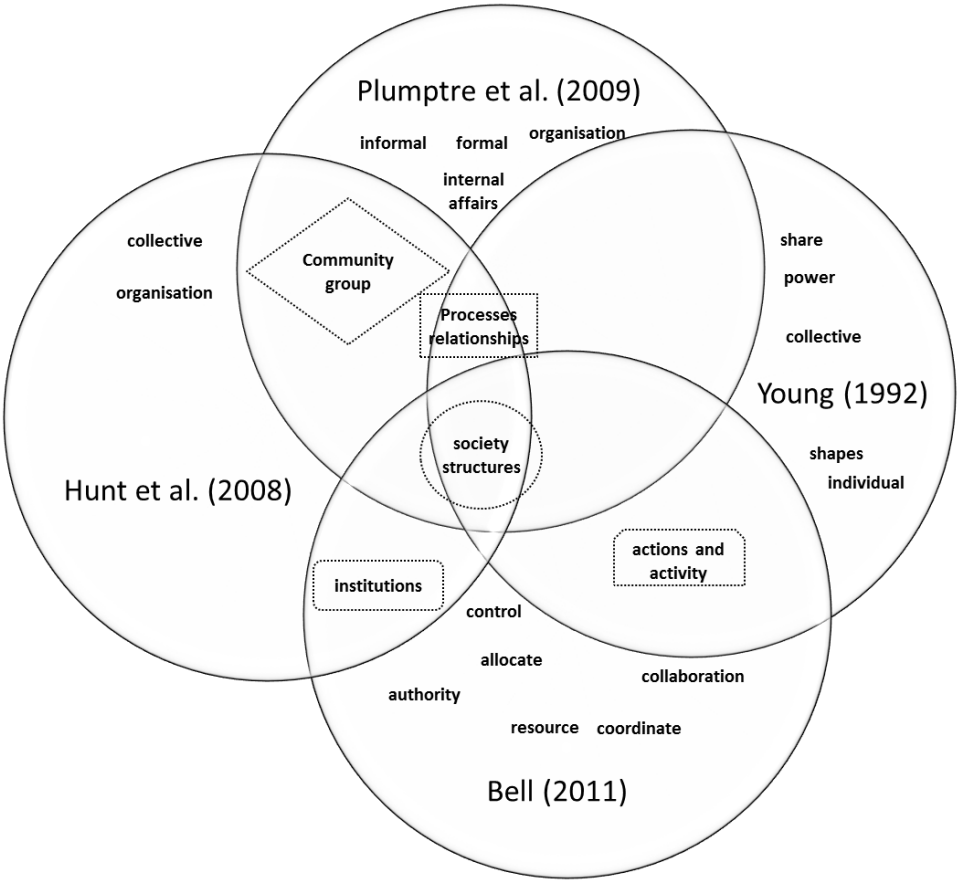

Figure 5.1: The commonalities of four "governance" definitions

Young (1992) defines governance as "the structures and processes by which societies share power and shape the individual collective actions". Hunt et al. (2008) refer to governance as

"evolving processes, relationships, institutions and structures by which a group of people, community or societies organise themselves to collectively achieve things that matter to them". According to Plumptre and Graham (2009) governance can be seen as "encompassing both formal and informal structures and processes through which a group, organisation, community or society conducts and orders its internal affairs as well as its relations with others". Bell (2011) on the other hand defines governance as "the use of institutions, structures of authority and even collaboration to allocate resources and coordinate or control activity in society".

Evidently, "governance" is a term employed in many different scenarios and so there is a lack of consensus on its scope within the literature. Based on our review, shown in Figure 5.1, the key components are processes, relationships, structures and controls. Hence we describe governance as mainly the control of processes, structures and actions for resource management and dissemination of knowledge by collective, coordinated and assimilated activities.

Conventional approaches of ICT-based IKM tend to be more focused on managing data and information resources than on processes and activities (Zent, 2009). For indigenous community, knowledge represents a critical resource as an intrinsic part of the governance system. Hence, it is necessary for researchers and Information and Communication Technologies (ICT) professionals to address the needs of holistic indigenous governance systems by considering the parts (processes, technology, people, economic, social and cultural aspects) and also how the parts interact to form a whole system. Existing tools have been designed and implemented in the same way as practiced in organisational data and information governance initiatives. This mainly arises from the lack of clear conceptual distinctions between data, information and knowledge governance approaches. As there is a big gap in this respect, we explore the related literature that covers a broader scope of data, information and knowledge governance. In the next section, we

will analyse the concepts of data, information and knowledge governance in organisations as well as the context of indigenous community.

5.2 Data, Information, Knowledge and Indigenous Knowledge Governance Concepts

Existing literature incorporates diversified meanings for data, information and knowledge. Zins (2007) analysed 130 definitions of data, information, and knowledge as formulated by 45 scholars, although the terms "information" and "data" have been used interchangeably. For example, the Data Governance Institute (DGI) considers data governance to be "management of information". DGI defines data governance as a "system of decision rights and accountabilities for information-related processes, executed according to agreed-upon models, which describe who can take what actions with what information, and when, under what circumstances, using which methods" (Thomas, 2006).

However, IBM the American multinational technology and consulting corporation presents information governance as "management of data" and defines it as "the people, processes, policies and technology used to formally manage and protect structured and unstructured data assets to guarantee commonly understood, correct, complete, trusted, secure and findable information throughout the enterprise" (Ferguson, 2011). On the other hand, in defining the concept of knowledge governance, the focus is on the higher-level knowledge processes and governance structures instead of lower-level data and information architecture. For examples, Foss (2007) defines Knowledge Governance Approach (KGA) as "choosing governance structures and coordination mechanisms so as to favourably influence knowledge processes, such as transferring, sharing, integrating, using and creating knowledge". The KGA approach highlights some fundamental issues in the area of Knowledge Management (KM), which have

received relatively little attention before. The KM field requires moving toward understanding the sources of where knowledge resides and how knowledge is created as well as enhancing the understanding of how knowledge develops and transfers within and outside organisations. The KGA provides a collectivist approach and highlights the importance and existence of the social environment in which individuals are embedded. The governance structures and coordination mechanisms work as a specific apparatus that is deployed to influence organisational members' behaviours, particularly in relation to their engagement in knowledge processes (Foss & Michailova, 2009).

The review concedes that data and information governance concepts focus on the data and information architectures (as commodifiable asset) whereas the KGA emphasises the relationships between knowledge management and governance structure (more on the processes). The IK assets manifest principally in implicit and tacit forms – less so in explicit form -- so the information and data governance concepts do not adequately represent the holistic concept of indigenous knowledge governance. However, the combination of the concepts can offer some leeway and flexibility for developing the conceptual boundaries of indigenous knowledge governance where the factors of knowledge processes, decision-making, actions, beliefs, expectations, interests, imagination, preferences, social and cultural structure and activities are important to consider.

Based on our review, we define indigenous knowledge governance as the people, processes, system of governance 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.

This 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, the next challenge is to model the IKM processes and structure within the context of indigenous knowledge governance. For this purpose, in the next section, we present an analysis on selected frameworks of data, information and knowledge governance.

5.3 Data, Information and Knowledge Governance Frameworks

This section provides a review of Data, Information and Knowledge Governance Frameworks.

Khatri and Brown's Data Governance Framework

Khatri and Brown (2010) presented a data governance framework (Fig. 5.2) that includes five interrelated decision domains: Data principles; Data quality; Metadata; Data access; and Data lifecycle.

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.

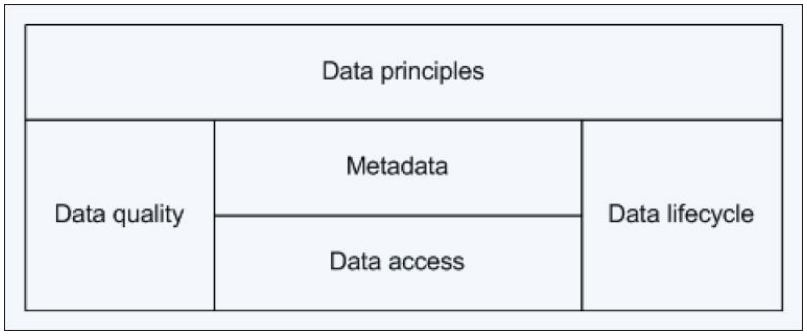

Figure 5.2: Decision domains for data governance (Khatri & Brown, 2010)

Data Governance Institute's Framework for Data Governance

Another framework (Fig. 5.3) 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.

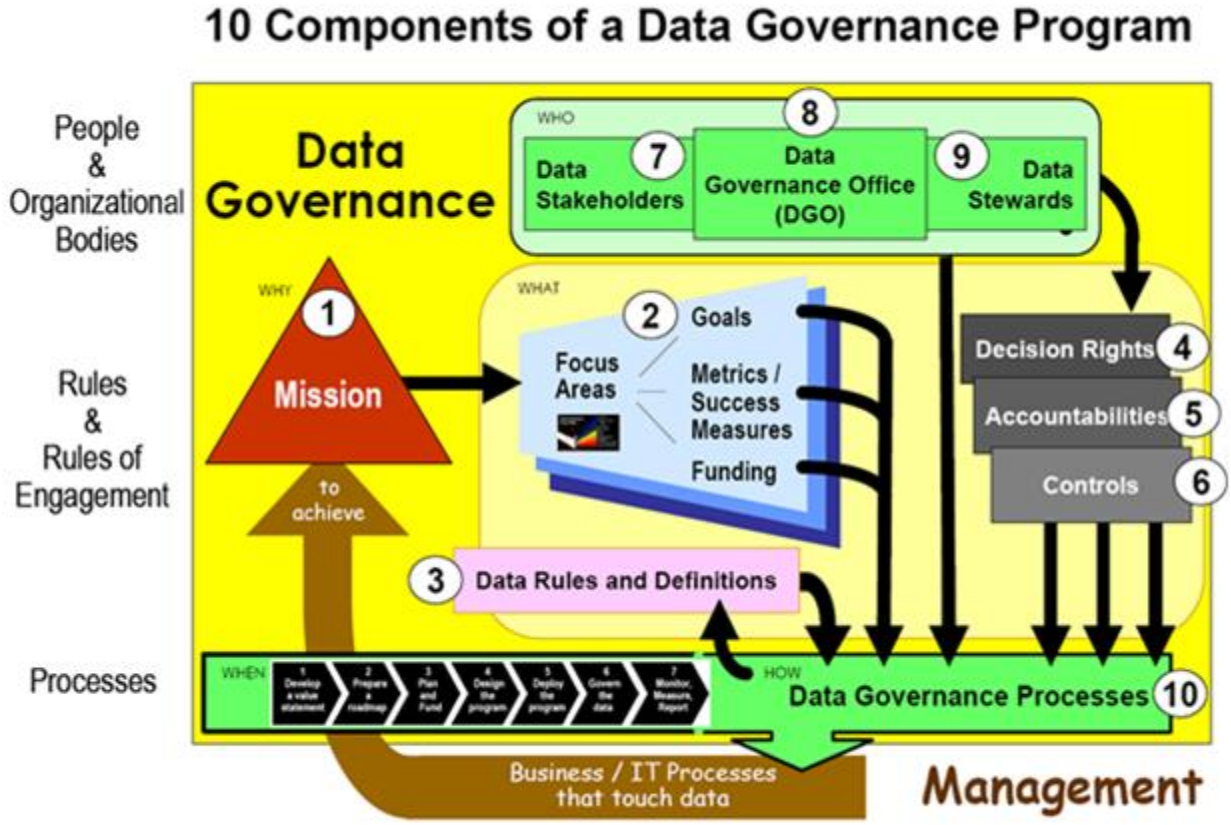

Figure 5.3: The DGI Data governance framework (Thomas, 2006)

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.

The First Nations' OCAP® Framework

The Ownership, Control, Access and Possession (OCAP) principle guidelines and framework (Fig. 5.4) is a Canadian First Nations initiative to govern and control health data in the Regional Longitudinal Health Survey. The OCAP guidelines are developed by the Ottawa based First Nations Information Governance Centre. The guidelines provide a way for community involved in research partnerships to make decisions regarding what research will be conducted, for what purpose data will be used and shared, where data will be physically stored, and who will have access to it (First Nations Centre, 2007).

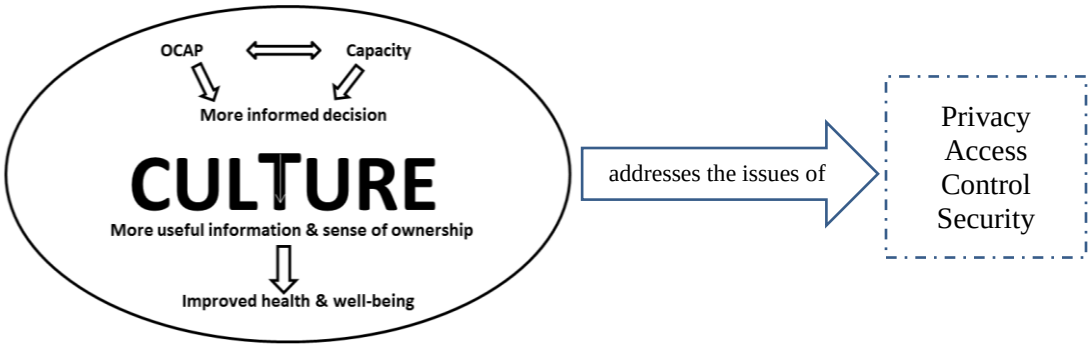

Figure 5.4: OCAP framework and addressed issues - adapted from First Nations Centre (2007)

One of the strong features of OCAP is that it also provides guidelines to researchers on how to engage a community in project planning and implementation. On the other hand, it is only limited to data and information governance when the knowledge takes explicit or codified forms.

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 (Fig. 5.5) (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.

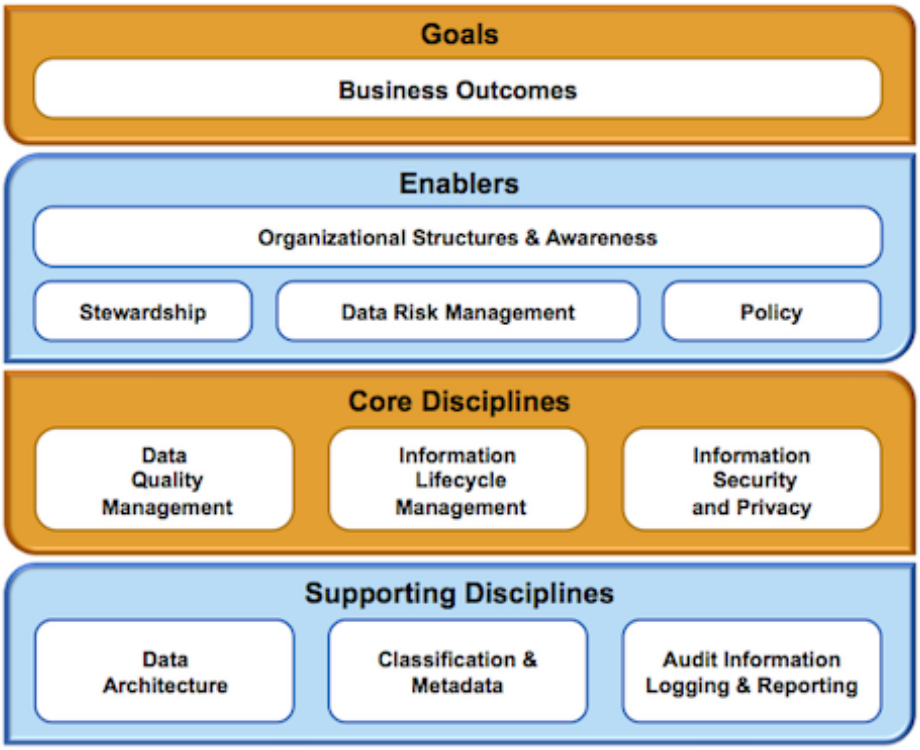

Figure 5.5: IBM Information governance framework (Soares, Deutsch, Hanna, & Malik, 2012)

The review of the literature has shown that no framework exists that addresses shortcomings listed above; that is, no available framework to model the 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).

As discussed above, the concept of IKG modelled as a holistic IKMS would then consist of tangible aspects (people, technology, and structured data) and intangible aspects (processes, system of governance and unstructured knowledge assets). IKMS is a complex structure where the different components are interconnected with each other and cannot be understood in isolation. Hence, a framework or conceptual model is required that not only examine the "parts," but also the process of interaction between the "parts," making a "whole system".

To address the literature gap, in our longitudinal study and engagement with community, we developed an Indigenous Knowledge Governance Framework (5.6) as a holistic model of IKM. The framework is presented and described in next section.

5.4 Indigenous Knowledge Governance Framework

Below, we feature a logical architecture view of the indigenous knowledge governance framework. At the highest and most abstract level, the logical architecture view of any system can be considered as a set of cooperating components grouped into layers. The standard IKGF (Fig. 5.6) contains seven layers: Capital Layer; IK Governance Layer; Activity Layer; KM Layer; Data Repository Layer; Community Engagement Layer; and Cross-Cutting External Environment Layer.

