

## Organizational Capacity Building for Sustainable Health Information Systems: A Case Study from Ghana

Denis Leanard Adalety

University of Oslo, Ghana Health Service, Norway

**Background and Purpose:** Implementing ICT innovations especially in low resourced countries has been documented in the information systems (IS) literature as a very challenging feat because of the existence of weak organizational structures leading to manifestations of silos of fragmented country ICT projects lacking the basic organizational structures to scale and become sustainable over time [31, 11, 33]. In 2010 Ghana adopted the DHIS2 software as a replacement of the existing and challenged health information system (HIS) to enable it track progress on the health related millennium development goals (MDG). The outcome has been a successful nation-wide implementation of HIS in all public health facilities. This paper looked at the factors that enabled the successful implementation and sustenance of the adopted software in Ghana.

**Methods:** Concepts from information infrastructure theory and the notion of the installed base were used as lenses to collect and analyse the empirical data. Data collection and analysis was qualitative using participant observation, focused group discussions, semi-structured interviews and document analysis.

**Results:** This has been possible because of realignment of selected elements of the installed base necessary for achieving set objectives. For Ghana the elements identified were manpower development, resource mobilization, strengthening of institutions and networking with stakeholders to leverage on available resources and technology.

**Conclusions:** Sustainability of HIS in resource constrained contexts requires selection of elements of the installed base necessary for effective organizational capacity building. And these elements must be interdependent otherwise the objective of sustainability might not be accomplished. Effective capacity building efforts of an organization therefore involves combining strategies synergistically to ensure long-term sustainability.

**Keywords:** Organizational Capacity Building, Installed Base, DHIS2

### 1 Introduction

Recent developments in information, communication and technology (ICT) have brought into focus organizations, governments and policy makers leveraging on ICT for their developmental agenda [45]. Literature on information systems (IS) abound with examples in researches into the development of complex large scale ISs called the information infrastructures (II) in areas such as commerce, telecommunication, banking, mining, health and so on [9]. The objectives of these technological innovations are mostly to either solve system problems or improve upon existing systems. The health sectors in developing countries have seen many of such ICT innovations enacted by different actors for improving healthcare delivery and reporting [11, 20, 48, 39].

With respect to health the different actors within the health organization field come with their own parochial agenda which come to bear on the introduction of such ICT innovations in their respective settings. Invariably these innovations come in the form of conditional aid packages which are at variance with individual country or organizational developmental agenda. Most of these initiatives have been pilot projects which by and large have not been able to scale in their respective contexts when project time elapses. These have resulted in IS 'silos' dotting the IS landscape [28, 31, 33].

In the past two decades developing countries have seen increased activities in modernizing their ISs. In the health sector there has been the urgent need for some countries for example Ghana to honour their

international obligations as signatories to international conventions and charters, for example the MDGs [31, 1, 11, 16]. For informed decisions as to progress towards achieving set MDG targets, data has been seen as crucial and this has compelled governments and health ministries to restructure their health sector to improve upon the quality of health service delivery and data reporting. This is amid health systems in developing countries which are generally struggling with multiple and overlapping inefficient parallel or siloes of information systems [30, 49, 38].

Broadly speaking health information connotes information on the health status of the population, health services, resources and other factors that affect health. Health information system therefore includes procedures, equipment and human resource involved in data generation, collection, processing and provision of information to health workers and the population at large for making informed decisions [2, 6]. Consequently, the success or failure of any health care system is contingent on the quality and soundness of the health information system or [31, 11, 13, 16]. By extension it is therefore expected that a sound and quality HIS should necessarily have the capacity to generate quality data and information to enable informed decision in the health sector [2, 6].

Information infrastructures evolution among other characteristics depends on the installed base [29]. Health information systems conceptualized as an II evolve on their installed bases consisting of people, institutions, artefacts, stakeholders, the health sector as an organization, and so on, which are involved in the process of continuous change [29]. Organizational actors function within organizational fields and are governed by formal and informal institutions [42, 46]. Actors central to this study are the DHIS2 application, the GHS as an organization, stakeholders, and existing and emergent institutions. This study conceptualizes the realignment of the elements of the installed base for continue change and sustainability of HIS implementation as organizational capacity building. In developing country settings such as Ghana focus will be on the interactive effects in the capacity building process by looking at manpower development, existing and emergent institutions, formation of networks, and resource mobilization. This is line with suggested framework in the literature and findings will therefore be contributing to this body of work [21, 18].

## **2 Materials**

### **2.1 Capacity Building**

Capacity building is a cross-cutting concept and pervasive in all human endeavours which has been well researched in different fields [21, 18, 37]. Being a multidimensional concept its application has varied conceptualization but the underlying components or principles remain the same irrespective of the field of application. Capacity by definition refers to the overall aptitude of the individual or organized group to perform assigned responsibilities [21]. Inherent in this definition is the attribute capability or ability which refers to the knowledge, skills and attitudes of the individual or group, and their competence to undertake assigned responsibilities [21, 43].

