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COLLABORATIVE KNOWLEDGE MAKING AND SHARING ACROSS SITES: THE ROLE OF BOUNDARY OBJECTS

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Abstract

A number of researchers on Science and Technology Studies (STS) have criticized the western view treating knowledge as objective and universal, with the argument that all knowledges are locally situated. In this article we draw on this view of *decentring* of scientific knowledge and on the concept of boundary objects to discuss an empirical case of a 'global' collaborative network called Health Information System Programme (HISP) involving a number of countries in a process of knowledge creation and sharing. The network consists of knowledge objects with seemingly universal characteristics shareable across sites. The paper discuss the 'localness' of the knowledge produced by looking at its originality and how it is made mobile, thereby giving it the seemingly universal characteristics. The article further, discuss how the involved multiple social worlds characterized by different knowledge practices, cultures and visions, participate through boundary objects shareable across the network and thereby contribute new knowledge in the network. The collective boundary objects created and shared within the network play a significant role in creating synergies which in turn sustains the involved countries' local initiatives.

Keywords: *Boundary Objects, Collaboration, Knowledge Sharing, Health Information Systems,*

1 INTRODUCTION

Knowledge has long been treated as objective and universal with assumptions of existence of one unique ordering of the natural phenomenon of the world obtained through powerful known set of procedures. However, this view has been criticized by many science and technology studies' researchers with an argument that all knowledge systems are locally produced and situated (Haraway 1998; Tunbull 2000; Suchman 2003). The critique is further cemented by the argument that the work of making the so called 'universal' knowledge assemblage such as software products and scientific models adapt to particular local sites is fraught with messiness and indeterminacies. Conversely Turnbull (2000) argue that we must strive to understand how scientists get from one local knowledge to another rather than from universal knowledge to its local instantiations. Standardization has been identified as the key strategy through which knowledge is assembled and moved across time and space (Tunbull 2000; Christiansen 2005). This involves making connections and negotiating equivalences between heterogeneous components for both traditional and scientific knowledge to be assembled and moved.

The only possibility for the creation of effective solutions to be shared between multiple local sites as in the case of HISP is through collective knowledge of the particular and multiple locations of their production and use (Suchman 2003; Tunbull 2000). HISP is a collaborative action research network which involves a number of countries from Africa, Asia and Europe with a goal to improve health information systems in these countries. Each country has its own locally grounded cultural, political and socio-economic knowledge practices which generally challenge the possibility of having one unique solution workable across the involved countries. This contextual diversity is however celebrated through collective knowledge creation and sharing using what we ontologically refer to as boundary objects (Star and Griesemer 1989).

The boundary objects are collaboratively created mainly through standardization and made plastic enough to adapt to local needs and constraints of the several parties employing them, yet robust enough to maintain a common identity across sites. In the HISP network boundary objects take the form of software modules, scientific publications, training manuals, and best practices templates. Apart from collaboration across countries, is the collaboration across diverse knowledge systems and disciplines. Health information system is a multidisciplinary field which brings together field of Medicine, Public Health, and Epidemiology, Informatics and Computer Science field together. These multiple diverse fields in different countries in the HISP network are brought together through boundary objects create synergies which further amplify the collective knowledge creation and sharing. Our argument is that, this approach is imperative not only for creating robust solutions shareable across countries and disciplines but also vital especially in developing countries where the necessary capacities in terms of technology are not readily available. The collective boundary objects therefore, play significant role in creating synergies in the HISP network which in turn sustains the involved partner countries' local initiatives.

The rest of the paper is organized as follows. In the next section we present the literature covering some of the debates on situated knowledge generally and in relation to information systems discourse. This is followed by the literature on boundary objects. The research methodology applied in the study is then set forth, followed by the HISP case description section. Analysis and discussion of the empirical materials is presented next. The paper ends with a conclusion section where the implication of the study is summed up.

2 SITUATED KNOWLEDGE

The traditional view on western scientific knowledge has always been that of objectivity, rationality and universality. The strongest and most persuasive arguments for the possibility of universal, objective knowledge are based on the assumptions that there is one uniquely correct ordering of the natural phenomenon of the world and the existence of a set of procedures sufficiently powerful to determine what that ordering is (Turnbulll 2000). This perspective conceals its messiness and unplanned character and has been found to be fraught with indeterminacies, painting the picture of the orderings as being partial and incomplete. Consequently, other knowledge systems are treated as mere beliefs, lacking objectivity and one that is inarticulate. Turnbull (2000) drew on the constructivist and interactionist approach to criticize the objectivity and universality of knowledge by bringing the concept of decentring of scientific knowledge. He argues that there is no one universal form of knowledge but a variety of knowledges which are 'locally' situated.