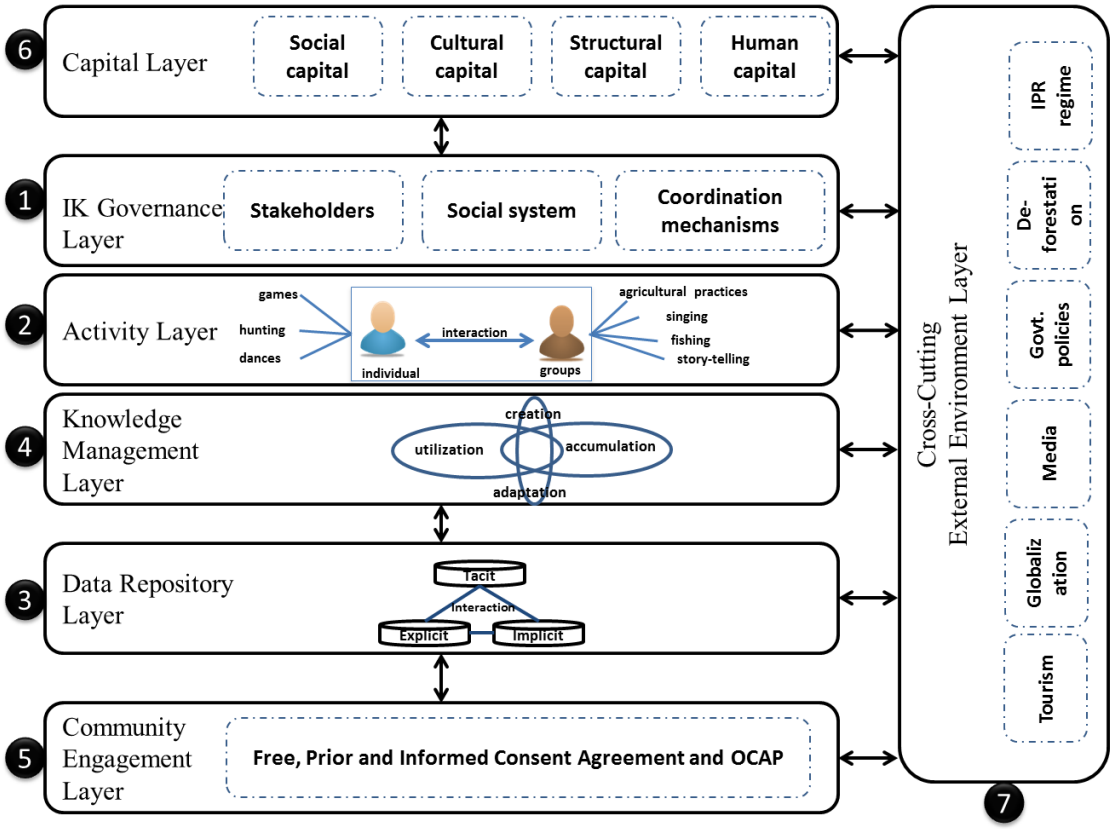

Figure 5.6: The logical architecture view of a layered indigenous knowledge governance system

5.4.1 Formation of the Layered Model

The different layers of IKGF have been derived and expended from the frameworks and models that were examined earlier (as shown in Fig. 5.7) such as Khatri and Brown (2010) (Fig. 5.2), DGIs Framework (Fig. 5.3), and IBM's Information Governance Framework (Fig. 5.5).

To address the issues of IK de-contextualisation and the enabling environment, we leverage the OCAP Framework (Fig. 5.4), IK learning system (Fig. 3.7) and TIE Model (Fig. 4.7). Figure 5.7 shows that no single comprehensive framework exists that addresses shortcoming mentioned in the previous chapters and incorporates the many difference facets and conditions of IKG.

To further explain the framework, we describe details in a non-sequential manner as two or more processes can run in parallel despite the layered order.

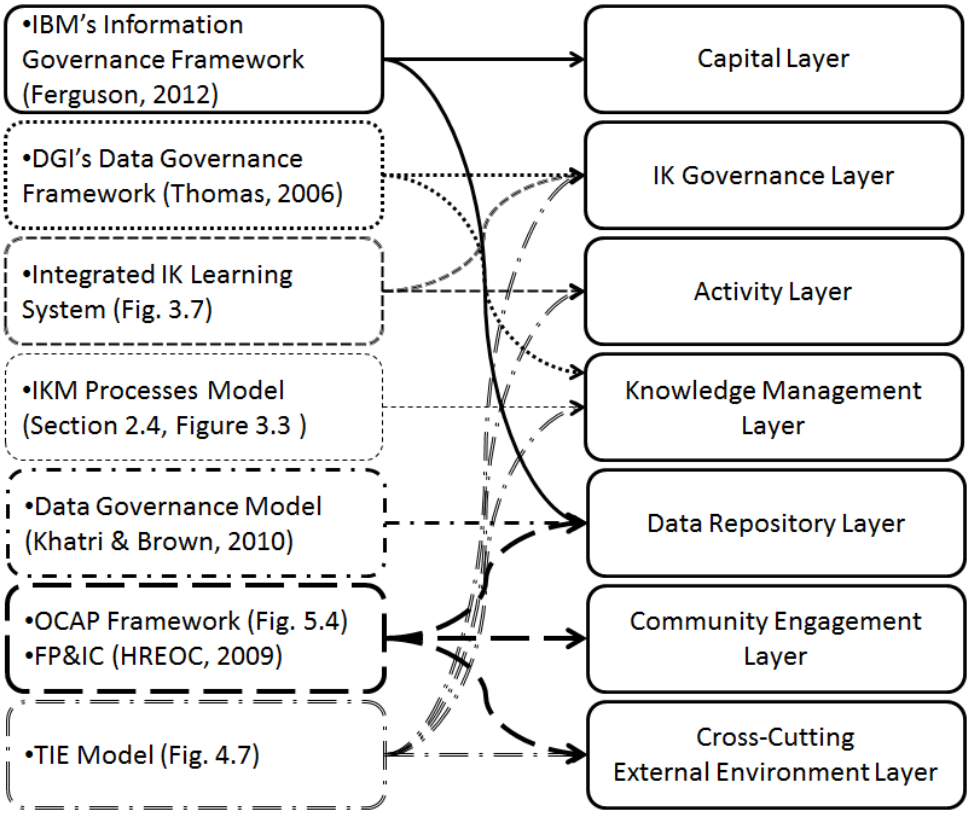

Figure 5.7: The relationship between indigenous knowledge governance framework layers and the existing frameworks and models

The details of the each layer are as follows:

5.4.1.1 Indigenous Knowledge Governance Layer

The main layer of the framework is the IK Governance Layer (see (1) in Fig. 5.6), which comprises three main components; stakeholders, social system, and coordination mechanism. The components in this layer are part of community governance system that controls the knowledge processes by influencing community activities.

Stakeholders: Stakeholders of IKMS can be divided into direct and indirect stakeholders (Oppenneer, 2008). Direct stakeholders are the current members of a community and their involvement depends on their role, traditional rights, gender, age, and/or profession such as traditional healers or community leaders. Community leadership always has the main role in an IKMS (Greyling, 2008) and their participation should be absolutely central to any information technology plan related to digital collectives in indigenous cultures and communities (Holland, 2002). This has been overlooked by the existing IKMS that take outside administered research perspective. Being part of the deep-rooted community governance structures, leadership has influence to mobilise the community and inform them of the directions of IKM program to suit community needs. Indirect stakeholders include the future generation, ancestors and the outside word.

Social System: The social system represents social structures that support and facilitate the knowledge management activities in indigenous community. IK exists as part of an intricate, elaborate and complex total social system that comprises cultural, economic, political and gender aspects within a social group (Botha, 2008). It creates the social contract between the stakeholders of the IKMS in three regards: it specifies the knowledge resources that stakeholders contribute to the common pool; it specifies the way decisions are to be made on the use of the combined knowledge resources; and it specifies how the participants share the benefits produced by the joint efforts. The social system guarantees the access control of the commonly understood, correct, complete, trusted, secure and findable information throughout the community. The ICT-based IKMS must take into account, either explicitly or implicitly and the social system within which knowledge is produced and consumed.

Coordination Mechanisms: The coordination mechanisms or combined actions and ceremonies provide a platform for peers and intergenerational learning and facilitate the exchange of knowledge flow from diverse contexts. The coordination mechanism has a key role in IKG to ensure IKM is assimilated into on-going community activities. The social system supports the coordination mechanisms by providing norms and rules (control) while the coordination mechanisms provide a platform for collective activities that strengthen the connections in a community. These connections decrease one's sense of personal isolation and develop a sense of connectedness and trust between the community members. The IKM program should be integrated with everyday activities and social and cultural ceremonies, rather than being introduced as additional processes and procedures. It is tantamount to "forcing someone to do something extra", which is an ineffective way of managing people, and counter-productive for any knowledge management initiative.

5.4.1.2 Activity Layer

Members of indigenous community engage in activities that encompass a common interest and on-going learning through practice, not only in their leisure time, but also as part of their daily work. These activities and experiences constitute the tacit knowledge base of a community and take the form of unstructured knowledge assets. The Activity Layer of IKGF (see (2) in Fig. 5.6) represents the management of these unstructured knowledge assets in the holistic indigenous knowledge governance system. The controlling or coordinating activities in community or in organisations are a function of governance (as defined in Section 5.1) and a medium to influence the knowledge management processes (Fazekas & Burns, 2012). For example, in Australia the Torres Strait Islanders have traditional dances, a form of activity that can be performed in specific cultural ceremonies. These dances play a central role as a unique way of knowing and

learning, with both intrinsic and instrumental value. The ceremonies work as a governance structure to control these performances. The dance performances usually occur in a "live" context under the pressure of immediacy, with the objective of a spontaneous transference of ideas. The alienation of these dances from the ceremonies or organising the ceremonies without these dances will affect the whole indigenous knowledge system.

5.4.1.3 Data Repository Layer

The Data Repository Layer (see (3) in Fig. 5.6) in IKGF represents community data sources, repositories and knowledge bases. These data repositories contain indigenous languages, songs, stories, skills and experiences in the minds of the indigenous peoples (Enrique, 2007). Data repositories support the community members activities such as storytelling, singing and dancing, which are the ways they keep IK alive and passed on from generation to generation. An example is the Songlines or Dreaming tracks of the indigenous Australians within the animist indigenous belief system (Chatwin, 1998). The paths of the Songlines are recorded in traditional songs, stories, dance, and painting. By singing the songs in the appropriate sequence, indigenous people could navigate vast distances, often travelling through the deserts of Australia's interior. Since a Songline can span the lands of several different language groups, different parts of the song are said to be in those different languages. In this case, language is not a barrier because the melodic contour of the song describes the nature of the land over which the song passes.

This example shows that repositories are closely connected with implicit context (the activities and governance structures), which needs to be considered while designing ICT-based IKMS. As shown in DGI Data Governance Framework (5.3), there is a need for proper characterization of data stewardship, control of data flow and data value creation. This is only possible if the indigenous community has the necessary level of skill, the infrastructure, and an environment

that enables their active participation in design, development and implementation of ICT-based IKMS.

5.4.1.4 Knowledge Management Layer

IK is a response to the practical challenges encountered in everyday life. It is a holistic and living system based on work practices and often carried out in particular physical and social contexts, which make these practices possible, such as farming, fishing and hunting. To perform the assigned tasks or activities, community members make every effort to adapt, create and utilise relevant knowledge and accumulate it in knowledge repositories (Fang, Huang, & Liu, 2004). The Knowledge Management Layer (see (4) in Fig. 5.6) represents these processes within the IKGF. Conventional approaches to ICT-based IKMS focus more on creating databases of artefacts while IKGF emphasises knowledge processes, i.e. how IK is created, who passes it on to whom, in what situations and contexts transmission occurs, why it is lost or changed, what is the social organisation of knowledge, how social relationships regulate the flow of information, how the patterns and contexts affect knowledge, and what social and ecological factors promote its conservation or extinction.

5.4.1.5 Community Engagement Layer

As discussed earlier, indigenous people need to participate in decisions related to information technology plans (Holland, 2002). They also need to influence policies and laws that support concepts of traditional protection, ownership, access and use that go beyond limited intellectual property laws (Kamira, 2002). This is only possible if indigenous people have the skill and understanding of information technology and researchers have a better understanding of the local system. The Community Engagement Layer (see (5) in Fig. 5.6) of IKGF represents the process

of establishing collaboration between researchers and community representatives. Engagement requires an open, active and voluntary approach to dialogue that develops a common vision and mutual understanding between all the stakeholders. The Free, Prior & Informed Consent principle is an internationally-acknowledged tool that is used to facilitate a thorough engagement process (HREOC, 2009). *Free* refers to a process that is self-directed by the community and obtained without any coercion, expectations or externally-imposed timelines. *Prior* refers to a period of time in advance of an activity or process when consent should be sought. *Informed* refers to the type of information that should be provided prior to seeking consent. *Consent* refers to the decision made through the local customary decision-making process. It refers to the right to say "no" or "yes" by the target group, the right to form an independent opinion after being well informed (Hajara, 2010). Free, Prior and Informed Consent (FP&IC) covers the overall partnership process, activities and decisions about rights and liabilities between the stakeholders of the IKM project. Another instrument is the OCAP guidelines and standards to ensure that the community is well-aware, informed, and has agreed with the local research agenda regarding what kinds of data are needed, how that data can best be obtained, about ownership of data, and how application of research findings can add value to local governance initiatives.

5.4.1.6 Capital Layer

The Capital Layer (see (6) in Fig. 5.6) in IKGF represents the concept of "the capital" as a key outcome of indigenous knowledge management in the community. The main aim of the knowledge management activities is to affect changes in knowledge resources, the cultural capital, the human capital, the social capital, and the structure capital (Holsapple & Joshi, 2001).

Social Capital: The social capital of a community can be assessed through a combination of its bonding (within group relations), bridging (inter-community or horizontal ties), and linking

(relations with formal institutions or vertical ties) dimensions (Mignone & Henley, 2009). Participation in the community collective activities is a platform for knowledge-sharing and learning that strengthens the bonding and bridging relationship within a community.

Cultural Capital: Cultural capital encompasses different sets of linguistic and cultural competencies that individuals and community inherit by way of the class-located boundaries of their family or community (Aronowitz & Giroux, 1987). McIvor, Napoleon and Dickie (2009) considers cultural capital as the repository of wealth that exists in community in the form of indigenous language, cultural knowledge, practices, and traditions.

Structural Capital: Structural capital includes methods, concepts, processes, infrastructure and knowledge bases that belong to organisations or the community as a whole (Muhammad & Ismail, 2009). Structural capital is considered as explicit knowledge assets and covers everything remaining, when employees or community members are excluded.

Human Capital: Human capital can be defined as the capacities (such as knowledge, skills, and abilities) that individuals or group of a community have and can be used to sustain their system (Hallsmith & Lietaer, 2011). It includes individual and collective skills, know-how, experience and expertise and it varies whenever changes in the community human resources occur.

The capital layers help in making decision on broader outcomes of IKMS initiatives. For example, the community members are generally more concerned about social and cultural capital while researchers normally focus on creating structural capital. Hence, the desired outcome can be clearly identified and addressed in initial stages of the project.

5.4.1.7 Cross-Cutting External Environment

The components of the Cross-Cutting External Environment (see (7) in Fig. 5.6) contain common functionality that affects the entire IKGF. For example, Ayahuasca, an Amazonian

plant and the main ingredient of an indigenous healing ceremony, is patented under the modern IPR system by an American scientist without the consent of the Amazonian local communities (Knight, 1998). Ayahuasca is used in a specific ceremony in which only shamans are authorized to prepare it and no member of the community can drink it without the guidance of a shaman. Although the patent has been revoked, the researcher was declared as "An Enemy of Indigenous Peoples" by the Amazonian Indians tribes (Wu & Lu, 2005). The Ayahuasca case shows how "external factor-IPR" affects the whole IKMS of the Amazonian Indians tribes, which includes the healing ceremony, activities of preparation and use of drink, the social and cultural context, beliefs; however, the case showed how the American scientists failed to consider the community's consent, and their social and cultural capital.

To control the adverse effects of the external environment on IKMS and to extend the community's capacity to be a part of the decision-making processes, tools such as OCAP and FP&IC are recommended.

5.5 Discussion

The indigenous knowledge management system is closely tied up with complex systems of governance, activities, social and cultural frameworks and tacit, implicit and explicit knowledge sources. It has been highlighted that there are profound differences in the management and governance structures of knowledge in indigenous community and those of non-indigenous organisations. In organisations, the knowledge is mainly explicit, so research efforts focus more on developing frameworks, tools and methodologies for data and information governance. The structure of knowledge management in indigenous community is different, as knowledge mainly takes implicit and tacit forms and is governed by social and cultural system. Hence, the data,

information and knowledge governance frameworks of organisations cannot be used to understand and model the holistic system of indigenous knowledge governance.

Only making the explicit knowledge form can contribute in management of one (accumulation) of the processes of IKMS, but it can lose the other essential components the unstructured and non-persistent knowledge source such as community activities and social and cultural system. These are the community collective activities and ceremonies that provide the enabling environment to IKM processes so the knowledge accumulation, adaptation, creation and utilisation processes can occur.