Performance of responsibilities in this regard is not dependent only on the capabilities of the people but also on the overall nature of the tasks, available resource and the institutional arrangements within which these responsibilities are discharged [21,43]. In the health sector for example it is common to have highly skilled and capable staff but who do not have the capacity to function appropriately due to lack of resources and ineffective institutional arrangements. Therefore strengthening institutions and developing the capability of people in an organization must be seen as fundamental in capacity building efforts of the organization. These are done essentially through education and training of the human resource across all levels and strengthening of the managerial systems through consolidation of existing institutions and enacting new ones where necessary, and the provision of knowledge for the execution of assigned responsibilities. In effect capacity can be seen as both the organizational or sociocultural arrangements and the technical capabilities that allow organizations to carry out their functions [43].

From the foregoing therefore capacity building can be defined as a dynamic and multidimensional process of organizational change through an integrated approach of strengthening individual or group skills and abilities, formal policies, systems, practices, symbolic actions, networking, beliefs, values and attitudes [43]. This broad definition of capacity building enables different approaches to how organizations could fashion their capacity building efforts. In the literature reviewed one could identify

some common strategies to the concept under the disguise of different terminologies and which are also context dependent. For example in a health promotion study [18] (Crisp et al, 2000) suggested using the following approaches for capacity building ; a top-down organizational approach for changing policies, a bottom-up organizational approach for provision of skills to staff, a partnership approach for strengthening inter-organizational relationships, and community participation approach for improvement of health in the community. In a related work [21] (Franks, 1999) in developing capacity in the water sector at the Deft Conference on water resources, similar components were identified as appropriate for the sector; that is, the creation of an enabling environment with appropriate policies and legal frameworks; human resource development and strengthening of managerial systems; and institutional development, including community participation.

## 2.2 Installed Base

Information infrastructures have inherent complexities and cannot be built from scratch but cultivated from the existing structures or systems. In contemporary organizations however ICT solutions and their developments are complex because they incorporate many technological elements, have large user bases, and are usually built or developed on existing configuration of information infrastructure components called the installed base [50, 47, 39]. The installed base is the totality of the existing infrastructure prior to the introduction of an ICT solution into an organization. This consist of the organizational set up as a group, the governing institutional structures, material elements such as paper and equipment, human and financial resources, existing coalitions and networks, physical infrastructure, and so on and so forth. It is the configuration of these components which forms the foundation or base on which the perceived II sits, nurtured and grows and this can be experienced as inertia to the change process. Whatever is added needs to be integrated and made compatible with this base and this sets up demands for compatibility and imposes constraints on what can be designed at any given time [39]. Therefore to study the evolution and sustainability of an II such as DHIS2 application in our case it is essential to take into consideration the components of the installed base.

## 2.3 Research Objectives

The objective of this research is then to analyse the organizational capacity building efforts for sustaining a recently deployed national data warehouse application within the GHS [21, 8, 18, 19]. To do this we frame the research problem as: How can the implementation of ICT innovations be sustainable in resource constrained contexts? Ghana is a developing country that depends heavily on donor funding for its developmental agenda and aspires to be a middle income country by the year 2020. In addition to this national goal it also has other international commitments, for example, attaining set targets for the millennium development goals (MDGs) by the year 2015. Information Communication and Technology (ICT) has been identified as key to all these national efforts. For the Ghanaian context the study focus will be on manpower development, strengthening of institutions, mobilization of resources, and partnerships through networking. The study will follow the implementation of the DHIS2 data warehouse application by evaluating essential components of the installed base for sustainability as it evolves.

The rest of this paper will be as follows; a description of the materials, context and the research approach. This is followed by the results, discussions and some concluding remarks.

## 3 Research Context

This is a longitudinal study that started in 2010 and is still ongoing. The GHS undertook a major restructuring of its HIS to enable it measure progress towards achieving set targets for the health related MDGs 4, 5 and 6, and also improve upon the quality of the routine health service data it generates to enable it make informed decision [3, 4]. Different stakeholders are involved in the provision of healthcare in Ghana and these include the government (public), private, quasi government, faith-based and traditional medicine practitioners. Among these it is the government/public which is the largest health care provider [3].

Healthcare provision in the public sector is three tiered. At the primary level are the community-based health programmes and services (CHPS) compounds and health centres (HC) which provide both preventive and curative health services through static clinics and outreach programmes to the communities [24, 25]. The secondary levels comprise the district and regional hospitals and the tertiary levels are made up of the teaching hospitals and specialized facilities such as leprosanatoria, psychiatric hospitals and cardio centres. For this study the emphasis will be on the public sector where the DHIS2 application was implemented. As a result of healthcare providers offering service to clients, data is generated and this is collected and managed using the DHIS2 which is locally called the District Health Information Management System (DHIMS2). The study will look at the organizational structures that enabled successful implementation and continued sustenance of the DHIS2 application in Ghana.

## 4 Research Methodology

This paper is the outcome of HISP involvement in the implementation of DHIS2 application in Ghana as a result of partnership between the GHS and the University of Oslo, who are the developers of the software. The main motivation of the HISP network stems from the strand of action research practiced in Scandinavia where the researcher is actively engaged in a real-world context with the quest for new knowledge whilst improving the context through cyclical problem diagnosis, designing, implementing interventions and evaluation of the outcomes [10, 7]. Through many years of practice the "networks of action" concept was also developed by [11] (Braa et al, 2004), to describe the action research process within HISP. The main tenet of the 'network of action' concept is the importance of sharing knowledge among nodes in the network to ensure sustainability over time and space.

I have been actively involved in the implementation of this project since 2010 to date and have had the opportunity to interact with the system and its environment at different levels. I have also participated in systems development, training of end-users and implementation country-wide. Such close involvement in this project has given me the opportunity to observe systems activities, access documents, discuss and interview many stakeholders at different levels over time and space.

