GIS Initiatives in Health Management in Malawi: Opportunities to Share Knowledge

Patrick Albert Chikumba[1(✉)] and Patrick Naphini[2]

[1] University of Oslo, Oslo, Norway
pchikumba@poly.ac.mw
[2] Ministry of Health, Lilongwe, Malawi
pnaphini@gmail.com

Abstract. Knowledge is recognized as the most important resource in organisations including public organisations and its management is considered critical to organizational success. The literature suggests the development of indigenous knowledge as one of characteristics of the successful GIS implementation in developing countries. The topic of knowledge has been discussed extensively in the information system and organisation literature but much is written about *why* managing knowledge is important to organisations and little on *how* knowledge is identified, captured, shared, and used within organisations. As a contribution to '*how'*, this paper discusses opportunities of sharing knowledge in the GIS implementation in health management through some initiatives in Malawi. We can confidently say that there are a number of GIS implementation activities in the health sector in Malawi which are important for knowledge sharing but they are not utilised as expected.

Keywords: Health management · GIS initiatives · Knowledge · Knowledge sharing

1 Introduction

Today, strengthening and sustaining the use of computerised health information systems (HIS) is believed to be mainly based on intangible assets such as knowledge and skills. Employee's knowledge and skills in using computer systems have become a critical factor for successful use of information technology (IT) in organisations [1]. In the case of Geographic Information System (GIS) in developing countries, there are several challenges and some of them are related to the lack of knowledge and skills. In GIS, people are the most important part who can overcome shortcomings of the other elements [2]. GIS users need certain knowledge and skills in order to use GIS properly [3]. Longley et al. [4] argue that GIS technology is of limited value without people who manage and develop plans for applying it to real world problems.

In developing countries, including Malawi, GIS is applied in various health areas such as health programs, health management, primary health care, and health research. Since 2002, there have been GIS initiatives in Malawi towards the implementation of GIS in health management with the aim of improving data integration, analysis, and visualization. The combination of GIS and health applications with decision-making

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processes can assist in the operational control, management control and strategic planning [5].

Knowledge is recognized as the most important resource, and its management is considered critical to organizational success [6]. Literature suggests the development of indigenous knowledge as one of the successful GIS implementation characteristics in developing countries [7]. Knowledge can be understood as information processed by individuals relevant for the performance of individuals, teams, and organisations [8]. Kim and Lee [9] have taken knowledge as a fluid mix of framed experiences, contextual information, values, and expert insight that provide a framework for evaluating and incorporating new experiences and information.

With reference to the case, this paper focuses particularly on the sharing of IT knowledge between GIS implementers and technical support teams. Proper transfer of knowledge and skills from the system implementers to target system users, particularly in developing countries, is crucial in realizing the intended benefits. López et al. [10] define IT knowledge as the extent to which the firm possesses a body of technical knowledge about elements such as computer systems (in this case, GIS). According to Taylor in 1971, cited in [10], the technical knowledge is the set of principles and techniques that are useful to bring about change toward desired ends.

The topic of knowledge has been discussed extensively in the information system and organisation literature [11], but much is written about why managing knowledge is important to organisations and little on how knowledge is identified, captured, shared, and used within organisations [6]. As a contribution to 'how' (processes of), this paper discusses opportunities of sharing knowledge in the GIS implementation in health management in Malawi through some GIS initiatives. The paper tries to answer the following two questions: Which opportunities to share knowledge exist in GIS initiatives in health management in Malawi? How can opportunities to share knowledge be utilised for knowledge sharing? These research questions have been answered through the analysis of empirical material being guided by the notion of knowledge sharing, particularly opportunities to share from Ipe [6]. The rest of the paper includes the concept of knowledge sharing, study methodology, GIS initiatives, opportunities to share knowledge and conclusion.