The proposed IKGF accommodates structured and unstructured data sources and enabling environment in one single model and demonstrates the working relationship of interconnected, inseparable components of IKMS. It is also notes that knowledge management research focuses mainly on designing and developing conceptual frameworks. Limited attention has been given to implementation and validation of these frameworks. Hence, the validation and implementation of IKGF would be a challenge, but a notable contribution to the research field.

5.6 Summary

The chapter examines the definitions of data, information and knowledge governance in organisations and discovers that these definitions do not properly relate to the structure of holistic indigenous knowledge management. Existing works have only partially addressed IKM and have to a large extent neglected the community perspective. Hence Section 5.2 describes the concept of indigenous knowledge governance. Section 5.4 presents the conceptual indigenous knowledge governance framework and describes in details the different layers of the model. The model 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. In the next chapter, the IKGF is validated with specific case studies to show whether it can be used to understand and depict the community's holistic indigenous knowledge management system.

CHAPTER 6 INDIGENOUS KNOWLEDGE GOVERNANCE FRAMEWORK: CASE STUDY OF THE PENAN TORO

In Chapter 5, we presented the Indigenous Knowledge Governance Framework (IKGF) as a holistic approach to describe, in a layered model, assimilated relationships and alignments between Indigenous Knowledge Management (IKM) processes, data repositories, activities and governance systems. To validate the framework, the current chapter presents an explanatory case study of using IKGF as an analytical tool for understanding Penan Toro activity from an IKM perspective. In the first section, we present IKGF for the Penan Toro activity. Based on that case study, we will extract the description and examples for each component of the framework.

6.1 IKGF for Penan Toro System

In order to illustrate how IKGF can be used to represent the holistic Indigenous Knowledge Management Systems (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. Before describing the detailed design, we provide the context and introduce the Toro activity in the next section.

Penan, a hunter-gatherer indigenous group in Borneo, depend on the forest for hunting and for collecting various forest products. *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. An entire family, parents and children, complete

the journey together. Normally, the parents do not bring along children below the age of seven. There are six activities in the Toro journey. The activities start from leaving the *lamin Toto* (house in the village) and finding a place in jungle that has enough food such as fruit trees, fish in nearby river, sago plants, and animals for hunting. When a family finds the place, they establish their *lamin Toro*, or traditional temporary hut. The subsequent activities include extracting sago, cooking food, catching fishes and hunting. Figure 6.1 depicts the IKGF for Toro considering it a collaborative indigenous knowledge management system.

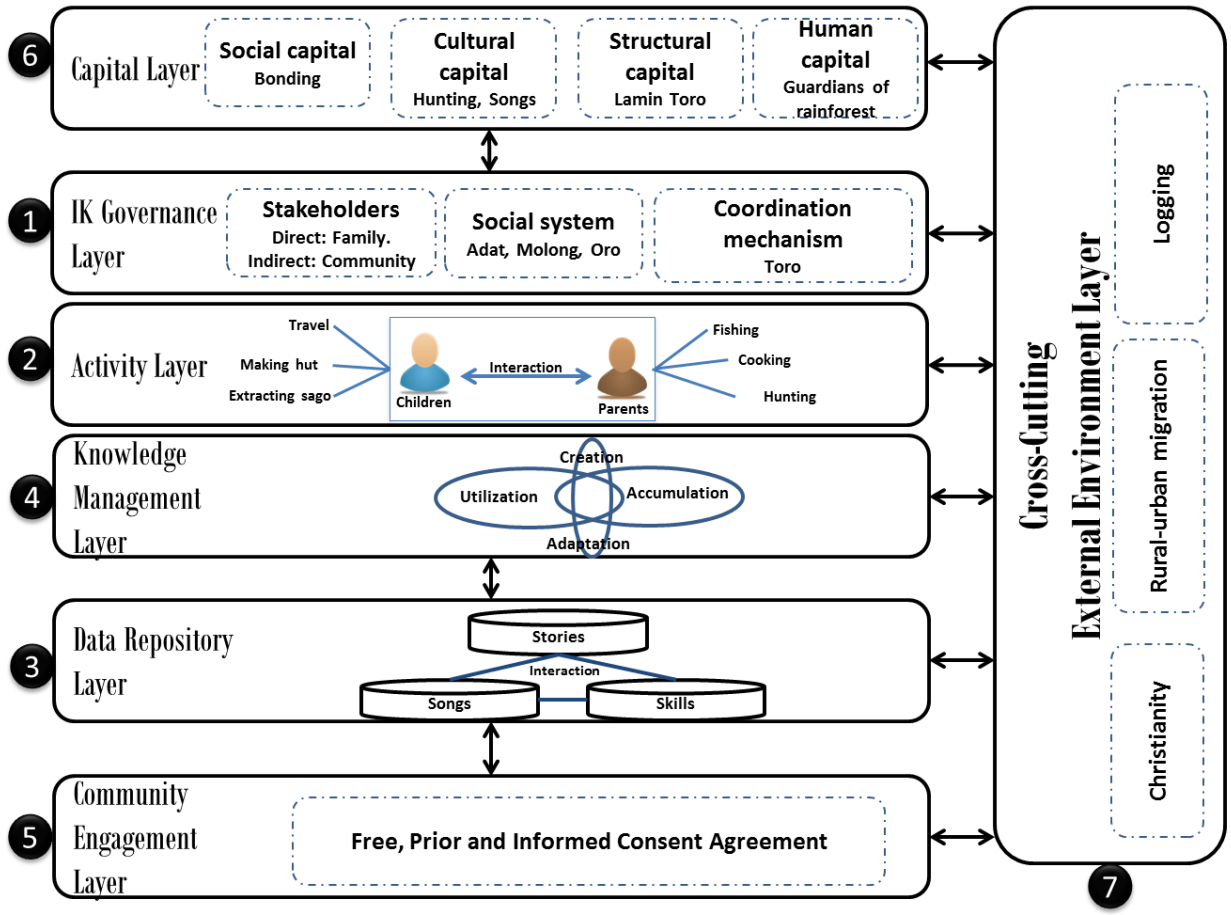

Figure 6.1: Indigenous knowledge governance framework for Toro

The Penan Toro IKGF (Fig. 6.1) describes the embedded Knowledge Management (KM) processes within a context defined by activity-centred social exchanges closely tied in with

implicit values and sensitivities. As we take a community-centric perspective, the context defines situational parameters that are then aligned with social, cultural, structural and human attributes and constraints to sustain and enrich the IKMS.

In the following section, we illustrate the components and layers of IKGF with the description from Toro activities. We follow the same non-sequential order to present the layers of the framework.

6.1.1 Indigenous Knowledge Governance Layer

As depicted in Figure 6.1 (1), the Indigenous Knowledge (IK) Governance Layer consists of three main components: stakeholders, the social system and coordination mechanism. First we will define the components in the context of the Toro journey and then we will describe the relationships between these components using an example.

Stakeholders: The direct stakeholders of the Toro are the parents and children of the family who undertake the journey. As shown in the framework, the indirect stakeholder of Toro is the greater Long Lamai community, because the journey can be only performed in the forest, which is defined as a collectively-owned resource of the community, to which the family belongs. The journey can also be performed in other communities' forests but only after obtaining the explicit permission.

Social System: The IKGF (Fig. 6.1) shows the Penan *adat*, *molong* and *oro* as the three main components under the social system (we will define *molong* and *oro* in below section). The social system governs the activities and knowledge processes that occurs during Toro. The context embedded in ontology and entities of land, animals, plants, waterways and spiritual systems and interconnected with the processes of: listening, sensing, viewing, reviewing,

watching, waiting, observing, exchanging, sharing, conceptualising, assessing, modelling, engaging and applying the knowledge.

Coordination Mechanisms: Yakel and Torres (2007) highlight "collaborative activities" as one of the ways younger generations of indigenous community can learn and engage with traditional knowledge. The IKGF (Fig. 6.1) shows Toro as a coordination mechanism and a platform that enables the two direct stakeholders, parents and children, to exchange and learn the indigenous knowledge related to the forest.

Before describing that how these components works together and contribute in the holistic IKMS of Toro, we define some of the terms that will be used within the context of IKGF.

Molong is the Penan social system that deals with conservation ethics and stewardship of resources. In the Penan *adat*, one can *molong* a resources (such as tree or land) by making a declaration. The declaration process for the stewardship over a tree includes marking the tree and clearing the surroundings of the tree. The declaration works as a public statement that there is a steward of this specific tree who will take care of the tree and in return gain rights to use the tree, which will then be protected by the *molong* system.

Oro is a mark or identifying sign. *Oro* is a set of symbols or communication language that the Penan normally use to mark the *molong* resource or more generally while travelling in the jungle. From IKM perspective, Garen Jengan, an elder from Long Lamai community, describes the three main factors of Toro as certain *context*, *ways* and *time*. He said, *"The knowledge of the jungle is required to be taught and learned in certain* ***contexts****, in certain* ***ways*** *at certain* ***times****"*. The Toro journey is normally performed in the places where the community or the family has a stake in the protection of natural resources. To perform the Toro journey, one needs to have extensive knowledge of the plants, tracks and animals, which one may encounter in the forest. All these

are parts of the *contexts* that affect the knowledge processes and resources. When the Long Lamai community lost their primary forest and wild plants surrounding their village in a forest fire, it resulted in the loss of knowledge about plants, birds and animals, leading to many of the older generation forgetting parts of their indigenous knowledge. According to Garen Jengan, *"this is one of the reasons, that many of the young people from Long Balai have better knowledge of wild plants then the older people of the Long Lamai".* Long Balai is another Penan village in Ulu Baram, located in the middle of the primary forest with a two to three days walking time to Long Lamai. Hence, it is noted that the stake of community members in the forest also defines their level of knowledge.

The *oro* and *molong* are the "*ways",* which facilitate learning and teaching in the forest. For example, the *oro* symbols include information of tracks, schedule of meeting, number of people, quantity of food and directional cues. Without *oro,* it is not possible for Penans to communicate inside a dense primary forest. The children who help their parents in the whole process of clearing and marking the trees also learn the values and ethics attached to the *molong* and *oro* systems. They learn not only the skills of how to "own" a tree but also the values that bind the stewards to fulfil some obligations.

In addition to the holistic nature of Toro IKMS, the social system *molong* and *oro* is dynamic in nature. The community creates news rules for *molong* for instance, a community member in Long Lamai can *molong* a tree for two years subject to the renewal of mark and approval from the village head. They can also create new symbols (*oro*) to represent a new situation in a message. This is seen as a living system that can be blended in and adapt to a variety of context and scenarios.

6.1.2 Activity Layer

The Activity Layer in IKFG (see (6) in Fig. 6.1) shows the number of joint activities that create a cross generation platform for knowledge transfer. Normally there are seven activities in a Toro journey. The activities include travel (see (1) in Fig. 6.2) and finding a suitable place in the jungle for building hut (see (2) in Fig. 6.2), collecting firewood and cooking food (see (3) in Fig. 6.2), catching fishes (see (4) in Fig. 6.2), hunting (see (5) in Fig. 6.2), extracting the pulp (*Paleu*) (see (6) in Fig. 6.2), and thrashing the pulp to get sago (*Maték*) (see (7) in Fig. 6.2). The Figure 6.2, depicts the main activities performed in a Toro journey.

Figure 6.2: Activities in Toro (a drawing of local Penan artist, Gayut Lim)

There is a gender-based division of labour as well as knowledge in performing the Toro activities. Thrashing the pulp to extract sago and cooking food are the activities performed by the

women folks while solely men folks perform hunting and extracting the pulp. The fishing and making of huts are performed together. The distribution of activities also indicates that women and men have expertise and knowledge based on their experiences and labour. For example, males have better knowledge about identifying the pulp while females possess good knowledge about identifying the burning wood and vegetables for cooking.

Normally when a child turns seven years old, he or she will be brought to the jungle. The boy will accompany his father and learn from his father the hunting techniques such as hunting without a blowpipe, walking in the jungle without producing any sound and how to properly tie the animal after hunting. A girl will accompany her mother to learn the process of collecting water using bamboo, collecting firewood, cooking and making porridge (*linut*) from sago. Children also gradually gain knowledge about the plants and trees. The plants knowledge domain has some sacred attributes. Normally the children only learn the detail knowledge about the poisonous plants when they become mature and are able to hunt with a blowpipe. A boy is taught how to move along the river with the sun to guide him during the hunting activities, so that he will not be lost in the jungle. The social system is a part IK governance layer (Fig. 6.1) that governs all these activities. For example, the pulp for sago cannot be extracted from a tree that is already declared as being taken care (*molong)* of by someone else.

6.1.3 Data Repository Layer

The Data Repository Layer of IKGF (see (3) in Fig. 6.1) represents the tacit, implicit and explicit sources of data and information that support the community members when they are performing the Toro activities. The Penan have a rich oral literature of folk stories (*suket*), songs (*sinui*) and prayers or chants (*tivai*). The *suket* are divided into *suket jian* (good stories), *suket sa'at* (bad stories) and *suket kelete* (playful stories). The *sinui* are categories into two types; *hak kajung*

played to praise others and *ipet* played during the marriage ceremony, or to somebody the singer admires. *Tukit* is another form of stories and about the real history about the Penan legends or about any particular incidence. In the Toro journey when the family is relaxed in the evening, the father tells the stories to the children and teaches them how to play *Keringot,* a nose flute, while the mother plays the *Pagang,* which is another musical instrument made of bamboo. The songs represent stories and myths and tend to imitate animal sounds.

Data repositories are governed by omens and taboos as part of the social system. For instance, if the *Pagang* is played by the father, it is believed that he would get attacked by the animals in the forest. Hence, any system that is developed for the purpose of managing these repositories needs to be sensitive to the values and beliefs that support the existing structure as well as to accommodate the social and cultural framework in which the data repositories are rooted.

6.1.4 Knowledge Management Layer

The Knowledge Management Layer in IKGF (see (4) in Fig. 6.1) represents the knowledge management processes that occur when the activities are performed as part of Toro. For example when the parents build the hut (*lamin toro*) they exercise the knowledge utilisation process and use their skills. The children also take part and help the parents while at the same time learning how to make the hut. After learning, the children interpret the information in the local context, and assimilate the newly-acquired knowledge in the activities by assessing, modelling, engaging and applying.

The Penan IKM is empirical as it is based on practices such as extracting and thrashing the pulp. It is also normative, such as is the case with *molong*. The values are so deeply embedded in the practices that it is difficult to separate the empirical contents from normal messages. For example, the signs (*oro*) refer to and represent a human being by a complete plant from root to

the leaf. The stories about animals sometimes may not be about animals at all but about proper human behaviour. The knowledge is not abstract but embedded in the social context in which the activities occur; the environment (jungle) works as a classroom. It is a holistic system where the activities, objects, place, ecosystem, people and plants are interconnected so that nothing can be seen as an independent entity.

To design a system that addresses the holistic and living characteristic of the Toro IKMS, better understanding of the existing system is required – one that engages the community as a co-designer in the development, design and implementation phases of the new system.

6.1.5 Community Engagement Layer

The Community Engagement Layer of IKGF (see (5) in Fig. 6.1) represents the free, prior and informed consent of the community members in every decision related to their knowledge resources. For example, as stated earlier, a family can perform the Toro journey in their forest or in another community's forests but that depends on explicit permission from the other community. This explicit permission of the host community must be obtained by free, prior and informed consent.

Toro activities contain information about the Penan traditional life and knowledge about plants, which come under the community sacred knowledge. Hence, it requires community cultural protocols and free, prior, and informed consent when researchers study it. Cultural protocols need to be designed in such a way that they reflect community ownership, respect rights of governance on knowledge resources, and are linked with social and cultural capital. The designed cultural protocols contain details about roles, responsibilities, rights and the processes of conducting and reporting research. The details of the protocols that we developed can be seen in Appendix VI and Appendix VII. Cultural protocols help build the trust relationships and

environment conducive for knowledge and information sharing between researchers and local community members. The cultural protocols consider the level of the community engagement in the system development and promote a level of community participation in co-designing projects from the passive users as illustrated in Figure 2.7.

6.1.6 Capital Layer

The Capital layer of IKGF (see (6) in Fig. 6.1) represents the types of capital (as discussed below) that are the perceived outcomes of the family as well as the community in general from performing the Toro journey.

Social Capital: Apart from the harvesting festival, *Irau Ajaú*, the Penan do not celebrate any other ceremonies as such. The Toro and other communal collective activities are opportunities for the community members to interact and create an environment conducive for IK exchange between older and younger generations. It facilitates knowledge transfer and strengthens bonding between the generations.

Cultural Capital: The Penan have rich cultural capital in the form of dances, songs, skill and stories. Toro is platform where the community members practice, refresh and transfer this cultural capital to their children and younger generation. Hence, if the community members and younger generation do not perform the Toro activity, it will ultimately result in loss of the rich cultural, botanical, and social knowledge bases.