### 4.1 Data Collection

Data collection has been through different qualitative data collection methods such as stakeholders' consensus building fora, customization of the DHIS2 to DHIMS2, training of end-users, participation in annual review processes and other meetings, participation in integrated quarterly monitoring and evaluation exercises to the regions, districts and facilities, focus group discussions with end-users, interviews and analysis of documents. Interviews were interactive and were used in an attempt to have a deeper understanding of the issues being studied [36]. Over the years I have also had many discussions and interviews (formal and informal) with National Divisional/Programme Heads, District Directors of Health Services (DDHS), Regional Directors of Health Services (RDHS), health facility heads, Public Health Nurses (PHN), Disease Control Officers (DCO), Health Information Officers (HIO) and Biostatistics Officers (BSO). Informal discussions were also held with peers, stakeholders and national representatives regarding emerging trends in HIS in the GHS and Ghana as a whole.

Depending on the calibre of staff views were sampled from participants on the software application performance, activities surrounding data management and strategies that will ensure system sustainability. Discussions were also held on issues on data quality and data use, integration prospects (especially for the stand alone programmes such as TB, HIV/AIDS and Malaria), collaboration (internally and externally), resource mobilization for data processing, local training initiatives to build capacity of staff, constraints and how in the participants view DHIS2 application could be sustained over time. During all these visits and end-user encounters field diaries were used to take field notes which were later transcribed for analysis. Bias in the research was also reduced by providing feedbacks to key respondents and revisiting some research sites [36, 40].

## 4.2 Data analysis

In qualitative research data collection and analysis goes on concurrently as there is no clear distinction between the two in that the data analysis affects the data and the data affects the analysis in significant ways [41]. This research is interpretive and qualitative in nature hence the data was analyzed using hermeneutic approach where text from interviews from the field were transcribed, reduced, categorized and displayed in order to find patterns in the data [40, 36]. From these themes and trends were identified and explained in the findings. These themes were on perceptions, advantages and disadvantages of the system, issues of the system relating to data quality, organizational influences, governance and recommendations for system improvement and sustainability. The data collection and analysis were all guided by the underlying theoretical concepts. Having been involved in all the implementation processes also gave me better insights and knowledge on issues that would not have been possible otherwise.

## 5 Research Findings

Capacity is here conceptualized as both the organizational arrangements and the technical capabilities that allow organizations to carry out functions related to set objectives [43]. Many studies have been conducted on capacity building (CB) in organizations and the findings of these studies are that capacity building is a multidimensional concept and contextual for the simple reason that organizations are idiosyncratic in their operations and formation [32, 17, 34, 43]. Because of these characteristics studies in capacity building assume different approaches contingent on contextual influences. Despite the differential approaches to studying capacity building in organizations studies have shown the existence of some cohesion. These could broadly be classified as manpower base, institutional arrangements, availability of resources, and formation of coalition or networking with stakeholders. Furthermore, these categorizations are interdependent to form a complex whole and cannot be appreciated in isolation [32, 17, 34, 43]. This study draws on the above suggested classifications to evaluate the organizational initiatives of the GHS which have facilitated the successful implementation and sustenance of the DHIS2 data warehouse application in the public healthcare service in Ghana.

### 5.1 Manpower Development

Human resource development is fundamental to the success or failure of any developmental agenda and key among the range of strategies for improving skills and competencies of the workforce in an organization is through continuous training and education [43, 21]. In the context of Ghana and the implementation of the DHIS2 application these took different trajectories and levels.

The DHIS2 software is structured in modules which enable it to be adapted to different contexts. Having identified the modules suitable for the GHS a technical team was constituted made up of staff from the Centre for Health Information Management (CHIM), the department in the GHS responsible for managing health service data, to customize the DHIS2 application to suite the Ghanaian context. Members of the team are from backgrounds such as statistics, disease control, computer science, health informatics, epidemiology and biostatistics. This background-mix was necessary for the customization process because of the inherent complexities in the health sector. The objective of the formation of a team from the CHIM to facilitate the customization is to strengthen the human resource base by developing skills internally within the GHS for future maintenance and sustainability of the DHIS2 application.

For the skills development efforts first a consultant was engaged for two weeks to introduce the team to the software after which a prototype was built for demonstration to the management of the GHS of the feasibility of the project. Second, based on this initial tutorial a technical assistance was provided through networking with the HISP group in the University of Oslo. This coalition with the HISP facilitated completion of the customization of the DHIS2 application for deployment in all public health facilities (and some private, mission and quasi-government health facilities) and health directorates (district, region and national) in the country [3].

After systems development end-user training was conducted in batches at different levels consisting of staff at the regional, systems administrators at regional and district levels, and all headquarters staff who are involved in data processing and management. Composition of the regional training consisted of users from the regional health directorate (RHD), district health directorates DHDs in the region, all hospitals in

the region, all special programme coordinators, and all departments who generate health data as result of the services they provide e.g. Family Health, Nutrition, Disease Control, EPI, surveillance, etc. Special training was also given to systems administrators at the various levels i.e. RHDs, DHDs, hospitals and special programmes, to enable them administer the system at these levels. The content of the administrators training consisted of tasks such as granting user access, running data quality checks, maintenance of organization unit structure and generation of reports for management and stakeholders.