2 Knowledge Sharing

It has been observed that there are significant changes on how public organisations are being managed; moving from a traditional, bureaucratic approach to a more managerial one [8], in which knowledge is recognized as one of critical resources. In this context, the public organisations are treated as knowledge-based organisations, which have to contend with competition for resources [8] and there is the need for processes that facilitate the creation, sharing, and leveraging of knowledge [6]. In this paper, some processes in the GIS implementation in health management and how they can facilitate the sharing of knowledge as a critical asset have been discussed. This study takes resources as assets and capabilities that are available and useful in solving GIS-related problems or meeting GIS user needs. Generally, assets and capabilities are respectively what an organisation has and does [12]. A capability is repeatable patterns of actions in

the use of assets to create, produce or offer a good or service to a particular market or user [13]. Knowledge, as an asset, needs to be acquired and accumulated [14]; this can be through sharing because knowledge multiplies when it is shared effectively [15]. When we talk of knowledge, learning can be one of the strategies for accumulating such an asset in which interactions occur between individuals, teams, or organisations and hence knowledge is shared.

Within organisations, knowledge is at multiple levels: individual, group and organisation. In this paper, the individual knowledge sharing is emphasised with the understanding that without individuals the knowledge cannot be created, and unless individual knowledge is shared, the knowledge is likely to have limited impact on organisational effectiveness [6]. Knowledge sharing refers to the provision of knowledge to help and collaborate with others to solve problems, develop new ideas, or implement policies or procedures [8]. According to Ipe [6] there are three types of individual knowledge: 'know-how' (experience-based), know-what (task-related), and dispositional knowledge (including talents, aptitude, and abilities). It is expected that knowledge held by an individual is converted into a form that can be understood, absorbed, and used by other individuals [6].

Ipe [6] suggests four major factors that influence knowledge sharing between individuals in organisations: (a) the nature of knowledge, (b) the motivation to share, (c) the opportunities to share, and (d) the culture of work environment. By its nature, knowledge exists in tacit and explicit forms whose difference is related to the ease and effectiveness of sharing [16]. Tacit knowledge is situated in the deep recesses of the human mind and non-codifiable [15] and its tacitness is natural impendiment to the successful individual knowledge sharing in organisations because it cannot be communicated or used without the knower [6]. On the other hand, explicit knowledge is recognised and expressed by formal techniques; it can be easily codified, stored and transferred across time and space independent of knower [6, 16]. Explicit knowledge can be generated through logical deduction and acquired by formal study while tacit knowledge can only be acquired through practical experience in the relevant context, which Lam [17] refers as learning-by-doing.

In order to share tacit and explicit knowledge opportunities, either formal or informal, should exist in the organisation. Acording to Ipe [6] formal opportunities are formal interactions (including training programs, structured work teams, and technology-based systems) that are designed to acquire and disseminate knowledge while as informal opprtunities include personal relationships and social networks that facilitate learning and knowledge sharing. However these opportunities alone, without personal motivation, cannot bring much influence on the knowledge sharing. Ipe [6] argues that individuals are not likely to share knowledge without strong personal motivation. Knowledge sharing is challenging because, for example, it is typically voluntary and individual's tacit knowledge is difficult to transfer [8]. Therefore, it is important to understand what motivate individuals to share knowledge; for example the perceived power attached to the knowledge, reciprocity that results from sharing, relationship with recipient, and rewards for sharing [6, 16, 18].

Generally, knowledge is actually created, shared, and used by people in organisations [6] and hence the knowledge sharing should involve dissemination of individual work-related experiences, and collaborations among individuals, subsystems

and organisations [9]. Ahmad et al. [15] emphasise that the ability to share knowledge among collaborators represents possibly the greatest strategic advantage an organisation can achieve; for instance, for the public organisation the knowledge sharing represents the means for continous performance improvements.

3 Study Methodology

This case study was conducted at the national level in Malawi health sector between June 2015 and September 2016. Malawi is a landlocked country in southeast Africa and it has borders with Tanzania to the northeast, Zambia to the northwest, and Mozambique to the east, south and west. In its health system, there are five levels of management (nation, zone, district, facility, and community). The GIS application in Ministry of Health (MoH) in Malawi started as early as 2002 when a booklet of maps of the health facilities was produced and distributed in compact discs (CDs). Since then there have been several GIS initiatives and in this study the focus is on the user training, spatial data collection and mapping, and composition of technical team at the national level.