Structural Capital: The Penan perceive their territories as a shared communal estate over which all members of a community have rights. Their traditional practices can enact their structural legal claims; for example, the Penan use *lamin Toro* as marks of their traditional ownership in court cases against logging companies threatening to encroach upon their lands (Interhill, 2010). In addition, there are also other examples of converting the cultural capital into structural capital

by Penan community. One of them is the “Picnic with the Penan”, which is a community based eco-tourism project (Picnic with the Penan, 2013). This program includes activities such as trekking, fishing, cultural experiences (living with a local Penan family, cooking, blow pipe making, folklore and storytelling), camping, swimming in rivers and waterfalls, ethno-botany and food gathering.

Human Capital: Toro is the activity that helps groom the members of the younger Penan as future guardians of the rainforest. Parents teach the lessons on livelihood combined with a notion of stewardship, incorporating conservation ethics and ownership.

The above stated perceived and specific social, cultural, structural and human capital of the Toro journey indicate that the ICT-based IKM projects should be designed to protect and preserve the stated tangible benefits.

6.1.7 Cross-Cutting External Environment

The cross-cutting external environment layer of IKGF (see (7) in Fig. 6.1) includes external factors such as Christianity, urban migration and logging, which effect on the Toro journey and related knowledge management processes. For example, the stories and songs (the data repositories) that are not compatible with the beliefs of Christian religion have been deemphasised leading to potential of loss of memory and preservation of oral traditions.

Due to limitations in educational and economic opportunity, young people normally prefer to live in urban areas, thus becoming disconnected from their indigenous life. Their livelihood no longer relies upon the jungle, so they rarely perform the Toro journey. In addition, numerous researchers also highlighted logging activities as threats to Penan IK and their forests (Wilk, 2005). The logging activity is destroying the source of their livelihoods and their traditional medicines as well.

Ultimately, young people are not adequately equipped with the skills that are necessary for living and surviving in the jungle. On the other hand, many of the young people from Long Lamai are users of ICTs and Internet, providing an opportunity for an integrated knowledge management approach of indigenous and modern organisational knowledge.

The external layer of IKGF (Fig. 6.1) depicts the effects of external factors on all the other six layers. For example, it affects the capital layer, such as social bonding in case of rural urban migration.

6.2 Discussion

As a validation process of IKGF, in this case study we used IKGF to understand and depict the Toro activity and IKMS of the Penan community. A brief introduction of the Penan Toro activity, IKMS, significant features and central values of this activity are discussed in this case study. Through observations of the Toro, the study provides several important social and cultural dimensions and the consolidated work models to illustrate the overall context of the Penan, including the workflow, the interactions among community members, the knowledge sources and the surrounding environment. The case study describes the Penan social system *molong*, *oro* and the coordination mechanism Toro in relation to knowledge management process and knowledge repositories the practices, skills and oral literature.

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 and researchers perspectives of IKMS, focus on the broader outcomes and explore the relationship with external environment.

As earlier mentioned, the focus of existing research in the KM field mainly focuses on developing theoretical frameworks while overlooking the implementation process of those frameworks. Without validation process, the IKGF provides a partial view of the IKMS. Hence, in the next chapter, we will share our experience of using IKGF for developing an ICT-based IKMS.

6.3 Summary

The case study of Penan Toro highlights the holistic nature of IKGF and explores the cultural, social and governance components of the framework in which the Penan IK is rooted. The chapter also highlighted the holistic nature of Toro and discussed the components of Toro and their relationship in the context of IKMS.

Depicting the complex structure of Penan IK in IKGF layers model helps in understanding the holistic context of Toro IKMS while in the next chapter the framework will be used to develop an ICT-based IKMS for Penan Indigenous Botanical Knowledge Management System.

CHAPTER 7 VALIDATING IKGF: CASE STUDY OF DESIGN, DEVELOPMENT AND IMPLEMENTATION OF eTORO

After illustrating the Indigenous Knowledge Governance Framework (IKGF) for the Penan Toro activity, the current chapter presents a step by step guideline to apply the framework for a development of an Indigenous Knowledge Management Systems (IKMS) in any community. A case study, the eToro as a proof of concept of the framework and the development approach is presented in the second part. The eToro platform is a combination of Information and Communication Technologies (ICT) and community activities to support the Indigenous Botanical Knowledge (IBK) of the Penan community of Long Lamai in Sarawak. The proposed framework has helped in developing a common understanding of the eToro team members for contextualising, designing, developing and implementing ICT-based IKMS. Finally, the inferences and observations from the project are presented, along with lessons learned.

The main objective of the chapter is to apply the IKGF to ensure the integration of ICTs into the existing governance structures of a certain community. Thus the case study demonstrates the merge of ICTs with the existing practices of Toro into the eToro platform.

7.1 Generalised Digital Indigenous Knowledge Management System Development within Indigenous Knowledge Governance Framework

The IKGF provides a model for the context and structure of IKMS in indigenous community. It ensures appropriate ICT tools development, which are integrated in the community social and cultural system. The correct balance between social and technical aspects constitutes one of the greatest challenges of ICT tools adoption for IKM. To apply the IKGF in any community,

researchers need to follow two mains steps; first to collect information about existing IKMS and structured in the seven IKGF layers. It will help to explore the existing inherent structure and important factors of IKMS in the target community. Secondly, to transform the IKG model into an ICT-based IKMS, any of the standard development processes can be followed.

IKGF provides a skeleton and a logical architecture view of IKMS that ICT researchers can populate with information gathered and developed during intensive investigation with the community. The standard validation process of the IKGF comprises six phase (Fig. 7.1). In the following section we will provide the details of each stage and guidelines for researchers so they can apply the framework in any community.

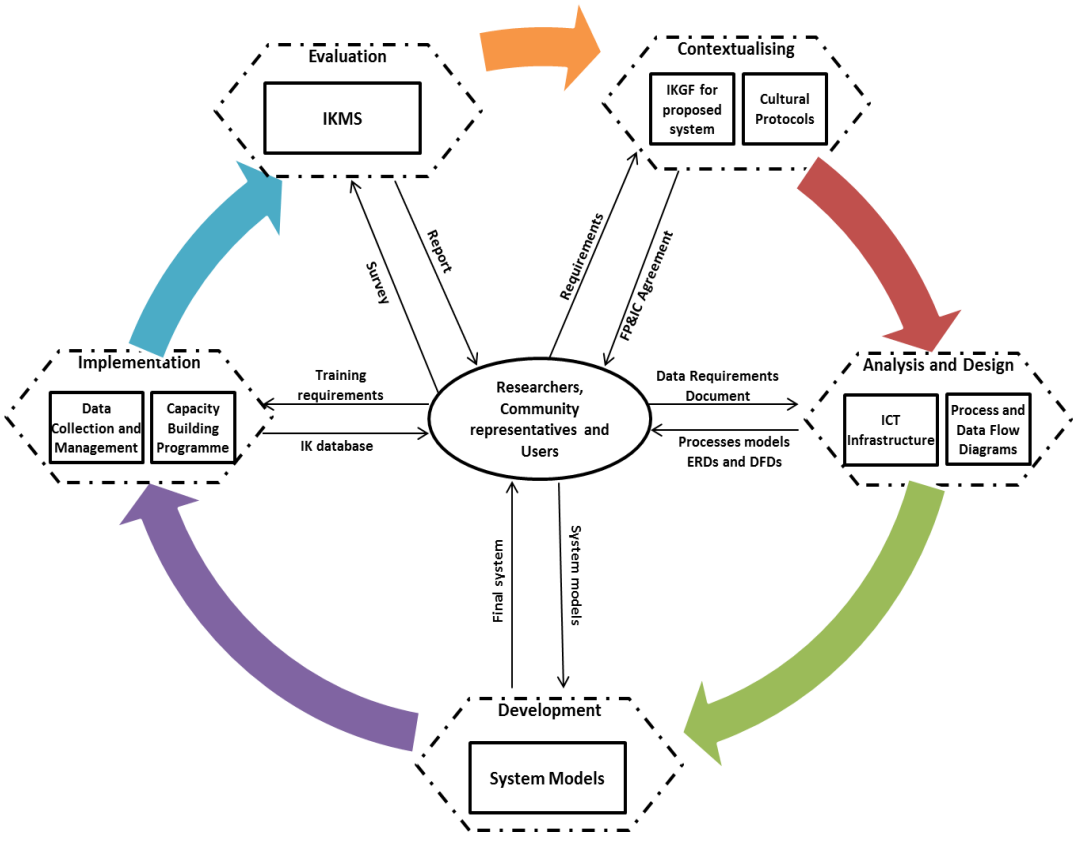

Figure 7.1: Methodology to validate framework and develop indigenous knowledge management system

7.1.1 Phase 1: Contextualising

In conxtualising phase, researchers and community members jointly explore the research and development issues. In this phase, the researchers develop their hypothesis and the community formulate the expected outcome form the joint collaboration. There are a number of questions that help determine the characteristics of the existing IKMS, the needs of the local community and the components of IKGF. Table 7.1 provides some of the guiding questions and the process of investigation in relation to IKGF layers.

Table 7.1: Questions and guidelines for information and communication technology researchers

Questions	**Process of investigation and outcomes**		**IKGF Layers**
How community governs Indigenous Knowledge (IK)?	**Step 1**	Identify the community collective activity(ies)	• IK Governance Layer
	Step 2	Explore customary rules and/ or sacred beliefs related to this activity and identify the process to transform these rules into ICT security policies	
	Step 3	Identify main stakeholders and their stake in IKMS	
How community manages IK?	**Step 4**	Identify essential components(sub-activities) of the collective activity and IKM processes, which occurs while performing the activities	• Activity Layer • Knowledge Management Layer • Data Repository Layer
	Step 5	Identify tacit, implicit and explicit data/knowledge sources that support IKMS	
Why community manages and governs IK?	**Step 6**	Explore importance of this knowledge for community and researchers and identify the factors that impact on existing or new proposed system	• Capital Layer • Cross-Cutting External Environment Layer
How to develop community and researchers partnership?	**Step 7**	Develop Free, prior and informed consent agreement with active participation of community members to safeguard the interests of all stakeholders	• Community Engagement Layer
	Step 8	Validate the collected information and interpreted data with community representatives	

A comprehensive and joint consultation process allows community members and researchers with ideas and concerns to be heard, and they have the benefit of understanding the process and the ultimate outcomes of the project. A jointly populated IKGF for the desired project is an outcome of this phase.

7.1.2 Phase 2: Analysis and Design

After understanding the local context and jointly exploring the research and development issues in phase 2, the focus are requirement elicitation, analysis and design of the system. Eliciting and analysing requirements within IKMS represents particular challenges (Winschiers-Theophilus, Bidwell, Chivuno-Kuria, & Kapuire, 2010). Research has shown that users from rural communities have difficulty articulating their requirements until they see them. Hence tools such as paper prototype allow imagination to work. If there is technology barrier for the user; the paper prototype should be added with the examples of actual digital media/ICT tools and explanations.

Another issue is the design of software and selection of appropriate hardware tools so the system can sustain in the existing social, cultural and physical environment. Kwacha (2007) noted that the most common problems associated with the effective implementation of ICT in rural areas are usability, maintenance of software and hardware system and inconsistent electric power supply. Mobile tablet devices could provide a practical solution for all or few of these obstacles such as the devices are easily carried everywhere, consume less power, less maintenance required and have multiple functions in single device for example picture/video/audio and GPS coordinates capturing capabilities. In addition, it is noted that the structure and user interface of the tablet PCs is friendly and easy to use for indigenous communities (Rodil, Eskildsen, & Rehm, 2011).

Indigenous communities typically have a complex system of restrictions regarding access to significant places, objects and information. Typically these security protocols are based on social and cultural variables such as gender, age, status in community and family relationships. The researchers also need to identify the security concerns and structure of these protocols and the software system must address and accommodates these restrictions in ICT security policies.

The researchers also need to consider the relationship between digitisation process, ICT tools and the collective activity (collaborative mechanism) of the community. It is suggested to embed the digitisation process in the existing collective activity of the community so use of ICT for IKM is not considered as imported components (For example see Activity Layer in Section 7.3.1).

The outcomes of this phase include process and data flow diagrams and data requirements document.

7.1.3 Phase 3: Development

Based on the data flow diagrams and data requirements documents the software developers can develop appropriate ICT tools for IKM although it is not a simple and single step process. For indigenous communities the security and privacy are typically major issues of concern and multifaceted challenge (Dyson et al., 2007), which is not easy to discover and transform into ICT security policies. Hence, the software developers need to be actively involved from the beginning so they can better understand and discover the social context of computing and needs of the users. The outcome of this phase is the ICT based IKMS.

7.1.4 Phase 4: Implementation

In the implementation phase, software developers and community test the software tool in specific conditions by using it for actual data and information management. Indigenous users are

typically different from urban users, having less familiarity to ICT tools. Hence, during this phase, specific training requirements also need to be identified and addressed. The length of time needed for this phase is important. The community should have enough time to develop a level of understanding of the newly built system, reflect and absorb it at their own pace rather than with project deadlines.

7.1.5 Phase 5: Evaluation

In the contextualising phase, community members set their objectives and expectation (capital layer) for the newly designed system. In addition, the researchers may have hypothesis for the project; similar to the community with expectations of the project. In evaluation phase, both researchers and community members individually and jointly reflect on their achievements and lesson learned. The quantitative evaluation of the system usability and user's satisfaction can be performed with the help of survey questionnaires. For quantitative evaluation focus group discussion can be conducted based on the objectives set in contextualising phase.

In the next section, we present the case study of eToro: an Indigenous Botanical Knowledge Management System of Penan to validate and verify the IKGF.

7.2 Background of the Case Study

The eToro project is a collaborative effort of the Institute of Social Informatics and Technological Innovations (ISITI-CoERI), UNIMAS and the local community of Long Lamai, Sarawak. The project goal is to preserve the traditional knowledge of the community, given that the older generation is slowly dying out and knowledge is not being transferred to the younger

generation. Also, the young tend to be not as interested in learning and retaining indigenous knowledge.

The Penan have a detailed classification system and recognise many useful wild plants. Their use of knowledge is relatively simple and differs from that of the other ethnic groups of Borneo (Koizumi & Momose, 2007). For the Penan, all of these plants are sacred, possessed by souls and born of the same earth that gave birth to the people (Davis & Henley, 1990). The Penan's IBK management has a complex structure governed by a social and cultural belief system, assimilated with the community activities and tacit, implicit and explicit knowledge bases. The proper representation of this complex system in ICT-based IKMS may face the challenges of knowledge gaps between researchers and local community, language barriers and the lack of equivalent concepts and terminologies on both sides. Some of these challenges can be handled by developing the common understanding of the system and processes on both sides. For this purpose we have developed and used IKGF for eToro in the contextualising phase. The IKGF helped in identifying the current knowledge structures, existing/traditional intergenerational knowledge transfer processes, as well as identifying how ICT and IK can be employed in the development of eToro. The community will benefit (all going well) from having a system that would allow them to preserve their IBK, as well as an opportunity to bring the young and old together.

7.3 Methodology

The validation methodology of the IKGF consists of six distinct phases (see Fig. 7.2).

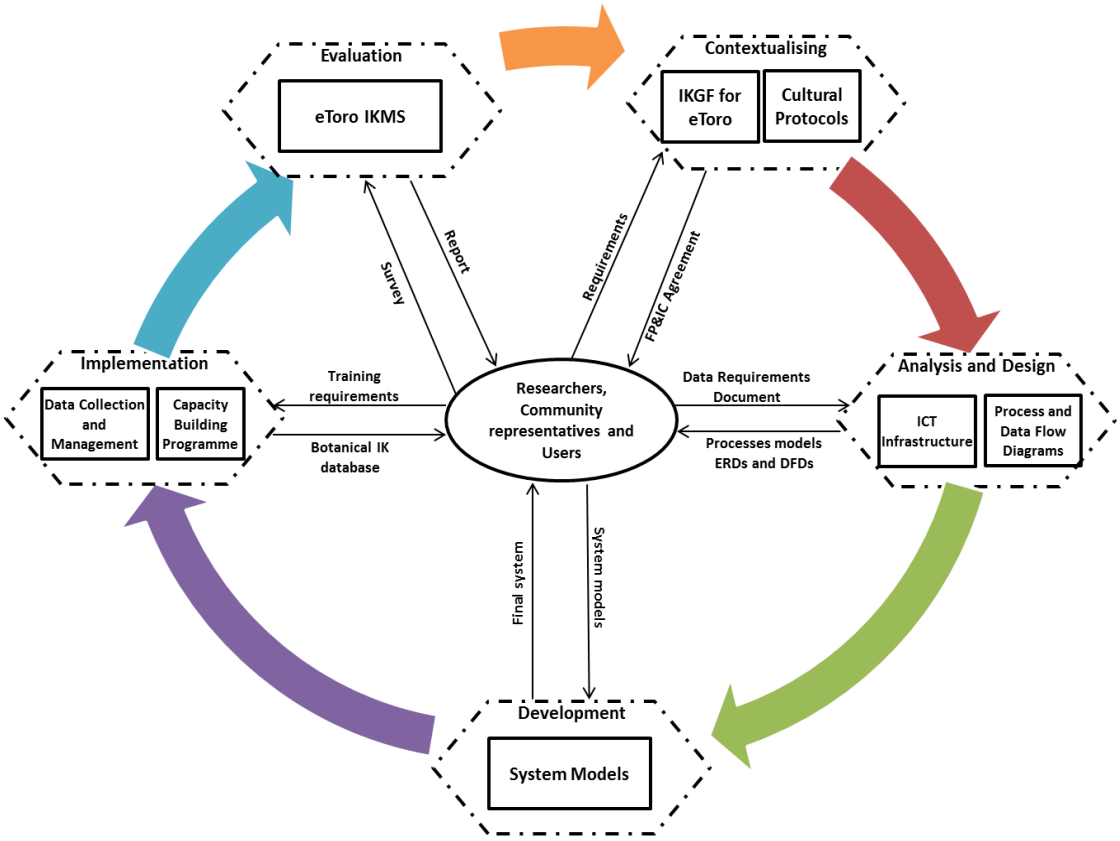

Figure 7.2: Methodology to validate indigenous knowledge governance framework for eToro

The next section provides the detail of the six phases based on the eToro case study.