The thinking behind this broad spectrum of training was to make data open, accessible and transparent to end-users. It is also to enable all departments generating data to enter their own data since they understand their data better than the HIOs who hitherto has been responsible for all data entries thus reducing the workload on the HIOs who will then dedicate more time to data analysis and quality issues. As trainer of trainers (TOT) HIOs are also expected to function as resource persons to cascade end-user training to the lower levels when resources are available. Even though data entry is supposed to be at the district level observation in the field was that some districts have taken the initiative to provide the necessary resources down to the CHPS compounds, which is the lowest level for service delivery at the community, to enter their own data in the DHIS2 application thereby bridging the gap in data flow and compensating for some data transmission errors and challenges in the paper-based HIS.

As a policy directive data quality assurance teams are formed at each level starting from the CHPS compound through to the national level. The mandate of these teams is to ensure that data generated is vetted for quality before entry in the DHIS2 application. Heads of the data quality teams who normally are the facility managers are also expected to develop skills in data analysis and use especially at the facility levels where data is generated. Data use seems to be gradually gaining grounds as this was evident from simple graphs on selected health indicators which could be seen adorning the walls and notice boards at most facilities visited.

The curricula at the various MOH educational institutions also have components on health statistics and biostatistics where students are given introductory courses in these disciplines in relation to health information. Other specialized MOH educational institutions such as Kintampo Rural Health School, University of Health and Allied Sciences (UHAS) and the School of Public Health, University of Ghana, have courses in health informatics where students are trained to take up positions as health information officers in the health sector. As a long term plan there exist bilateral agreements between the GHS, University of Ghana and the University of Oslo for academic programmes in the field of information systems and research to train Ghanaians in these fields at the masters and the doctorate levels [3].

## 5.2 Resource Mobilization

At the heart of any successful HIS project is the availability of resources both human and material. Provision of material resources is correlated to access to financial resources without which HIS projects cannot be initiated. Ghana is a developing country and heavily dependent on foreign grants and loans for the implementation of national development initiatives including health programmes. The pursuit for a viable and efficient HIS for the GHS has been a major challenge with respect to acquiring the necessary financial mainstay for the commencement of the initiative. The defunct health management information system (HMIS) was proprietary software which had many challenges [3, 44, 4]. The decision on adopting FOSS was as a result of lack of funds for maintenance when the project ended. The previous proprietary HMIS was project funded by the European Union (EU). And when the project elapsed it became difficult to maintain it to accommodate emerging requirements from stakeholders [3, 44, 4].

Through networking with health partners the GHS secured the necessary financial support to implement the DHIS2 application. The financial support enabled broken down ICT equipment to be refurbished or replaced, end-user trainings to be conducted, the provision of logistics for monitoring and evaluation of activities at project sites, and payment for server hosting. The Government of Ghana on its part provided the human resource, physical infrastructure, other logistics and payment of staff salaries.

## 5.3 Strengthening Institutional Structures

Institutions are said to be cognitive, normative and regulative structures and activities that provide stability and meanings to social behaviour [46]. Organizations and the organizational field such as the GHS and its partners constitute an institutional life [46]. Institutions are therefore the regulative

frameworks, managerial practices and norms that enable organizations to function and endure [46, 42]. With reference to the GHS and DHIS2 application there exist the e-governance policies for government within which all e-projects in-country must comply with. From this the MOH/GHS has developed the Enterprise Architecture with e-health component that governs all its e-health projects.

At the operational level the GHS has also developed the Standard Operating Procedures (SOP) for health service data management. This document on SOPs provides a formalized system for evaluating the technical adequacy of data collection, collation and analysis. These activities start before data collection and continue after analysis are completed and require continuous and evolving coordination and oversight. These procedures outline how to keep records and obtain accurate, complete as well as thorough documentation of all activities in the GHS [27]. It also specifies the minimum data quality and quantity requirement as well as the procedures that will be used to analyse and report those data. The main objectives of the SOPs are therefore to maintain a reliable data quality system for the GHS, provide a current accurate data required by the service, donors and other stakeholders, and provide a record keeping system that will help evaluate and monitor promptly and allow for effective resolution of concerns and issues on on-going active programmes [27].

Other institutional strengthening mechanisms are institutionalization of peer reviews among directors and superintendents of health services, budget management centres (BMCs), and health information officers. The directors meeting which is dubbed Senior Managers Meeting (SMM) is a biannual institutionalized affair at which all managers of health services in the country meet to deliberate on the stewardship of their respective jurisdictions. Similar peer review meetings are held at facility, district, regional and national levels on quarterly, semi-annual and annual basis [4]. The HIOs also hold their separate quarterly meetings just as the previous two groups. At all of these gatherings presentations are made based on the sector-wide indicators which the MOH/GHS track each year on the basis of service provided and these are subjected to review by peers.

The RHIOs on their part now have an added responsibility of generating quarterly publications e.g. bulletins, on their activities based on these service indicators for their respective regions. The production of this bulletin on time determines release of funds for regional monitoring of health programmes and activities for the quarter. These peer review mechanisms coupled with the institutionalization of quarterly regional league tables have tremendously facilitated to improve the quality (completeness, timely, consistency and accuracy) and use of routine health service data [4]. In addition the regular quarterly regional monitoring and evaluation exercise jointly undertaken by national and regional officers has also facilitated the overall data management improvement process within the GHS.