The qualitative interpretive research methods were applied in this case study. The data was collected through observations, interviews, and analysis of documents. One stakeholder meeting was organised to share experiences on the GIS related activities by various institutions in the health sector and how to work together on the GIS implementation. The first author attended that meeting as a passive observer. Participant observations were also done through out our study period in MoH. Face-to-face interviews with five participants (IT officers and M&E officers) were conducted focusing on the effort and plans on GIS implementation and activities that had been already carried out. Another issue was on the support they have been getting from other institutions and internal capacity they have on the GIS implementation. Various documents were analysed including Health Information System (HIS) policy, electronic Health Information System (eHIS) strategy, and training reports and manuals. The analysis of empirical material was guided by the notion of knowledge sharing, particularly opportunities to share from Ipe [6].

4 GIS Initiatives: From 2002 to 2016

Table 1 below summaries some GIS initiatives in MoH from 2002 to 2016. Most of these activities were carried out by MoH in collaborations with its development partners and other government agencies. The GIS initiatives are presented in three categories: user training, spatial data collection and mapping, and composition of technical teams at both district and national levels.

In Malawi the health sector governance structure has the national and district levels. To strengthen the health management information system (HMIS), MoH established Central Monitoring and Evaluation Division (CMED) in its Planning Department which involves coordination, data management, advocacy and facilitation of information use in various activities at all levels in the health sector. CMED is also

Table 1. Some GIS initiatives in health sector in Malawi

Category	Initiatives	Participation/Collaboration
User training	2008 – inter-institutional training	MoH and its partners, other government agencies; one facilitator from WHO
	2009 – intra-institutional training	Zone M&E officers, and HMIS officers from districts and central hospitals; one facilitator from Surveys Department
	2010 – intra-institutional training	Zone M&E officers, and HMIS officers from districts and central hospitals; two facilitators from Surveys Department and NAC
	2013 – intra-institutional training	HMIS officers from districts and central hospitals; two facilitators from NAC and Lands Department
Spatial data collection and mapping	2002 – mapping public and CHAM health facilities	Pioneered by a consultant from JICA with support from Surveys Department and MoH Planning Department
	2008 – mapping ART clinics (HIV/AIDS program)	NSO, MoH, NAC, CDC, University of Pennsylvania, Roads Authority, Surveys Department, WHO
	2011 – updating 2002 mapped public and CHAM health facilities	Pioneered by a consultant from JICA with support from Surveys Department and Planning Department of MoH
	2013 – coordinates for public and private health facilities	ICF International and MoH
	Since 2015 – coordinates for village and outreach clinics	UNICEF Malawi, MoH and Lands Department
Technical team	At district level	HMIS officers and IT officers
	At national level	HISP Malawi, MoH-IT unit, JHPIEGO/SSDI, Baobab Health, University of Oslo

Note: CDC – Centre for Disease Control, HMIS – Health Management Information System, M&E – Monitoring & Evaluation, NAC – National Aids Commission, WHO – World Health Organisation, CHAM – Christian Health Association of Malawi, JICA – Japanese International Corporation Agency, MoH – Ministry of Health, NSO – National Statistical Office.

responsible for implementation and management of technologies, including GIS, in HMIS. At the national level CMED has inadequate technical capacity and therefore it gets much technical support on the implementation of various technologies from its partners. In the case of GIS implementation, it has been observed that the technical expertise has been from outside the health sector in both user training and spatial data collection and mapping.