7.3.1 Contextualising

The community selected four elders and four youths (Appendix V) as representatives and eToro team members to negotiate, discuss and help in the development of eToro. The eToro team developed the IKGF (Fig. 7.3) to understand the local context, functionalities and interconnections between components related to IKM processes, community governance system, the tacit, implicit and explicit knowledge bases and ICTs.

The eToro project is an assimilated approach of ICTs and the existing Toro IKMS. Figure 7.3 is adapted from the designed IKGF for Toro (Fig. 6.1) with the additional ICTs components and features such as e-Insitu and Botanical knowledge database.

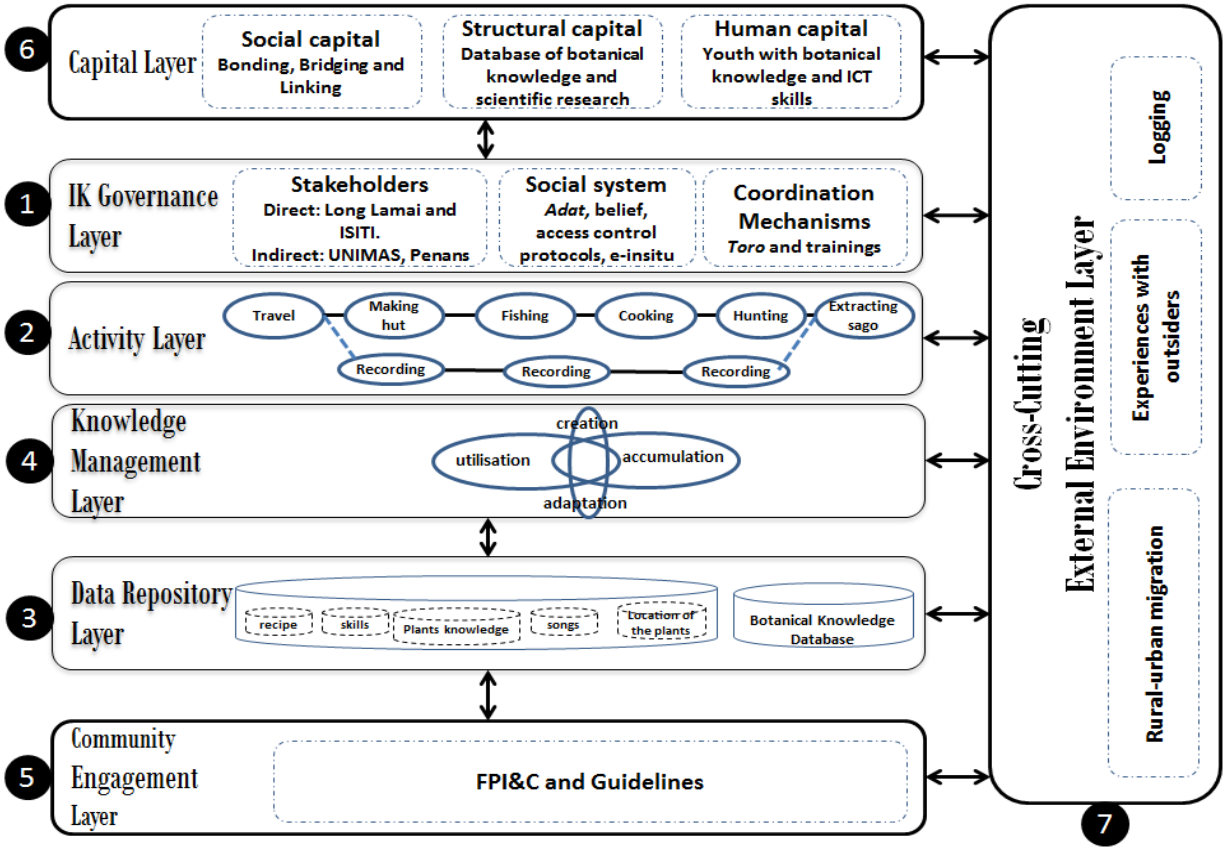

Figure 7.3: Indigenous knowledge governance framework for eToro

In the following section we will illustrate the additional components and features only.

IK Governance Layer ((1) in Fig. 7.3): The *direct stakeholders* in the project include: Long Lamai community and ISITI-CoERI; and *indirect stakeholders* include the Penan community at large and researchers at Universiti Malaysia Sarawak.

The *social system* has the same components of Toro activities with two additional components: the access control policies and e-Insitu approach. The access control policies define the rights and privileges of the eToro users and based on the Penan *adat* and beliefs, whereas e-Insitu

approach refers to physical control of the community on the data storage devices. In the later sections, we will discuss these features in detail.

The *coordination mechanisms* have an additional component of training for the community representatives and for using eToro ICT-based IKMS.

Activity Layer ((2) in Fig. 7.3): The Activity Layer shows the traditional seven activities of the Toro journey with an additional activity of the documentation process, which is designed to run in parallel of the other activities.

Data Repository Layer ((3) in Fig. 7.3): The community holds the knowledge in tacit, implicit and explicit forms such as beliefs, actions, performances and oral traditions. The eToro transforms the knowledge into explicit form (botanical knowledge database) and stores it on the memory devices as depicted in Data Repository Layer (Fig 7.3). In addition, during the conversation with knowledge expert (elders), the youth acquire implicit knowledge about the plants such as characteristics of the plant, recognition patterns and the process of the plants identification.

Knowledge Management Layer ((4) in Fig. 7.3): the Knowledge Management Layer represents the knowledge processes that occur during the eToro project activities. Although a part of the knowledge will be accumulated in the botanical knowledge database as videos, text and GPS coordinates, the interaction of youth and elders enables other knowledge management processes such as knowledge utilisation, creation and adaptation. The process of knowledge transfer is fully intertwined into the modified activity of digitisation as well as new usage of digital captured knowledge.

Community Engagement Layer ((5) in Fig. 7.3): For this specific project, we developed the cultural protocols containing two instruments: the guidelines for researchers working in eToro

project (Appendix VI) and Free, Prior and Informed Consent (FP&IC) agreement between ISITI-CoERI and Long Lamai community (Appendix VII).

The protocols are the main components of the Community Engagement Layer (5) in (Fig. 7.3). The FP&IC contains the details of eToro activities, data ownership, processes and the social and cultural protocols for the researchers. The agreement was translated into Penan language and approved by the Long Lamai community after seven months of intensive negotiations with the researchers.

Capital Layer ((6) in Fig. 7.3): The *social capital* that is perceived outcome of the project includes bonding and bridging inside the community between the elders and younger, while also linking UNIMAS with the Long Lamai community. The eToro project will also create the *structural capital* as database of botanical knowledge and scientific research. In terms of *human capital*, the community elders will groom the skilful youth with indigenous botanical knowledge.

Cross-Cutting External Environment ((7) in Fig. 7.3): Chapter 6 shows logging and rural-urban migration as the two main components of cross-cutting external environment layer. We also observed that the community has some unsatisfactory previous experience with outsiders in documentation of indigenous knowledge. Hence, the community elders were interested to know the details of how the knowledge resources will be managed and how we ensure the protection of community's rights and protocols in the collected resources.

The IKGF for eToro helped in exploring the community needs and perceived outcome of the system. In addition, the IKGF also helped the community representatives to understand the eToro structure. The Long Lamai community selected Garen Jengan, as the community representative for eToro project. He is a retired government employee with 20 years of work experience. He also worked as representative of Penan communities (councillor) for few years.

He is selected because of his experience with development projects and knowledge about the traditional Penan governance system. According to him, the IKGF provides a layered sketch of Toro activities and the related components of the Penan IBK system. He lists three parts of the eToro knowledge bases: first, the theoretical knowledge in memory and oral traditions (tacit knowledge-base); second, the practical knowledge in the skills and cultural performances (implicit knowledge-base); and third, the documented knowledge as video, audios, pictures and text (explicit knowledge-base). He said, "*the activities in Toro help to transform the theoretical knowledge [tacit] into practices [implicit] and eToro will create documented knowledge [explicit] of these theories and practices"*.

7.3.2 Analysis and Design

Two activities, the design of the solution and identifying the approaches to achieve the solution, were conducted in this phase. The resulting design has to be acceptable to both the community and the researchers/developers so that the developers can build the eToro in a way that eToro will actually be used. As discussed in Chapter 6, the Penan are quite sensitive about their plant knowledge. The IK governance layer of Figure 7.3 shows the strong social belief system that governs the knowledge management processes in the community. One of the main questions in the design phase concerned the security privileges and access control policies, i.e. "who can access the information stored in botanical knowledge database" and "to what extent". Through the various deliberations, a number of items were agreed upon. The access control policies are derived from the existing social, cultural and belief systems. The policies include user types of eToro, user access rights to the information resources (see Table 7.2), types of plant data to collect, as well as the processes needed for the collection, classification and verification of the plants. This discussion involves not only the community and researchers, but also software

developers, knowledge engineers, botanists, environmentalists, as well as the diaspora of Long Lamai.

Table 7.2: Indigenous knowledge management system's user types

User type	**Rights**
IKM Manager	Full access.
Community elders	Browse all information.
Youth	Browse all information but have limited access to poisonous plants information
Botanist	Browse the Pictures of the plant and enter the scientific name

The ICT researchers and developers also determined the datasets requirements, the Dublin Core elements, and meta-data structure of IBK (which was translated into Penan, as not all Penan are literate and/or speak English or Malay, the national language of Malaysia). The design of eToro accommodates the characteristics of Penan IBK and also incorporates the social, cultural and belief systems that governs the Penan IBK.

7.3.3 Development

Given the design, requirements and methodologies from Analysis and Design phase, the tools employed and the techniques in the development and data collection processes were identified in this phase. In data collection (Activity Layer in Figure 7.3), we used Android-based Tablet PCs and Open Data Kit (ODK). ODK is an extensible, open-source suite of tools designed to build information services for Android system, created by developers at the University of Washington's Computer Science and Engineering Department. The data-collection form has been

manually designed by the community (Appendix VIII) so ODK is used to build function help in integrating the manual data collection form into the digital ODK survey form for mobile device.

After capturing the data, the Indigenous Content Management System (iCMS) is used for content management. The iCMS architecture is based on front-end and back-end distribution. The application runs on the main system in front-end while the data stores on the externally attached hard drive in back-end. As discussed earlier, the iCMS deals with data, which is transformed from IK during the documentation process so the system ensures maximum level of protection and data governance facilities for IKM Manager or Data Steward. The information requirements are initially documented in data instrument designed in local Penan language (Appendix VIII), and then we convert it into database schemas in terms of entity-relationship diagram of iCMS (Appendix IX).

To address the community requirements, the iCMS provides profile-based access rights to view or update information to users of the system. The collected information is protected and not available publicly. Once the rules have been created and implemented, the system accommodates an accountability mechanism of the user's activities. The IK Manager can generate reports of a user's activities performed during login sessions. On the base of the activities the manager can make a decision to moderate the user role and activities.

In addition to data protection, the data storage in web-based or local repository is another factor of appropriate IKMS development. To give the feeling of maximum control, iCMS store the data on external hard drives with e-insitu approach. The e-insitu approach is the facility for the community to have the physical control of the data and storage device in addition to logical data protection mechanisms. Under the e-insitu approach, the hard drive is kept under custodianship of a community-appointed member. The concept is based on the Penan nomadic assets

ownership principle where a nomad can only own the assets that he can physically move along; if he left the things behind, it is considered as “the common”. The community calls the hard drive *kitong*. The word *kitong* is adapted from the name of the box where a Penan family normally keeps traditional herbs.

7.3.4 Implementation

This step involves the implementation and the testing of the system. Figure 7.4 shows the components and services of eToro project that were implemented.

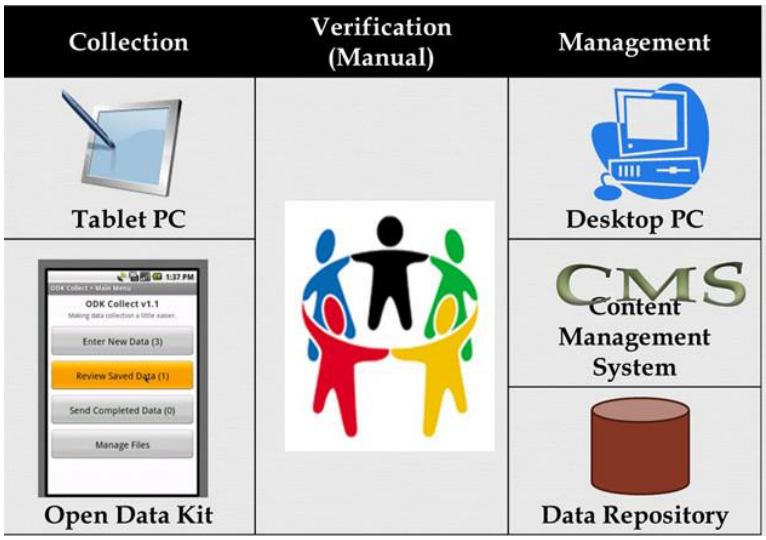

Figure 7.4: Components and services of indigenous knowledge management system

The documentation activities consist of three phases. In the first phase, the young community members travelled to the forest with elder members of the community to collect and document plant data. Here the data is considered as part of knowledge, which is shared by elders during the process of documentation. This data includes the text, images, videos and global positioning system coordinates of the plants. In the second phase, the collected information is manually

verified in community meetings and in the third phase, iCMS is used to store the data on an external hard drives.

After the prototype development, both the data collection software and iCMS have been tested by collecting 30 plants' information in three cycles (ten plants per cycle). The test was conducted to confirm that the developed system fulfil the requirements of the users. In the first two cycles, we accompanied the team in the data collection and data management process. The third cycle was performed in the absence of researchers. As the community language does not have a standard spelling system, in first cycle of data collection, eight spellings errors were reported in the data collection form. In second cycle, only three errors were reported and in the third cycle, no errors were reported; i.e. they are improving and learning to work independently.

7.3.5 Evaluation

The evaluation conducted in this step determines whether the software achieved the set goals. The software is evaluated by the community representative team (Appendix V) to determine if it is usable and accepted by the target community. The team members were selected in a larger community meeting (Fig 7.5) based on their interest, experience, knowledge and skills. The community evaluation team had a balanced representation from different age groups, gender and JKKK.

All the community evaluation team members understand English as well as local Penan language while 4 of them are fluent speakers of English language. All members of the team are computer literates except the Penan botanical knowledge expert (Richard). The team members used the system for documentation of 30 plants for duration of 4 months.

Figure 7.5: Community meetings: Discussion on eToro and selection of community representative team

In general, the team members were satisfied with the processes and features of eToro; as 67% of their responses are "strongly agree", indicating that they were satisfied with eToro, while 15% "agree", 11% "undecided". The responses of "disagree" and "strongly disagree" were small, less than 1% (Fig 7.6).