Developing and implementing an information infrastructure such as the DHIS2 data warehouse application takes a lot of effort and resources and the end product and the IT infrastructure needs protection and security in case of a disaster. The IT is an important resource of an organization and must be properly secured [26]. As part of health systems strengthening activities during the implementation of the DHIS2 project the GHS developed a Disaster Recovery Plan (DRP) containing comprehensive statement of consistent actions to be taken before, during and after a disaster. It is an evolving document that contains a set of procedures to recover and protect the information technology infrastructure of the GHS in the event of a disaster in order to recover IT data, assets and other infrastructural facilities. The DRP document also contains policy guidelines in relation to accessibility to cooperate data, information and use. This is to espouse ethical issues with regards to patient data confidentialities.

#### **5.4 Networking**

For sustainability of interventions such as implementation of HISs in resource constrained contexts invariably depends on building coalitions both at the micro and macro levels, and this creates opportunities for utilizing these partnerships to strengthen the capacity of organizations in the process [18, 11]. Coalition building or networking is based on the assumption that providing possibilities for the two-way flow of knowledge between nodes in the network can lead to sharing of available resources for planning and implementing health projects. The traditional alliance with health partners such as World Health Organization (WHO), Japan International Cooperation Agency (JICA), the United Nation (UN) Bodies, Global Fund, World Bank (WB), etc. have been providing financial support to programmes in many developing countries. It was inferred from the data gathered for this study that donor fatigue has set

in such that the amount of funds being released by donors currently is decreasing therefore governments and organizations need to be more innovative in attracting funding for health programmes.

Strategy	Benchmark	Outcome
Manpower	<ul style="list-style-type: none"> <li>• Skills development</li> <li>• Incentives</li> </ul>	<ul style="list-style-type: none"> <li>• Training (technical team, end-users, HISP academy and educational programmes)</li> <li>• Working tools, personal emoluments, feedbacks on operations</li> </ul>
Resources	<ul style="list-style-type: none"> <li>• Infrastructure</li> <li>• Financial</li> </ul>	<ul style="list-style-type: none"> <li>• Buildings, equipment, other logistics</li> <li>• Operational funds</li> </ul>
Institutions	<ul style="list-style-type: none"> <li>• Policies</li> <li>• Enabling environment</li> </ul>	<ul style="list-style-type: none"> <li>• SOP, DRP, EA, Peer reviews, quarterly integrated M&amp;E, etc.</li> <li>• Conducive working environment</li> </ul>
Networking	<ul style="list-style-type: none"> <li>• Internal collaborations</li> <li>• External coalitions</li> </ul>	<ul style="list-style-type: none"> <li>• MDAs, Earmarked health programmes (HIV/AIDS, TB, MCP, etc.), educational institutions</li> <li>• Global health partners, Global Infrastructure (HISP)</li> </ul>

**Table1.** Framework for Assessing Organizational Capacity Building Initiatives in Ghana

Newly established partnership with HISP has open new capacity building opportunities for the GHS in the area of technical assistance through knowledge transfer and education. In addition to providing the TA for customizing the DHIS2 application for the GHS the HISP group is also providing training on advanced features of the application through the HISP regional academies in West Africa. For sustainability and eventually becoming self-reliant and less dependent on the HISP technically, the GHS has taken the initiative, by leveraging on the TA from HISP, to build the skills of its core technical team in server administration of which the first training session took place in January 2013 and has been recurring when the need arises. In the memorandum of understanding (MOU) between GHS and University of Oslo, fellowships are also to be provided for higher education in information science and research. This is to be seen as a strategic plan to build the skills of Ghanaians in these fields so that eventually the GHS weans itself from dependency on external assistance to become self-sufficient.

## 6 Discussions

Each of the approaches analysed in this paper incorporates a range of strategies for accomplishing elements of organizational capacity building initiatives. It will therefore be necessary to consider mechanisms to establish whether capacity building did occur and whether the occurrence has elements of sustaining the DHIS2 implementation in Ghana. Studies on capacity building in organizations have shown that such evaluation procedures are contextual and vary from organization to organization. However, irrespective of the approach, the ultimate question which emerges when assessing attempts at capacity building is whether changes that have taken place in the organization as a result of interventions are sustainable [21, 43, 18, 11]. **Table 1** shows the framework used in assessing the capacity building initiative by the GHS when the DHIS2 application was implemented.

Humans are central to every organization's development hence it was of little surprise to observe that the competence and skills development of the workforce of the GHS is crucial in its capacity building efforts. Enhancing this capability will depend on effective education and training and on equipping individuals with the ability to learn continuously. These were evident on the premium put on training programmes at different levels, and the formation of core teams for systems management at district, regional and national levels as short to medium term measures to initiate and maintain project implementation.