CMED has put much effort at the district level in terms of developing GIS-related knowledge to HMIS officers through training. With reference to Table 1, the first GIS training for local capacity was conducted in 2009 and participants were all HMIS officers from District Health Offices (DHOs) and central hospitals, and M&E officers

from zones. The training was just for introducing GIS and was facilitated by a GIS expert from Surveys Department. A year later, second training was provided to the same officers covering the spatial data collection using GPS and facilitated by two GIS experts from Surveys Department and NAC. The same HMIS officers were also trained in 2013 by two GIS experts from Lands Department and NAC. In the past three years, CMED recruited and deployed IT officers in all DHOs and central hospitals to work with HMIS officers but they have not been given any GIS training.

Table 2 summarizes some initiatives that can facilitate knowledge sharing in GIS application the Ministry of Health (MoH).

Table 2. Some initiatives that can facilitate sharing of knowledge

Initiatives	Authors' remarks
User training	This is done to transfer knowledge from the national level to district level. In some cases it is within the same level, e.g. during the setup of DHIS2 GIS, there was a training at the national level for GIS implementation team being facilitated by some members within the team
Collaborations	The collaboration is mainly at the national level
Structured work team	It is mainly at the national level.
Learning-by-doing	This is an institutional initiative at the national level and individual initiative at the district level. Some HMIS and IT officers have learned GIS through particular tasks requested by stakeholders in their respective districts.
Codification	There is no much codification of knowledge; particularly the production of documentation. For example, in almost all user trainings presented in Table 1, there were no training manuals that would be referenced at the workplace after training. For spatial data collection there are some manuals for reference.
Workshops (or meetings)	In MoH, workshops and meetings are always available which HMIS and IT officers attended. MoH can take advantage of these activities to share experiences in GIS among officers.

5 Opportunities to Share Knowledge

In Malawi, as observed in other developing countries [19–21], there is no adequate GIS expertise and it is difficult to recruit people with all necessary GIS knowledge and skills. Alternatively, CMED has been developing such resources internally and the emphasis has been on the technical team at district level. It has been observed that CMED pays much attention on GIS user training and structured work teams which are some of formal opportunities to share knowledge [6]. In this regard, this paper discusses how these opportunities are utilised for sharing knowledge in the GIS implementation in health management in Malawi with emphasis on collaboration and learning-by-doing.

The literature of GIS implementation in developing countries emphasises the importance of collaboration [7, 20, 22]. Ramasubramanian [7] has observed that

strategic alliances could promote the sharing of resources; for example, in GIS programmes of Vista University and University of Pretoria, these universities collaborated with local and international organisations and the programmes were successful. In Mozambique, despite having a number of institutions being involved in GIS activities, they face some challenges due to lack of 'strong' institutional collaboration [22]. This has also been observed in this case study; CMED collaborates with other institutions which are experienced in GIS and its use. In user training and spatial data collection, Departments of Lands and Surveys, and NAC have played great roles with their vast experiences in GIS. In terms of the knowledge acquisition and accumulation these collaborations has allowed CMED to build work teams of both experienced and non-experienced GIS users, leading to knowledge sharing. As Sirmon et al. [23] point out, if an organisation may not have the required knowledge, it might form strategic alliances with those having the desired knowledge which can be valuable to the organisation for learning new knowledge.

Training is one of the formal opportunities that help sharing knowledge. In all GIS user training, there were experienced facilitators from other government agencies, sharing knowledge with non-experienced HMIS officers. This demonstrates the collaboration aiming for HMIS officers to acquire the required knowledge. Due to the decentralization in public sector in Malawi, HMIS officers have been providing all necessary technical support at district level; such as data verification, compilation, analysis, reporting and provision of feedback to health facilities [24]. It is a good decision to invest in HMIS officers in terms of GIS knowledge because it is recommended that when building local capacity the local team should be equipped with understanding of both the application domain and the technology being implemented; this contributes towards the sustainability of the system [25]. HMIS officers have vast experience in the health information management because majority has worked with district health managers since the establishment of HMIS in 2002. Providing them with GIS knowledge and skills can equip them with both understanding of the health management (as application domain) and GIS (as technical domain) which might contribute towards the sustainability of GIS in health management.