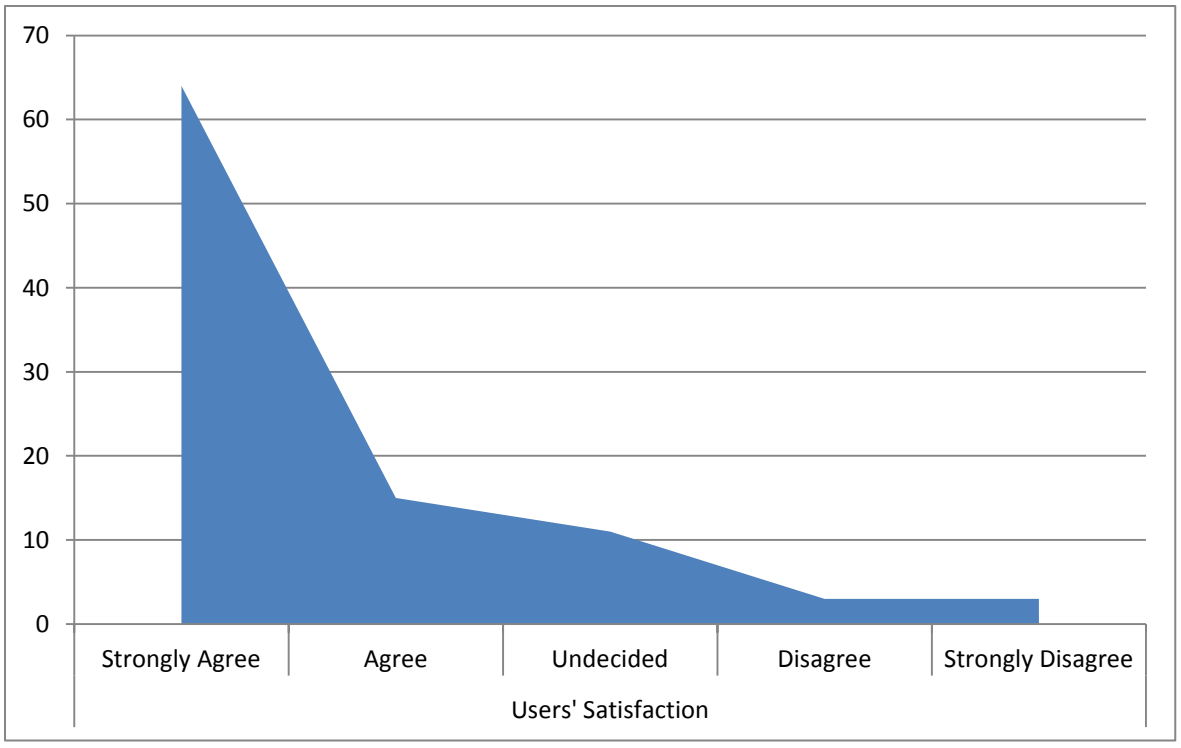

Figure 7.6: Users' satisfaction level

The high satisfaction level of users also indicates that the software accommodates their requirements. We used IKGF as a main component for requirement analysis and elicitation. The feedback received included comments that the system could be more interactive, and that it could be used deep in the jungle (i.e. need to resolve the power problem). Researchers encountered several difficulties in this process, including understanding how the local governance, co-ordination and cultural system work. There was also the language barrier, and the lack of equivalent terminology in Penan to describe the ICTs. The elders also had to be open to changes; not all community members were privy to all the data collected. Thus, with the system, the elders now had to explicitly state who should have access to what information.

eToro showed that IKGF can be validated and an indigenous knowledge management system (eToro) can be developed, one that can capture IBK, involve the young and is usable to the community. Using the eToro project as an applied case study, we demonstrated that ICTs can be employed to not only develop the IKMS but also with the right processes, develop a product that is accepted by the community, as well as bringing the young and old indigenous community members to work together. The project also underlined the importance of having a local champion to help to move the project along, and the importance of elders in supporting the project. The rapport UNIMAS has with the community also ensured that discussion about typically sensitive information was made available due to the trust that exists between the two parties. Community participation is also crucial; without this, the project design would be unacceptable and would not address the community's needs. Multidisciplinary teams were needed as the project involved not only IK experts, but also botanists, environmentalists in addition to the ICT experts.

7.4 Summary

The chapter presents a step by step guideline to apply the framework for a development of an indigenous knowledge management system in any community. A case study, development of eToro, an indigenous botanical knowledge management system of Penan is presented as a proof of concept of the framework validation process. The chapter also highlighted the important observation and lessons learned in this process.

CHAPTER 8 CONCLUSION

The main research question driving the study is *How can we introduce indigenous knowledge governance into ICT-based Indigenous Knowledge Management System?* The investigation was done in three phases; first we explored the theoretical gaps and the inherent structure of Indigenous Knowledge Management System (IKMS) in a community. Second, we addressed the gaps by modelling IKMS and proposing a structured indigenous knowledge governance framework. Third, we used the framework to model an existing IKMS and then validated the framework by using it as a base for designing, developing and implementing ICT-based IKMS.

This final chapter concludes the work presented in this research. This chapter is divided into several sections; the first section focuses on the general conclusion and the second section presents the contributions of this research. The concluding section suggests directions of possible future research to enhance this field of study.

8.1 General Conclusion

Based on the results of this research, Indigenous Knowledge Management (IKM) is a complex system that cannot be understood by examining individual parts (such as processes, data, activities, people and economic) only. It is also about how these parts interact and combine to make a whole system. In addition, a wide range of digital IKM tools have been developed and special attention has been given to use Information and Communication Technologies (ICT) for the management of this highly valuable resource. Indigenous Knowledge (IK) is predominantly in tacit and implicit forms, locked in the community's activities and governed by local social and cultural frameworks. Often ICT solutions for IKM, store de-contextualised knowledge as static

data only, rather than developing tools supporting its dynamic and holistic features. 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. The inherent structure of the IKMS is different from organisational knowledge management. The conceptual modelling and design of ICT tools also needs to be based on the inherent unique structure of IKMS. If the tools and the designed system do not accommodate the social, cultural and governance structures of the IKMS, then the system will increase vulnerabilities of the indigenous community. Oppenneer (2010) referred this scenario as "computer mediated colonialism".

In Chapter 2, we have identified the factors of appropriate IKMS development. Based on these factors, Chapter 2 also provides a comparison and analyses of current approaches and tools developed for IKMS (see Table 2.4). The proposed solution IKGF and eToro design satisfies the unique features of existing IKMS and accommodates these factors on different levels of project development (Fig. 8.1). Apart from the similarities between the influencing factors of IKMS and eToro, the data requirements document helped in eliciting the community's perception and requirements of storage and data protection, which have been addressed in the design of indigenous content management system. Community ownership issues have been addressed in free, prior and informed consent agreement and interests safeguard architecture (Appendix VI), where each stakeholder's rights and roles are explicitly declared.

The research further argues (Section 2.8) that in order to make the ICT-based IKM system useful and sustainable, the community's perspective as co-designers and curators should be incorporated in all phases of system development. It is important, on one hand, to discover

channels through which the members of the community can develop their skill and capacity to understand and learn the complex digital technology. But it is equally essential to be aware of the form in which the new proposed system can be incorporated into a consolidated process of tacit, implicit and explicit transmission of IK (Section 7.2.1).

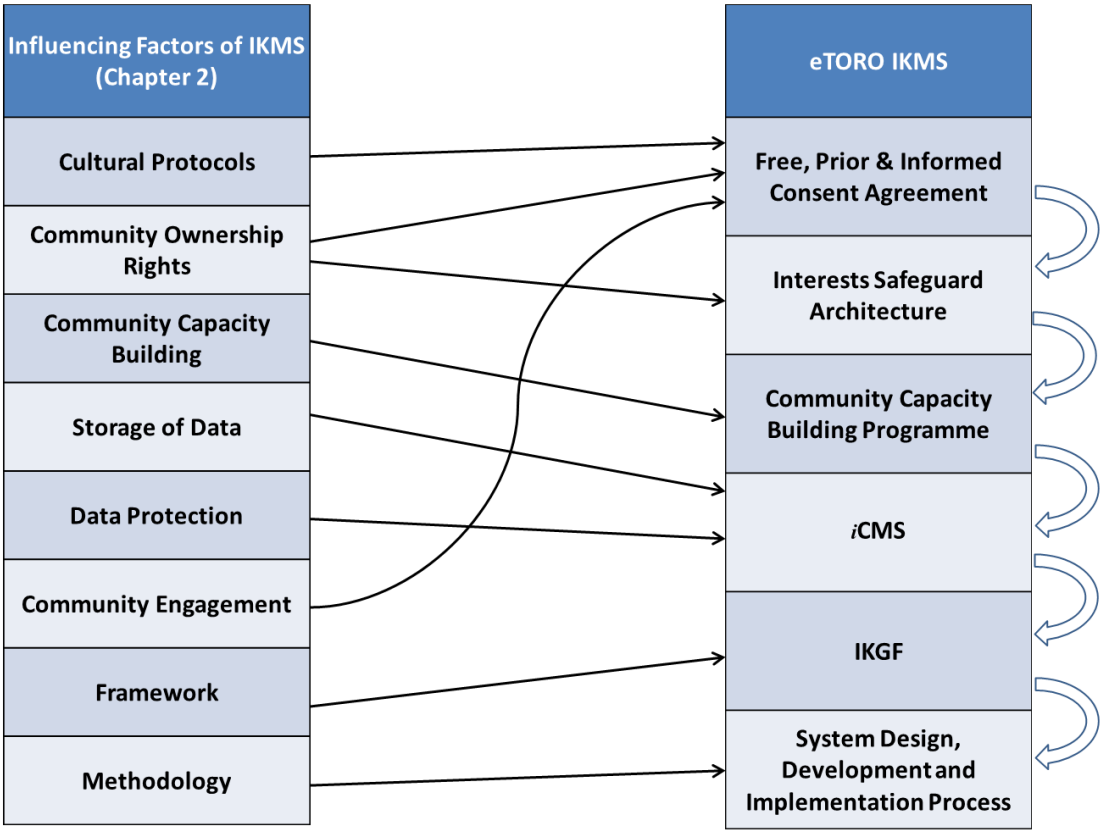

Figure 8.1: Factors of appropriate indigenous knowledge management system development, indigenous knowledge governance framework and eToro

It may be that the most important factor of the digitisation project is not the creation of the digital collection as such, but the group's engagement in the process that motivates new generations to value their IK. It is not enough to consider the efficacy of ICT at the technological level; it should be considered whether, through its use, the given problem domain has been addressed, and whether the system has achieved the desired goals. For instance, the eToro system is

successfully implemented and community is still using it for documentation of indigenous botanical knowledge. Thus the problem of rapidly deteriorating knowledge is addressed in part by our ICT initiative.

The findings of this research are of particular importance to ICT professionals and knowledge engineers for understanding the current structure of IKMS in communities, who can then use this understanding as a basis for ICT-based IKMS development.

8.2 Contributions

This research covers distinct topics related at various levels. Therefore results and applications are diverse. Firstly, this thesis serves as a guideline for ICT professionals and knowledge engineers working in cultural settings different from their own. The tools and the system designed for one community and a specific domain would not reflect the problems or solution of another community or domain. Hence, the research operationalisation process and methodology developed for this thesis is of value to those who work within the IK domain in indigenous communities whose literacy, social, cultural, spiritual logic and values profoundly differ from others.

The existing literature has the gaps to provide comprehensive definitions; hence the first contribution of the thesis is the definitions such as of indigenous knowledge management and indigenous knowledge governance. The empirical investigation, theoretical gaps and factors of appropriate IKMS development are additional contributions.

The next contribution is the methodology to design a holistic framework based on the intensive investigation, community engagement and reflection exercises with local community representative team. In Chapters 3, 4 and 6, the investigation is extended to field research for

confirmation of theoretical gaps and to explore the inherent IKM structure in indigenous communities. The field research work contributes significant empirical findings. The methodology helps in identifying the current status of knowledge processes and developing strategies for better management of IK assets.

The IKGF is another contribution. The framework is general in nature and tested with different case studies so it may be valid in settings of similar nature, whether related to Information Technology or not, as long as essential processes and factors are considered.

This research also contributed various conceptual and workflow models such as levels of community engagement in the system development (Fig. 2.7), IKM processes model (Fig. 3.3), model of integrated IK learning system (Fig. 3.7), TIE model (Fig 4.7) and methodology to validate framework and develop IKMS (Fig. 7.1). These models are based on the inherent structure of IKMS and could enrich computer-mediated communication or interaction designs in the future. The validation methodology of the framework extends the approach of developing theoretical model to practical solutions, which is beyond the scope of the current debate in KM field.

The thesis also provides a beginning-to-end solution; from analysing current IKMS in a community, to designing, developing and implementing an ICT-based IKMS for a particular domain of IK. Other contributions include outputs of the research, such as the prototypes of the indigenous content management system and the data collection software and cultural protocols for the researchers and community engagement. The prototypes are fully customisable and the applications can be converted to any other language. The cultural protocols were the main instruments that helped in building the rapport between researchers and community representatives. The diagrams and pictorial representation of the project structure and activities

helped in bridging the gap in understanding between researchers and community members. Partial results of this thesis have been published and presented at national and international platforms, revealing scope and complexity of the problem and contribution to the knowledge (see list of the publications/presentations and proceedings in Page xxii).

8.3 Future Directions

We developed the models and approaches based on the unique characteristics and processual perspective of the indigenous knowledge management system. These models and approaches can be used in the study of other knowledge domains in order to compare similarities and differences that might exist in relation to social, cultural, governance and external factors. The two proposed approaches assessment of IKMS (Chapter 3) and TIE model (Chapter 4) have been used to understand the inherent structure of IKMS and to design the IKGF. We suggest that an in-depth research should be conducted to explore the methodological approaches that help in determining requirements within an indigenous knowledge management system that fundamentally differs from the one usually supported by the conventional ICTs.

The developed prototypes are successfully used to collect the indigenous botanical knowledge of the Penan community. However, the products have been used in a single case study and require further technical improvements to increase their efficiency and effectiveness, and new technological concepts need to be devised (as reflected in Section 7.2.5). As suggested by the users, it further requires conceptual improvements in terms of data classification, retrieval, representation and design.

8.4 Summary

The chapter presents the concluding remarks of the thesis. In Section 8.1, the proposed solutions IKGF and eToro are analysed based on the influencing factors discussed in Chapter 2. It has been argued that the proposed solutions address the literature gaps and provide a holistic model for IKMS. Section 8.2 discusses the major contribution of the thesis while Section 8.3 provides the future directions.

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Appendix I: Indigenous Knowledge Management Diagnostic Tool

Survey Questionnaire for Assessing Bario's IKMS

	Section 1-Get Find the appropriate solutions	*stron g*	*mode rate*	*Weak*
Organize				
1	The community supports the specialists that wish to manage their knowledge. Organize meeting for them to share their knowledge, give them support to enhance and update the knowledge.	S	M	W
2	The Community provides suitable environment to adopt the new technologies to improve the quality and efficiency of how people work.	S	M	W
3	The community distinguishes the communal knowledge that needs to be controlled centrally and the individual knowledge that anyone can document and share.	S	M	W
4	The community has developed electronic and paper-based tools which direct people to available resources.	S	M	W
5	The community has facilities and support systems that help people to use on-line tools, including the internet.	S	M	W
6	The community has specific individuals/group(s) that manage the knowledge and the individuals that are knowledge content focused.	S	M	W
7	The group who manage the knowledge is easy to identify, making it clear to others in community where to go for specific information.	S	M	W
8	The Community has the forums where the people can request for information.	S	M	W
9	People only request information when they really need it.	S	M	W
10	People can search for information across a wide variety of applications and databases.	S	M	W
11	Requests for information made on that forums are generally easy to understand.	S	M	W
Verify				
12	The electronic and physical places where we store our knowledge are kept up to date.	S	M	W
13	Experts play a role in identifying important information to other users.	S	M	W
14	The electronic and physical places where we store our knowledge contain the best information available on a wide range of critical topics.	S	M	W
Acquire				
15	Groups and individuals routinely document and share information about their expertise.	S	M	W
16	The community has collective mechanism for people to document and share information.	S	M	W
17	People provide complete explanations when they make information request.	S	M	W
18	People distinguish between information those are available with and without request.	S	M	W

Annotate				
19	If the information is not locally available and people are given the task of searching for information they are able to fulfil the request.	S	M	W
20	Peoples have and play their role to customize their information environment.	S	M	W
Section 2-Use Innovate to make better use of knowledge				
Know				
1	The community has the common meeting places for formal meetings where everyone feels comfortable and has sense of ownership.	S	M	W
2	People would say that the changing in management structure and workspace are based as much on a need to collaborate as on a need to cut costs.	S	M	W
3	People would describe our community as flexible rather than rigid.	S	M	W
4	Our management structure does not interfere with people getting the information they need.	S	M	W
5	Our management structure is flexible and we can adjust it according to the people needs.	S	M	W
6	The community structure has space for informal meetings because it helps us think more creatively about problem solving.	S	M	W
7	Involving the different stakeholders in decision making is a well-established practice.	S	M	W
8	Every member of the community has the basic information about our finances.	S	M	W
Pick				
9	Our workspace provides us with the flexibility to take our work where we need to with very little effort.	S	M	W
10	We have just the right level of security protocols for our sensitive information.	S	M	W
Adoption				
11	The community views the collaboration with other/same communities as a good thing to do for development.	S	M	W
12	Everyone speaks up if they have an opinion or idea to offer.	S	M	W
13	We seriously consider what others might call crazy or outrageous ideas as part of our problem-solving process.	S	M	W
14	We give all promising ideas thorough consideration, no matter who they come from.	S	M	W
15	Everyone can describe how their decisions can affect overall community.	S	M	W
16	We frequently partner with Government to improve the value we deliver to the community members.	S	M	W
17	Our workplace is helpful to promote the flow of ideas between work groups.	S	M	W
Apply				
18	Anyone who has a good idea can get support to follow up on it.	S	M	W
19	People in our organization can use the information they get to improve	S	M	W

	their work.			
20	We use approaches that people would call playful as part of our problem-solving process.	S	M	W
Section 3-Learn Find ways to embed learning process into working process				
Observe				
1	Before people fix problems, they consider the overall context in which the problem occurred.	S	M	W
2	Our planning process includes looking at a number of scenarios so that we can think through how to respond in different situation.	S	M	W
3	We support group activities that promote mutual learning.	S	M	W
4	We try to ensure that people have some overlapping responsibilities, so that it is easier to learn from one another.	S	M	W
5	We treat disagreement as an opportunity to learn from one another.	S	M	W
Identify Gaps/success				
6	Reflecting on lessons learned from work experiences is an established practice in our community.	S	M	W
7	When people finish projects, they generally take the time to meet with their team and analyse what went wrong and what could have been done better.	S	M	W
8	Our learning process often includes gathering feedback from users.	S	M	W
9	People admit when they fail.	S	M	W
10	When we have a big success, we talk together about what we did right.	S	M	W
11	Learning from failure is incorporated into how we conduct subsequent work.	S	M	W
Decision Making				
12	We have a traditional decision making system.	S	M	W
13	When a failure occurs, our first response is not to assign blame.	S	M	W
14	At some time or another, everyone in our community does 'hands-on' work to get first-hand experience of the consequences of their decisions.	S	M	W
Creativity/Formation of Explicit Knowledge				
15	Teams engage in off-site learning experiences to find better ways of working together.	S	M	W
16	We use work-related games and simulations to think more clearly about our community situations.	S	M	W
17	People apply what they learn outside the community to their work.	S	M	W
18	People in our community exhibit a natural curiosity.			
19	People apply the ideas they developed in past work situations to new ones.			
20	The community has formal and informal networks with other communities and organizations.			
Section 4-Contribution Sharing, packaging for all to use				
Sharing				
1	The community has experts (i.e. knowledge manager or knowledge coordinator) that support the knowledge-sharing process.	S	M	W