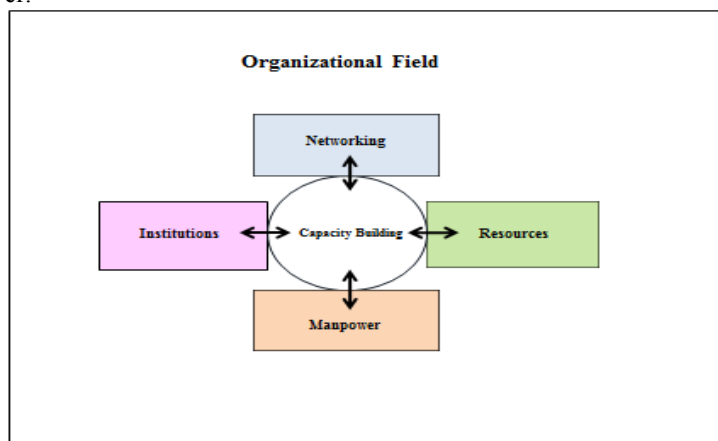
Organizational capacity building is an evolutionary and dynamic process in the growth of an II such as the DHIS2 application. Therefore the GHS for its long term plan has networked with the HISP group and the University of Oslo for continuous refresher trainings on new release versions of the DHIS2



application through its regional academies and online tutorials. Technical assistance for specific requests on in-country trainings as in the case of the periodic server trainings and educational opportunities through scholarships for the staff of the GHS at the post graduate levels are seen as innovative ways of cultivating the installed base with respect to skills development in order to strengthen and sustain the DHIS2 implementation in the country. These long term educational programmes could be the critical factor for increasing the knowledge base through the development of research capacity of beneficiaries who might assume academic positions in Ghanaian educational institutions to impact knowledge to others.

The existence and evolution of IIs is interlinked with defined standards and this has generated much interest in studies in standardization strategies [29, 14]. Standards are accepted ways or norms or procedures of doing things and for II development these must be generic and flexible in application [14]. Institutions are the lifeline of organizations and IIs development and if IIs are to persist and scale its institutions must be strengthened. The implementation of the DHIS2 application in Ghana has seen the emergence and strengthening of standard institutions such as SOPs, e-health policy, DRP, data accessibility policy and empowerment of health staff to be enrolled in the DHIS2 application space. The creation of an enabling environments and legislative frameworks are indeed essential components of organizational capacity building blocks for enhancing DHIS2 application development and implementation. No matter how competent and committed an organization’s workforce, it needs to be able to work within a supportive environment. In addition the workforce must be adequately recompensed to enable it to deliver [21].

Networking with health partners both internally and externally had enabled the implementation of the DHIS2 application in a resource constrained country like Ghana. Donors financed all the end-user training programmes and this was the component which took the chunk of the DHIS2 implementation budget. Their participation was crucial as central government was not having the necessary funds for a national project such as this. Partners continue to support post implementation efforts such as routine monitoring and evaluation activities to sustain the system. For example the World Bank (WB) released funds in 2013 for the integration of the e-Tracker which is an individual client mobile medical record system for supporting maternal and child health service at the community level into the DHIS2 application [5]. This development is significant in the sense that it will enable the e-Tracker as a module of the DHIS2 application to scale nationally. The reason being even though it is being piloted in just some few districts currently by virtue of being part of the DHIS2 application it will automatically be available to end-users throughout the country since the DHIS2 application is a web-based system and accessible from a central web server.



**Fig.1.** Interlinkages in Organizational Capacity Building Components

Organizational capacity building efforts must necessarily embody the element of sustainability [17]. In this study it has been observed that the overarching factor for a sustainable HIS is the interdependency among the organizational capacity building components identified for a given context (**Figure 1**). For example human resource is the mainstay of every organization and this is the same for the health sector. Therefore high staff attrition due to unfavourable working environment and other extraneous factors will obviously lead to challenges in the operations of the organization and consequently the II. Again in Ghana

this project has been successful primarily due to the coalitions that the GHS has forged with the HISP group and its health partners of which a breakdown in such coalition might lead to breakdown in the evolution and growth of the II [29]. The IS literature gives many examples of HIS projects which have either failed or are still in their pilot stages after many years of implementation. This might probably be due to lack of interdependency among the components of the specific organizational capacity building efforts [31, 35]. Consequently for a sustainable HIS there is the need to preserve the relationship between all identified components of the organizational capacity building efforts in lieu of this the II is bound to founder.

## 7 Concluding Remarks

This paper describes four approaches to organizational capacity building initiative for the implementation and sustainability of HIS in a resource constrained country such as Ghana. The four approaches identified and used by the GHS to successfully customize, implement and maintain the DHIS2 application in all government and some private health facilities were manpower development through training and education, mobilization of resources both human and material, strengthening of existing institutional frameworks and enactment of new ones, and building networks through partnership with the HISP group and other stakeholders in healthcare [11]. Concepts from information infrastructure such as the installed base and cultivation with regards to selected elements of the installed base were used as lenses for data collection and analyses to ascertain sustainability of the DHIS2 application in Ghana.

For a sustainable implementation of HIS in a resource constrained countries for example Ghana, adoption of the approaches in the organizational capacity building process in the specific context must be interdependent without which the objective of sustainability might not be accomplished. This is because, for example in Ghana's case, a delay in scheduled donor financial support for retraining of end-users in new release versions of the DHIS2 application occasioned some challenges resulting in some districts not able to use the system with resultant data quality implications.

Again for this network to also endure it is imperative that the nodes in the network are constructively engaged continuously. The findings also suggest that organizational capacity building is not simply the provision of training opportunities, workshops and enacting institutions that lead to short-term outcomes. Effective capacity building efforts of an organization involves combining strategies synergistically to ensure long-term sustainability.