However, it has been observed that HMIS officers are not given a conducive environment to practice what they have learnt so that they can improve their knowledge through learning-by-doing [17]. It was expected that they would be part of the spatial data collection exercises in 2013 and 2015-2016 because by then HMIS officers had been trained in GIS, but it has not been the case. In 2013 the exercise of spatial data collection was done by medical assistants and nurses during the service provision assessment at health facilities. Only two HMIS officers were involved in compiling data in this exercise at the national level. Although the spatial data collection being facilitated by UNICEF from 2015 is for mapping village and outreach clinics in their respective districts, HMIS officers are not included; instead the GIS technical support has been provided by officers from Department of Lands. In 2016, CMED has been in the process of setting up GIS on DHIS 2 for the health management and this exercise is also in the hands of GIS experts from development partners; HMIS officers are not part of the implementation team at the national level (see Table 1 – technical team at national level).

It is necessary for CMED to provide a suitable work environment for HMIS and IT officers at the district level to continuously share the individual knowledge, which in this case study has been observed as lacking. It could be better for HMIS and IT officers to be part of work teams of the spatial data collection and GIS configuration exercises so they would share knowledge and put that knowledge into practice. Another observation is that HMIS officers were trained in many occasions since 2009 but there had been no GIS applications for them to put the knowledge into practice. Now CMED is implementing GIS in the health management and it is expected that HMIS and IT officers will be providing all necessary technical support but they are also not participating in the exercise. The inclusion of these officers could create an opportunity of sharing knowledge through learning-by-doing and at the same time building social networks and relationships that may result in the continuity of individual knowledge sharing. There is a high possibility that after the GIS implementation exercise these implementers will be there and then HMIS and IT officers are to take over the responsibility of the system management and maintenance. One participant said: "*We bought GPS for HMIS officers and we trained them because they would be custodians of GIS in their respective health districts"*

Most of activities in GIS implementation have been carried out at the national level and in some cases it is difficult for HMIS and IT officers to be part of the work teams due to the culture of work environment and the nature of work [6]. There are 68 officers (34 HMIS officers and 34 IT officers) in 29 DHOs and 5 central hospitals and it is not easy to include all of them in, for example, spatial data collection or setting up of GIS. These activities require very few skilled people. In 2013 coordinates of health facilities were collected as part of the service provision assessment which involved mainly health practitioners such as medical assistants and nurses. Therefore, MoH decided not to include HMIS officers. One participant commented: "*In this exercise we felt HMIS officers would not have much work to do … instead we trained medical assistants and nurses on collection of coordinates using GPS while they were assessing health facilities…*"

6 Conclusion

From the discussion above, we have noticed that GIS knowledge and skills are available at the national level through collaborations and there is a need to transfer such knowledge and skills to the technical team at the district level. The collaborations provide a platform for acquiring required GIS knowledge from the outside of MoH but the challenge is how to maintain it. It seems that HMIS and IT officers, who are 'prospective' custodians of GIS in the health management, are ignored in many GIS implementation activities which could help them to accumulate the relevant knowledge. Although it is fine now that the development partners are providing all necessary technical support in the GIS implementation, it reaches a point in time when majority of these GIS experts will not be available.

It has been observed that CMED takes mainly user training as a strategy for sharing the knowledge with the HMIS and IT officers and this knowledge needs to be continuously accumulated. In this context the learning-by-doing strategy [17] is essential

because, for example, it provides an environment for accumulating individual tactic knowledge which contributes the large portion of individual knowledge. Apart from the user training, CMED needs to continue promoting structured work teams by including HMIS and IT officers in some GIS implementation activities in so doing the officers can have a chance to build personal relationships and social networks that may provide the environment for continuous sharing of knowledge. Some task-related (know-what) and experienced-based (know-how) knowledge [6] can be codified, for example, as documentation so it might easily be shared at any time and any place. In conclusion, we can confidently say that there are a number of GIS initiatives in the health sector in Malawi which are important for the knowledge sharing but they are not utilised as expected.

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