2	The community has determined where knowledge sharing across groups will yield the highest mutual benefits.	S	M	W
3	People are members of multiple groups, making it easier to transfer knowledge across the entire community.	S	M	W
4	The group formation for a project or a task is accomplished in such a way that it links the people across community to promote knowledge sharing	S	M	W
5	Our community discovers the ways to remove barriers in knowledge sharing.	S	M	W
6	Processes for contributing knowledge to the community' repositories are seamlessly integrated into work activities.	S	M	W
7	People can identify others in the community who might benefit from their knowledge.	S	M	W
8	The community supports the sharing knowledge process by giving people the opportunities to do it.	S	M	W
Acknowledgment				
9	The community acknowledge individual contribution to groupware systems by linking it to the name of the original author/or providing some special privileges.	S	M	W
10	People would say that sharing knowledge does not diminish the individual's value to the community.	S	M	W
11	Electronic and physical spaces where we store our knowledge have an intuitive structure that helps people direct their contributions.	S	M	W
12	People have a say in what happens to ideas and expertise they share with others.	S	M	W
13	Knowledge sharing is publicly recognized.	S	M	W
14	People operate under the assumption that when they use knowledge contributed by others in the community, they are obligated to contribute their own knowledge at some point.	S	M	W
Incentive				
15	People who refuse to share knowledge do not get certain benefits.	S	M	W
16	Knowledge-sharing behavior is built into the system in such a way that it benefits the person in future i.e. giving weight to his opinion in public forums.	S	M	W
Expression				
17	Face-to-face interactions are used to strengthen electronic communications.	S	M	W
18	Professional moderators and facilitators help people better express what they know so that others can understand it.	S	M	W
19	Face-to-face interactions are used to transfer difficult to articulate 'tacit' knowledge.	S	M	W
20	People focus their knowledge sharing activities on mission-critical information.	S	M	W
Section 5- Assess Metrics to value knowledge assets				

Recognition				
1	We recognize that knowledge is part of our asset base.	S	M	W
2	Members of the community management body are well aware about the importance of knowledge management and endorse the efforts in this respect.	S	M	W
3	On time of allocation resources the community assesses what knowledge needs to be developed.	S	M	W
4	We have been practicing knowledge management for some time without calling it that.	S	M	W
5	We rely on a team whose members have evaluation, measurement and operating expertise to assess our knowledge management process and its results.	S	M	W
Measurement				
6	We measure our knowledge management process and its results.	S	M	W
7	The process of measuring knowledge helps us better understand what it is we are trying to manage.	S	M	W
8	We know what metrics are used to monitor the knowledge management process and its results.	S	M	W
9	We talk about measuring knowledge in ways that people can readily understand.	S	M	W
10	We experiment with different ways of measuring how well we manage knowledge.	S	M	W
11	We rely on a blend of hard facts, numbers, rules of thumb and non-metric information to make knowledge management decisions.	S	M	W
12	Assessment of knowledge-based assets is one of our assignments.	S	M	W
Result				
13	We share our practice and result of knowledge management with outside communities.	S	M	W
14	We share our practice and result of knowledge management inside community.	S	M	W
Monitoring/Evaluation				
15	People can explain the difference between evaluation and performance measurement.	S	M	W
16	We use qualitative as well as quantitative metrics to gauge the effectiveness of our knowledge management process and its results.	S	M	W
17	We have mapped the process flow of knowledge management activities.	S	M	W
Create Links				
18	We have developed a framework that links knowledge management activities to strategic outcomes.	S	M	W
19	We have a framework that describes how our organization's knowledge-based assets interact with one another to create value.	S	M	W
20	We can link knowledge management activities to measurable results.	S	M	W
Section 6- Build/Sustain Ensure growth of Knowledge Assets through relationships				

Reuse				
1	We routinely ask ourselves how we can leverage our knowledge into other areas.	S	M	W
2	It does not matter which group came up with an idea or technology, anyone in the community can use it.	S	M	W
3	We have a formal policy that insures we share technology and ideas across unit or group borders.	S	M	W
4	We see our products and services as having both a tangible and intangible (or knowledge-based) dimension.	S	M	W
Promote innovations				
5	We believe that knowledge management is everybody's business.	S	M	W
6	We encourage people to think about how their non-work-related activities could benefit the community.	S	M	W
7	We have an IT system that connects us to information sources we need to do our work.	S	M	W
8	Our formal and informal values are aligned.	S	M	W
9	Our community management body b/elders ask all community members to include knowledge management in their everyday plans.	S	M	W
10	We view information technology as a tool to help us get our work done.	S	M	W
11	We have had successful new product ideas come from community members' non-work interests.	S	M	W
Trust development / sustainability				
12	Our product development process explicitly includes our stakeholders.	S	M	W
13	Our community treats people like assets.	S	M	W
14	We have launched a group or appointed a person to lead our knowledge management effort.	S	M	W
15	People generally trust the information they find in our documentation systems.	S	M	W
16	Our products (or services) deliver much higher value as a result of the knowledge they contain.	S	M	W
17	We strive to listen people who have mission-critical skills.	S	M	W
Networking				
18	Our system promotes the formation of different networks of people.	S	M	W
19	We find ourselves increasingly teaming up with other communities and competitors in strategic networks or partnerships to bring innovative products to market.	S	M	W
20	People know when it is not appropriate to share knowledge externally.	S	M	W
Section 7- Divest Alternative sources of value for knowledge assets				
Selection				
1	Our decision to acquire knowledge is based on how much we can leverage it.	S	M	W
2	We make divestment decisions based on both the strategic importance of knowledge-based assets and financial projections.	S	M	W
3	Before we accept new projects or orders, we think about whether the knowledge we will build for our community can be used in other ways.	S	M	W

4	We may refuse to work if it does not build knowledge that we can use in other ways.	S	M	W
5	We divest knowledge in a planned, deliberate way.	S	M	W
6	When we divest tangible assets, we are aware of the knowledge components they carry.	S	M	W
7	We routinely examine whether we are supporting non-strategic knowledge at the expense of strategically critical knowledge.	S	M	W
Redeployment/Reorganizing				
8	When a new opportunity arises, we first try to retool our existing skills before we hire from outside the community.	S	M	W
9	We try to understand the impact of relationships on productivity before we automate tasks and replace person-to-person contact with person-to-computer contact/reshuffling the person to person contacts.	S	M	W
10	When groups find ways to work with fewer people, they figure out how to pursue higher value activities rather to decrease the number of people.	S	M	W
11	We support/apprentice our people to other communities/organizations to determine if we need to acquire new skills or expertise.	S	M	W
12	We outsource skills and expertise.	S	M	W
13	We prefer to use the resources and skills we have in place when testing a new idea.	S	M	W
Restructuring				
14	When we get rid of businesses or groups of people who are affected with dignity and respect.	S	M	W
15	We regularly review our community environment to make sure that we are not losing people with strategically important knowledge.	S	M	W
16	We consider carefully the skills and expertise of the community members so it can be used elsewhere.	S	M	W
17	Our organization considers the impact that letting people go will have on loyalty, contribution and commitment.	S	M	W
Networking				
18	We form alliances with other communities that complement our skill sets as an alternative to doing everything ourselves.	S	M	W
19	We participate in industry-based research groups to help us decide whether we need to acquire new knowledge.	S	M	W
20	We make use of formal relationship with related businesses in our local area to keep our knowledge pool up to date.	S	M	W

Appendix II: Respondents Profile of Survey Questionnaire

S. No.	Interviewee	Occupation	Gender	Age	Village	Interview date
1	Douglas Monnie	Lodge Owner	Male	41-50	Arur Damu' Bario	26th November, 2009
2	Sylvester Kalang	Tour Guide	Male	31-40	Pa' Umor	26th November, 2009
3	Laju Iboh	Retired Teacher	Male	60+	Bario Asal	26th November, 2009
4	Sinah Rang	Farmer	Female	60+	Bario Asal	26th November, 2009
5	Lian Tarawe	Tour Guide	Male	41-50	Pa' Ukat	9th June 2010
6	Jaman Riboh Tekapan	Farmer	Male	41-50	Pa' Umor	9th June 2010
7	Scott Apui	Lodge Owner	Male	31-40	Bario Asal	9th June 2010
8	Balan Nuri	Farmer	Male	60+	Pa' Ukat	9th June 2010
9	Nancy Harris	Lodge Owner	Female	60+	Padang Pasir	9th June 2010
10	Gerawat Nulun	Farmer	Male	60+	Bario Asal	25th June 2010
11	Jeanette Nulun	Farmer	Female	51-60	Bario Asal	25th June 2010
12	John Tarawe	Councillor	Male	41-50	Bario Town	25th June 2010
13	Stanley Apoi	Farmer	Male	60+	Ulu Palang	25th June 2010
14	Millie Balang	Lodge Owner	Female	41-50	Arur Damu' Bario	25th June 2010
15	Seluma Jalong	Handicraft maker	Female	31-40	Bario Asal	25th June 2010

Appendix III: Survey Questionnaire for Assessing Bario's Indigenous Knowledge Management System

Knowledge Processes	Statements	Strong	Moderate	Weak
Section 1- Knowledge Accumulation	The community gives recognition to individuals for contribution of knowledge.	S	M	W
	The community has sense for protection of knowledge assets.	S	M	W
	The community members share successes and failures freely.	S	M	W
Section 2- Knowledge Adaptation	The community identifies the knowledge gap and recognises the required knowledge.	S	M	W
	The community provides support to acquire knowledge from external sources.	S	M	W
	The community supports using external knowledge.	S	M	W
Section 3- Knowledge Creation	The community provides support for introducing new technologies and practices.	S	M	W
	The community promotes team building and group activities.	S	M	W
	The community members use skills, expertise and resources as service providers.	S	M	W
Section 4- Knowledge Utilisation	The community has mechanism(s) for knowledge sharing.	S	M	W
	The community has collective decision making system(s).	S	M	W
	The community has collaboration with other communities, organisations and government.	S	M	W

Appendix IV: Results of the Survey to Assess Bario's Indigenous Knowledge Management System

Knowledge Processes	Statements	Strong	Moderate	Weak
Section 1- Knowledge Accumulation	The community gives recognition to individual for contribution of knowledge.	3	4	8
	The community has sense for protection of knowledge assets.	1	3	11
	The community members share successes and failures freely.	5	4	6
		9	11	**25**
Section 2- Knowledge Adaptation	The community identifies the knowledge gap and recognises the required knowledge.	6	5	4
	The community provides support to acquire knowledge from external sources.	1	5	9
	The community supports using external knowledge.	2	8	5
		9	**18**	**18**
Section 3- Knowledge Creation	The community provides support for introducing new technologies and practices.	8	**6**	**1**
	The community promotes team building and group activities.	6	**6**	**3**
	The community members use skills, expertise and resources as service providers.	3	**3**	**9**
		17	**15**	**13**
Section 4 Knowledge Utilisation	The community has mechanism(s) for knowledge sharing.	5	**6**	**4**
	The community has collective decision making system(s).	4	**7**	**4**
	The community has collaboration with other communities, organisations and government.	4	**8**	**3**
		13	**21**	**11**

Appendix V: eToro Team Members (Community Representatives)

S. No.	Team member	Occupation	Gender	Age
1	Garen Jengan	Farmer	Male	65
2	Wilson Bian Belaré	Ketua Kampung	Male	48
3	Richard	Farmer	Male	67
4	Ezra Uda	Govt. Servant	Male	34
5	Siti Fadzila	Student	Female	19
6	Peru Aya	Student	Male	19
7	Diana	Student	Female	24
8	Silviana	Student	Female	23

Appendix VI: Guidelines for Researchers

eToro: Penan Botanical Indigenous Knowledge management Project.

Why?

Indigenous peoples and many local communities have unique protocols, procedures, rules, and regulations that regulate their interactions within and between communities and with the resources and areas upon which they depend. Protocols provide clarity to community members about rights, responsibilities, and appropriate behaviour. Respecting and acting according to community protocols helps ensure social cohesion and reinforces customary laws, values, and decision-making processes.

Indigenous peoples and local communities are increasingly engaging with external actors such as government agencies, researchers, companies, and non-governmental organisations (NGOs). However, external actors often do not understand customary protocols and governance systems because they are codified in ways specific to each community, culture, and location. Failing to respect community protocols, whether intentional or not, can lead to conflict, deterioration of otherwise constructive relations, and negative impacts on the environment.

How?

To address this issue, indigenous peoples and local communities have begun to document and develop their protocols into forms that can also be understood by others. They are using them to ensure that external actors respect their customary laws, values, and decision-making processes, particularly those concerning stewardship of their territories and areas. They are actively seeking recognition of customary systems of governance and management, including traditional knowledge and practices, and their roles in the conservation and sustainable use of biological

diversity and ecosystem adaptation. Many are referring to these instruments as 'biocultural community protocols'.

What?

The cultural protocols are comprised guidelines for community and researchers and the Free, Prior and Informed Consent Certificate. The guidelines will facilitate the engagement process between community and researcher and the Free, Prior and Informed Consent Certificate will help the stakeholders of the project to understand their roles and responsibilities. The Certificate needs to be signed by the representatives of each stakeholder, on behalf of the parent organisation or community.

Where?

The cultural protocols are specifically designed for eToro: Penan Botanical Indigenous Knowledge Management Project implemented in Long Lamai, Upper Baram, Miri Sarawak.

Who?

There are two stakeholders in the current project so the protocol is mainly binding for the signatory institute (in this case UNIMAS) and Long Lamai community.

The Guidelines

Article 1 A researcher should understand and respect indigenous world views, including responsibilities to the people and culture that flow from being granted access to traditional or sacred knowledge. These should be incorporated into research agreements, to the extent possible.

The first principle of these Guidelines is premised on a need for researchers to understand and respect indigenous world views, particularly when engaging in the sphere of sacred knowledge,

and the corresponding responsibility that possession of such knowledge entails. Researchers should understand the broader senses of accountability in order to understand the responsibility they have when entering into a research relationship with indigenous people.

Article 2 A community's jurisdiction over the conduct of research should be understood and respected.

Some indigenous communities manage and control matters dealing with research. Where this is the case, a researcher should comply with any by-laws, policies, rules or procedures adopted by the community. It is not necessary to be in the domain of indigenous knowledge but there could be possibilities where communities are engaged in other research areas such as educational, health, or tourism projects

Article 3 Communities should be given the option of a participatory-research approach.

Genuine research collaboration is developed between researchers and indigenous communities when it promotes partnership within a framework of mutual trust and cooperation. Participatory research enables a range of levels and types of community participation while ensuring shared power and decision-making. Such partnerships will help to ensure that research proceeds in a manner that is culturally sensitive, relevant, respectful, responsive, equitable and reciprocal, with regard to the understandings and benefits shared between the research partner(s) and indigenous community(ies).

Article 4 A researcher, who proposes to carry out research that touches on sacred knowledge of an indigenous community, or on community members as

indigenous people, should consult the community leaders to obtain their consent before approaching community members individually. Once community consent has been obtained, the researcher will still need the free, prior and informed consent of the individual participants.

A process to obtain the free, prior and informed consents from both the community affected and its individual participants should be undertaken sufficiently in advance of the proposed start of research activities and should take into account the community's own legitimate decision-making processes, regarding all the phases of planning, implementation, monitoring, assessment, evaluation and wind-up of a research project. The requirement for community consent is distinct from the obligation of researchers to obtain individual consent from research participants.