Since its introduction in Ghana in 2010 one can infer from this study that the DHIS2 has evolved over the years and has been sustained by the structures put in place by the GHS. It started as an aggregated system and has metamorphosed and capable of storing both aggregated and patient-based data. The organizational structures, even though not perfect and have their peculiar challenges, have withstood all the odds and have enabled the system to diffuse from the district to the community level where routine health service data (maternal and child health service data) could be entered by community health workers (CHW) [5]. This unique development has certain implications in relation to data quality because it reduces some of the error prone processes in the data flow from point of generation to the next and higher levels. For example data collation on paper summary sheets for onward transmission to the district for electronic input into the DHIS2 application for maternal and child health (MCH) programmes is in the process of being stopped in some districts. This is because MCH records are being entered into the DHIS2 application at the community level as a pilot and later to be scaled nationwide since the MCH paper registers has been digitized as part of the DHIS2 application.

## Acknowledgement

My appreciation goes to the Ghana Health Service for granting the permission for the conduct of this research at its facilities and to the Global Infrastructure Group for funding the research.

## Statement of conflict of interest

I will like to state that there were no conflicts of interest in the conduct of this study.

## References

- [1] AbouZahr, C. & Boerma, T. (2005). Health Information Systems: the foundations of public health, *Bulletin of the World Health Organization*, 83(8).
- [2] Adam T. & de Savigny D., 2012. Systems thinking for strengthening health systems in LMICs: need for a paradigm shift. *Health Policy and Planning*. 2012;27(suppl 4):iv1-iv3.
- [3] Adalety, D. L., Poppe, O, Braa, J., (2013). Cloud Computing for Development –Improving the Health Information System in Ghana, *IST-Africa 2013 Conference Proceedings*.
- [4] Adalety, D. L., Jolliffe, B., Braa, J., Ofosu, A., 2014. Peer-Performance Review as a Strategy for Strengthening Health Information Systems: A Case Study from Ghana. *Journal of Health Informatics in Africa*.
- [5] Adalety, D. L., 2015. Leveraging on Cloud Computing for HIS to Support Maternal and Child Health Services at the Community Level in Ghana. (forth coming)
- [6] Adindu, A., 1995. Quality of Health Information System. Incongruity and Health System Dysfunction. *Lambert Academic Publishing, PhD Thesis, 1995*.
- [7] Avison, D., Lau, F., Myers, M. D., & Nielsen, P. A. 1999. Action Research. *Communications of the ACM*,42(1), 94-97
- [8] Barker, A., 2005. Capacity building for sustainability: toward community development in coastal Scotland, *Journal of Environmental Management* 75
- [9] Blaya, J., Fraser, H., & Holt, B., 2010. E-Health Technologies Show Promise In Developing Countries. *Health Affairs* 29, NO. 2 (2010): 244–251.
- [10] Baskerville, R. L., & Wood-Harper, A. T. (2002). A Critical Perspective on Action Research as a Method for Information Systems Research In M. D. Myers & D. Avison (Eds.), *Qualitative Research in Information Systems* (pp. 129-145): Sage Publications.
- [11] Braa, J., Monteiro, E., & Sahay, S. (2004). Networks of Action: Sustainable Health Information Systems Across Developing Countries. *MIS Quarterly*,28(3), 337-362.
- [12] Braa, J., & Hedberg, C. (2002). The Struggle for District-Based Health Information Systems in South Africa. *The Information Society*, 18, 113-127.
- [13] Braa, J., & Sahay, S. (2012). *Integrated Health Information Architecture: Power to the Users*. New Delhi: Matrix Publishers.
- [14] Bygstad, B., Hanseth, O., Truong, O., 2015. From IT Silos to Integrated Solutions: A Study in E- Health Complexities. *Proceedings of European Conference of Information Systems (ECIS)*, 2015.
- [15] Charbel, Jose', Chiappetta Jabbour and Fernando Ce'sar Almada Santos, 2008. The central Role of Human Resource Management in the Search for Sustainable Organizations.
- [16] Chan, M, Kazatchkine, M, Lob-Levyt, J, Obaid, T, Schweizer, J, Sidibe, M, Veneman, A, Yamad, T, 2010. Meeting the Demand for Results and Accountability: A Call for Action on Health Data from Eight Global Health Agencies. *PLoS Medicine* | [www.plosmedicine.org](http://www.plosmedicine.org) 1 January 2010 | Volume 7 | Issue 1
- [17] Cooke, J., 2005. A framework to evaluate research capacity building in health care, *BMC Family Practice* 2005, 6:44 doi:10. 1186/1471-2296-6-44
- [18] Crisp Beth, Hal, R., Swerissen and Stephen J. Duckett, 2000. Four Approaches to Capacity Building in Health: Consequences for Measurement and Accountability in Australian Institute for Primary Care, Faculty of Health Sciences, La Trobe University, Bundoora, Victoria 3083, Australia.
- [19] Carl, F., Steve Carpenter, Thomas Elmqvist, Lance Gunderson, C. S. Holling, and Brian, 2002. Resilience and Sustainable Development: Building Adaptive Capacity in a World of Transformations Walker *AMBIO: A Journal of the Human Environment*, 31(5):437-440.2002.
- [20] Damtew, Z. A., Miscione, G., Mekonnen, S., Østmo, E., Staring, K., Sæbø, J. I., & Sun, V. (2010). Globetrotting health information systems. *Journal of Health Informatics in Developing Countries*, 4(1), 27-38.
- [21] Franks, T, 1999. Capacity Building and Institutional Development: Reflections on Water, DPPC, University of Bradford, UK
- [22] Fuchs, Lynn S; Fuchs, Douglas, 2006. A Framework for Building Capacity for Responsiveness to Intervention School Psychology Review; Winter 2006; 35, 4; ProQuest Psychology Journals pg. 621-626
- [23] GHS, 2011, Standard Operation Procedures for Data Management
- [24] GHS CHPS, 2005. Community-based Health Planning and Services (CHPS). The Operational Policy. *Ghana Health Service Policy Document No. 20. May 2005*.
- [25] GHS CHPS Manual, 2013. Strengthening Community-based Health Planning and Services. Manual for Community Health Management Committee. *USAID|Ghana|JICA Project*.
- [26] GHS DRP, 2013. Disaster Recovery Plan for Health Information System.
- [27] GHS SOP, 2011. Standard Operating Procedures. 2<sup>nd</sup> Edition, 2011
- [28] Giuse, DA, Kuhn KA, 2003. Health information systems challenges: The Heidelberg conference and the future. *International Journal of Medical Informatics* 2003, 69:105-114.