Article 5 Concerns of individual participants and their community regarding privacy and confidentiality should be respected, and should be addressed in a research agreement.

The researcher, the individual participants and the community should have a clear prior understanding as to their expectations with regard to the extent to which research data and results will remain confidential to the researcher. If confidentiality is not possible, or if there are necessary limitations, these should be clearly communicated.

Article 6 The research agreement should, with the guidance of community knowledge holders, address the use of the community's indigenous and sacred knowledge.

Article 7 Indigenous people and their communities retain their inherent rights to any

indigenous and sacred knowledge, and cultural practices and traditions, which are shared with the researcher. The researcher should also support mechanisms for the protection of such knowledge, practices and traditions.

Any research involving indigenous people will involve the sharing of some cultural knowledge, practices and/or traditions even when these are not the subjects of the study, as they provide necessary context. The recording of knowledge, practices and traditions in any form (written notes, audio, video, or otherwise) should only be done with explicit permission and under mutually-agreed terms that are set out in advance of the research with the guidance of appropriate Elders and knowledge holders. All uses and wider dissemination of cultural knowledge, practices and traditions should also be by permission.

Article 8 Community and individual concerns over, and claims to, intellectual property should be explicitly acknowledged and addressed in the negotiation with the community prior to starting the research project. Expectations regarding intellectual property rights of all parties involved in the research should be stated in the research agreement.

To respect the intellectual property rights of each party is the joint responsibility of the researcher and communities involved. Research with explicit commercial objectives and/or direct or indirect links to the commercial sector should be clearly communicated to all research partners.

Article 9 Research should be of benefit to the community as well as to the researcher.

A research project should lead to outcomes that are beneficial to the participating Indigenous

community and/or individual community members. Benefit sharing vis-à-vis a community should be interpreted from the community's perspective. This may include tangible and benefits, including those arising from altruism.

Article 10 A researcher should support education and training of indigenous people in the community, including training in research methods.

Researchers should work to foster capacity building among indigenous people to enhance their participation in research projects and improve the overall interactions between indigenous governance mechanisms and public educational institutions.

Article 11 A researcher has an obligation to learn about, and apply, indigenous cultural protocols relevant to the indigenous community involved in the research.

Article 12 A researcher would translate all publications, reports and other relevant documents into the language of the community.

Article 13 A researcher should ensure that there is ongoing, accessible and understandable communication with the community.

Indigenous communities often have cultural protocols involving interactions within the community. It is important that researchers learn about these and respect them. When providing a research project report to the community, the researcher should provide it in the language of the community unless the community has expressly waived this. The reports or other communications of results should use language and terminology that are readily understood by the community.

Article 14 A researcher should recognise and respect the rights and proprietary interests

of individuals and the community in data and information generated or taken in the course of the research.

Article 15 Transfer of data and information, related to indigenous knowledge, from one of the original parties to a research agreement, to a third party, requires consent of the other original party(ies).

Article 16 Secondary use of indigenous knowledge requires specific consent from community and researcher.

These guidelines set out basic principles for the collection, disclosure, use and transfer of data and indigenous knowledge. The details of safeguards protecting the privacy and confidentiality of data should be negotiated as part of the research process and specified in a research agreement. Subject to the community's views on sacred knowledge, co-ownership of data between researchers and communities is recommended because the indigenous community and the researcher are both integral to the production of data.

If there is to be transfer of indigenous knowledge to a third party, this should be done only with the consent of the researcher, the individual participants and the community. If the third party is to engage in secondary use of the transferred data, then a further consent to that use must be obtained. The consent should address how confidentiality and privacy will be respected.

In any case, secondary use of indigenous knowledge requires new consent unless such use is specifically agreed to in the research agreement. Notwithstanding the above, individuals retain the right to access data about themselves.

Article 13 The product of each parties activities should be considered "on loan" to the other party unless otherwise specified in the research agreement.

Each party, researcher and community, if produce some tangible output it should be considered as “on loan” to the other party, analogous to a licensing arrangement, and this should be detailed in the research agreement.

Article 14 An indigenous community should have an opportunity to participate in the interpretation of data and the review of conclusions drawn from the research to ensure accuracy and cultural sensitivity of interpretation.

Research involving indigenous people is susceptible to misinterpretation or misrepresentation when information about the group is analysed without sufficient consideration of other cultural characteristics that make the group distinct.

The opportunity for review of research results by the indigenous community should be provided before the submission of research findings for publication, to ensure that sensitive information is not inappropriately divulged to the public and that errors are corrected prior to wider dissemination.

This should not be construed as the right to block the publication of legitimate findings; rather, it refers to the community's opportunity to contextualise the findings and correct any cultural inaccuracies.

Article 15 An indigenous community should, at its discretion, be able to decide how its contributions to the research project should be acknowledged. Community members are entitled to due credit and to participate in the dissemination of results. Publications should recognise the contribution of the community and its members as appropriate, and in conformity with confidentiality agreements.

Appendix VII: Free, Prior and Informed Consent Certificate and Research Agreement

eToro: Indigenous Botanical Knowledge Gathering, Documenting and Dissemination in Long Lamai, Sarawak

Thursday, March 01, 2012

Institute of Social Informatics and Technological Innovations-Centre of Excellence for Rural Informatics (ISITI-CoERI) Universiti Malaysia Sarawak (UNIMAS) and Long Lamai Community, upper Baram, Miri Sarawak agree to conduct the named research project with the following understandings:

Introduction

1. The purpose of this research project, as discussed with and understood in the community of Long Lamai Upper Baram, Miri Sarawak, is to gather, document and disseminate Penan Indigenous Botanical Knowledge.

Scope

2. The scope of this research project, as discussed with and understood in this community, is: the initial partnership between ISITI- CoERI from UNIMAS and Ngerabit eLamai (Telecentre) from Long Lamai community. ISITI-CoERI will assist the Ngerabit eLamai and Long Lamai community by developing ICT-based data collection and content management systems, training for digital data collection and processing and priding the scientific names of the identified botanical plants. Ngerabit eLamai will provide the services of the telecentre. The Long Lamai community will arrange activities and provide potential local human resource for training, data collection and IK database management.

Structure of the Project: Roles and Actions

3. The development of this project is based on sincere communication between community members and researchers. All efforts will be made to incorporate and address local concerns and recommendations at each step of the project (Fig 1).

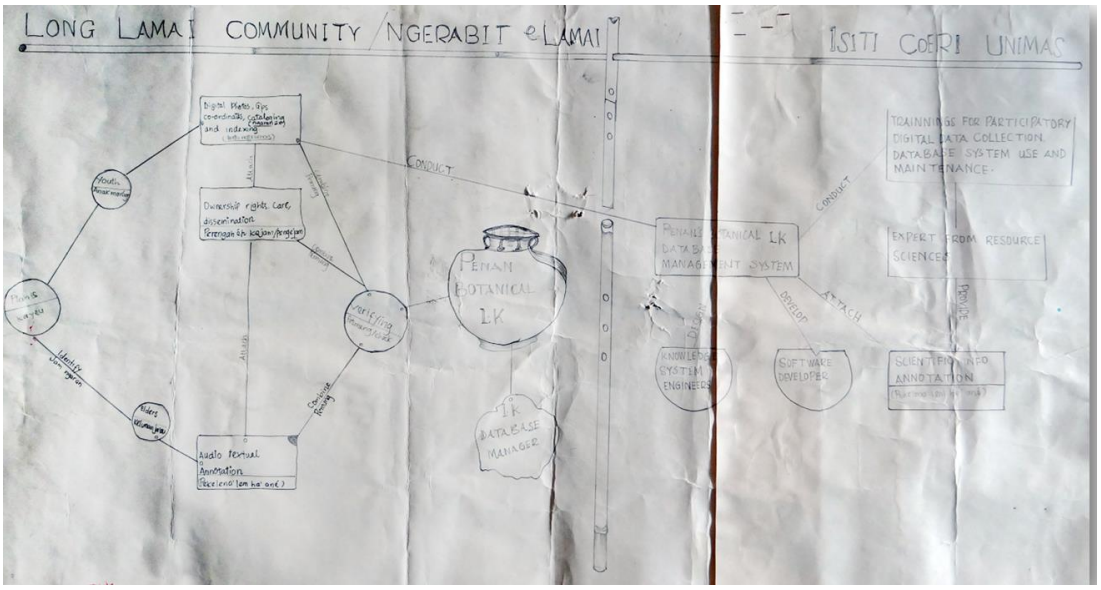


Figure 1: Interests Safeguard Architecture/Process flow diagram

Training, Data Collection and Content Management

4. The methods for training, data collection and content management to be used, as agreed by the researchers and the community, are:

a) Community training and participation, as agreed, are to include Participatory Digital Data (PDD) collection and Processing.

The process of PDD collection and processing is, in essence, extremely simple, and the equipment required is increasingly widely available and affordable. This is the way the process works:

i. The community will provide human resource for data collection.

ii. The community will learn how to use digital equipment through games and exercises facilitated by outsiders.

iii. The elders of the community will identify and analyse potential knowledge assets and practices in their community

iv. The facilitators will help in designing and developing suitable digital media to manage the knowledge resources.

v. The contents messages are collected and processed by the local groups

vi. The contents are shown to the wider community.

vii. The contents would be uploaded to secured database.

b) The process of data collection about the plants to be led by the community members (elders and Youth).

c) The Process of Content Management, as agreed, are to include:

i. The proposed database would base on the needs of the community. The database will contain information of indigenous medicinal plants which the community uses in daily life. Information includes taxonomic data on identified plant, including indigenous names and nomenclature, as well as their local traditional use. Scientific names of the plants are also part of the database. The database entries are complemented by geographical references, based on satellite localisation of areas where materials have been collected. Voice, videos, and digital images also form part of the database.

ii. As demanded by the community the database would be a "closed" system, and will not make Penan IK publicly available. The data would be generally considered as confidential and conserved with *e-insitu* concept while governed by the local customary laws. To get the scientific names for plants, the pictures of the plants will be provided to botanist.

Data and Information Management

5. Data and Information collected is to be shared, distributed, and stored in these agreed ways:

a) The data collected about the plants is confidential and will be kept secured. All the processing on the plants' data will be held in Ngerabit eLamai Telecentre where the data will be uploaded to the content management system from data collection devices. The processed data will be kept on external drives and under the custody of IK manager (a community member) who will be selected by the community. The researchers and eLamai will be available to answer questions and assist community members. A final report will be distributed after approval from the community members.

b) Each party will be the owner of the data that is created and/or developed by them and the other party is subject to use license conditions determined by the community and need to obtain permissions for the use of and storage of that data. ISITI-CoERI will have the right to copyright and replicate the process, data collection software and content management system, while the data collected about the plants will be in sole ownership/stewardship and *(molong)* of Long Lamai community.

6. The research publication, reports and other relevant documents will be translated into the language of the community.
7. Before distribution of the final report with any third party the community will be consulted once again as to whether the community agrees to share this data in that particular way.
8. At the end of the project, the researchers will participate in community meetings to discuss the results of the analysis with community members.

Funding, Benefits and Commitments

Funding

9. The main researchers have received funding and other forms of support for this research project from Universiti Malaysia Sarawak.
10. The funding agency has imposed the following criteria, disclosures, limitations, and reporting responsibilities on the main researchers.

a) To submit a bi-annually comprehensive report.

b) At least 5 research publications and one conference presentation.

Benefits

11. The benefits likely to be gained by the community through this research project are:

a) To preserve Penan's Botanical IK which is at risk of disappearing or being eroded.
b) To strengthen the indigenous knowledge management system of knowledge transfer within and between age groups.
c) To revitalise the indigenous identity through knowledge transfer in younger generation.
d) To support the maintenance and integrity of indigenous cultures.

e) To store and codify the tacit knowledge which could be a way to intellectual property rights on their knowledge assets.

12. The ISITI-CoERI Objectives of the projects are:

a) To devise possible mechanisms for secured protection, and preservation of IK, through community initiatives.
b) To collaboratively develop an effective and appropriate means of recording, storing, and managing data and information.
c) To develop a *sui generis* database protection.
d) To develop the capacity of Long Lamai community to record, control, access and use of IK by third parties.

13. The main researchers wish to use this research project for their benefit in the following ways:

a) For fulfilment of PhD, to design and experiment and
b) To test the Indigenous Knowledge Governance Framework on eToro case study.

14. The researchers will submit a final report to the funding agency at the end of the project. Scientific presentations in peer-reviewed publications and conferences will be made. The final report will be reviewed by community members prior to publication. Scientific presentations will be made and articles published after discussion with the respective community leaders.

Commitments

15. The community's commitment to the researchers is to:

a) Recommend capable and reliable community members to collaborate in this project.

b) Keep informed about the progress of the project, and help in leading the project toward meaningful results.

c) To get skills, run and manage the project in sustainable way even after project completion.

16. The researchers' main commitment to the community is to:

a) Inform the community about the progress of the project in a clear, specific, and timely manner.

b) Act as a resource to the community on questions related to technicalities of the project.

17. The researchers and community agree to interrupt the research project in the following circumstances:

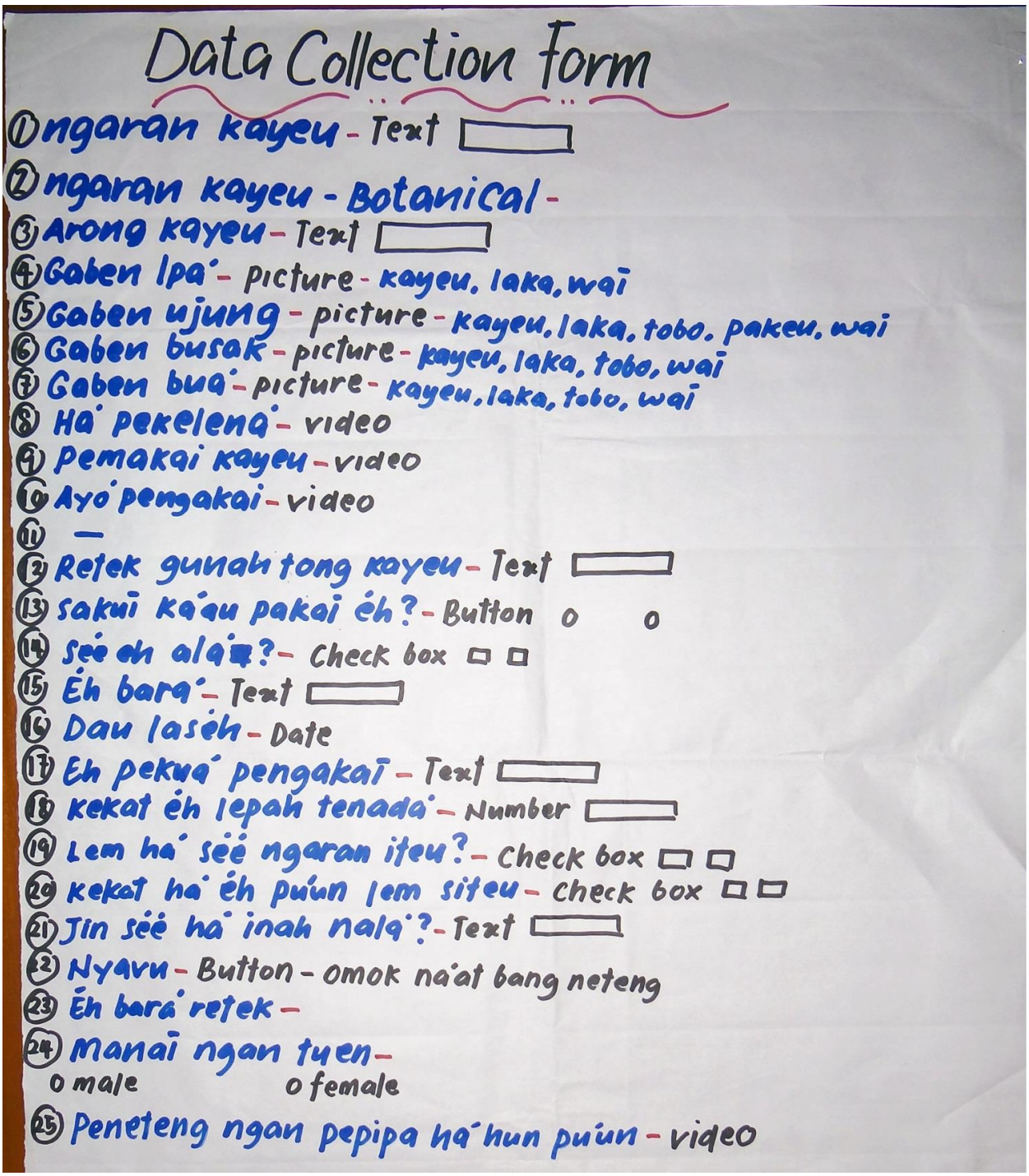
a) If community leaders decide to withdraw their participation.

b) If the researchers believe that the project will no-longer benefit the community.

Signed by:

Date:	Date: Community:
_____	_____
(Signature of Main Researcher)	(Signature of Community Representative)
Name:	Name:
Position:	Position:

Appendix VIII: Data Instrument



Appendix IX: Entity Relationship Diagram of Indigenous Content Management System