- [29] Hanseth, O., and Lyytinen, K., 2010. Design theory for dynamic complexity in information infrastructures: the case of building internet. *Journal of Information Technology*, 25, 1-19. doi: 10.1057/jit.2009.19
- [30] Health Metrics Network (HMN). 2008. Framework and Standards for Country Health Information Systems. *Second Edition. Geneva: Second Edition*
- [31] Heeks, R. (2002). Information Systems and Developing Countries: Failure, Success, and Local Improvisation. *The Information Society*, 18, 101-112.
- [32] Heward S., Hutchins C., & Keleher, H., 2007. Organizational Change, key to Capacity Building and Effective Health Promotion *Vision 2020 Australia, ACT Health Promotion Authority (Healthpact), Australia and Department of Health Science, Monash University, Australia.*
- [33] Honest C. Kimaro; José L. Nhampossa, 2010. Analyzing the problem of unsustainable health information systems in less-developed economies: Case studies from Tanzania and Mozambique. *Information Technology for Development.*
- [34] Jones, M., 2001. Sustainable Organizational Capacity Building: Is Organizational Learning a Key? *International Journal of Human Resource Management* 12:1 February 2001 91–98
- [35] Kuipers, Humphreys, Wakerman, Wells, Jones and Entwistle, 2008. Collaborative review of pilot projects to inform policy: A methodological remedy for pilotitis? *Australia and New Zealand Health Policy* 2008:<http://www.anzhealthpolicy.com/content/5/1/17>
- [36] Kvale, S., (2009). Learning the Craft of Qualitative Research Interviewing. Sage Publication Inc.
- [37] Lengnick-Hall, C A, Tammy E. Beck, T E, Lengnick-Hall, M L, 2011. Developing a capacity for organizational resilience through strategic human resource management. *Human Resource Management Review* 21 (2011) 243–255
- [38] Matavire , R., Chidawanyika, H., Braa, J., Nyika, P.,Katiyo, J., 2013. Shaping the Evolution of the Health Information Infrastructure in Zimbabwe. . *8thHELINA 2013 Conference.*
- [39] Mekonnen, S, M, Sahay, S, Lewis, J, 2015. Understanding the Role of Social Capital in Integrating Health Information Systems. *Journal of Health Informatics in Developing Countries.*Vol. 9 No. 2, 2015
- [40] Miles, M.B. & Huberman, A.M. (1994). Qualitative Data Analysis. *Thousand Oaks: Sage Publications.*
- [41] Myers, M. D., 1997. Qualitative Research in Information Systems. *MISQ Discovery.*
- [42] North, D. C. (1990). Institutions, institutional change and economic performance. *Cambridge: Cambridge University Press.*
- [43] Nu'Man, Jeanette, Winifred King, Ameer Bhalakia, and Shaniece Criss, 2007; A Framework for Building Organizational Capacity Integrating Planning, Monitoring, and Evaluation. *Journal of Public Health Management Practice*, 2007, January (Suppl), S24–S32 Lippincott Williams & Wilkins, Inc.
- [44] Poppe, O., Jolliffe, B., Adalety, D. L., Braa, J., Manyaa, A., 2013. Cloud Computing for Health Information in Africa. Comparing the Case of Ghana to Kenya. *8th Health Informatics in Africa Conference (HELINA 2013).*
- [45] researchICTAfrica.net: Annual Report 2010-2011
- [46] Scott, W. R., 2001. Institutions and Organizations. *Second Edition. Sage, USA*
- [47] Star, S. L. and Ruhleger, K, 1996. Steps toward an ecology of infrastructure: design and access for large information spaces. *Information Systems Research* 7(1), 111–134.
- [48] Sæbø, J. I., Braa, J., Sahay, S., Kossi, E. K., & Settle, D. (2011). Networks of Networks - Collaborative Efforts to Develop Health Information Systems Across Developing Countries. *Paper presented at the Ifip WG 9.4 Social Implications of Computers in Developing Countries, Kathmandu, Nepal.*
- [49] UN MDG Report, 2013. The Millennium Development Goals Report Wilkinson, A., Hill, M., Gollan, P., 2001. The Sustainable Debate; *International Journal & Production Management.* Vol. 21, No. 12, pp. 1492-1502.