Furthermore, (ibid) used the concept of 'universal' scientific models and what it takes to make them work on particular local site to describe the embedded knowledge as entrenched in site specific practices, where the model ceases to be universal but locally grounded. On the other hands, Haraway (1998) - the first author on situated knowledge came with what she dabbed *partial perspective* where she argued that it is not about universality but partiality. It is about a 'view from somewhere' and not a 'view from nowhere' while claiming to be everywhere equally (Haraway 1988). In their study on the design for indigenous knowledge management tool with Aboriginals Verran et al (2007) argued that Aboriginal's knowledge is always local and performed, and the moment you start to think of one solution for everybody you are already starting to compromise some peoples agendas, histories and contexts.

The study of the International Classification of Diseases (ICD), a list of universal, standardized diagnoses indicated that the problems faced in local sites is entrenched in the way diseases are locally understood, practices in handling them and the way information is collected, codified and verified (Bowker and Star, 1994). Taking a more critical view on universal solutions Timmermans and Berg (1997) argued that universality is always local, resting on real time work and emerges from localized processes of negotiations. By taking this perspective of knowledge as being locally grounded, we need to account for the seemingly global character that typifies most of the techno-scientific knowledge solutions. According to Turnbull (2000), this lies on the social and technical devices used for treating instances of knowledge practices similar or equivalent and for making connections/links enabling the local knowledge to be assembled and moved. This linking of heterogeneous components of a knowledge tradition is done with technical devices such as maps, templates, diagrams and drawings. By taking the HISP collaborative network, the context of our study described in later sections, devices used for linking disparate components of knowledge enabling its mobility across the network includes: templates consisting of 'best practices', training manuals, scientific publications, procedures and practices codified in the District Health Information Software (DHIS).

As the literature described earlier succinctly indicates, and as argued in (ibid), the movement of the local knowledge should be understood in terms of adaptation rather than in terms of the instantiation of universally applied form of knowledge.

> *In scientific research, we obtain a practical mastery of locally situated phenomena. The problem is how to standardize and generalize that achievement so that it is replicable in different local contexts. We must try to understand how scientists get from one local knowledge to another rather than from universal knowledge to its local instantiations* (Turnbulll 2000, p10).

The adoption of different objects – or 'knowledge assemblages' as (ibid) calls them, in the HISP network is based on strong adaptation, tinkering and continuous negotiations to ensure its application in particular local sites. As shown later, this adaptation and tinkering lead to changes in both local practices of use and in the 'knowledge assemblage' which in turn contributes knowledge back in the network for other local use. This creation of shareable 'objective' knowledge from and for multiple sites with different practices, cultures, visions etc.; is described by Suchman (2003) as she drew on the partial perspective by Haraway (1988), arguing that the only possible route to 'objectivity' is through collective knowledge of the specific locations of our respective visions. This means that the only possibility for the creation of effective objects/solutions is through collective knowledge of the particular and multiple locations of their production and use.

The common trait of knowledge assemblages which can be moved across sites through adaptation as in the HISP collaborative network is captured in what Star and Griesemer (1989) refers to as Boundary

Objects - objects which are plastic enough to adapt to local needs and constraints of the several parties employing them, yet robust enough to maintain a common identity across sites. We now present the literature on the concept of boundary objects and how we intend to apply it in the analysis of our case.

3 BOUNDARY OBJECTS

The concept of boundary objects, offers a promising analytical leverage to examine the collective creation and sharing of knowledge in form of standardized packages (best practices, software tools, publications) in the HISP network consisting of multiple sites with diverse cultural, political and social practices. Bowker and Star (1999) describe boundary objects as objects that inhabit several communities of practice satisfying informational requirements of each of them. However different contexts or communities of practices make different use of same objects where each participating world abstracts or simplify the object to suit its demands with extraneous properties being deleted or ignored.

> *They are weakly structured in common use, and become strongly structured in individual-site use. They may be abstract or concrete. They have different meanings in different social worlds but their structure is common enough to more than one world to make them recognizable means of translation* (Star and Griesemer 1989, p393).

The different connotations and assignment of meanings results from diverse areas of responsibilities encapsulated under respective social worlds (Puri 2007). Hence, diverse work in the multiple worlds proceeds in parallel except for the limited exchanges of standardized sort. Star's (in Turnbull 2000, p11) description of scientific theories building captures very well the collaborative and locally situated dynamics of boundary objects:

> *Each actor, site or node of a scientific community has a viewpoint, a partial truth consisting of local beliefs, local practices, local constraints, and resources, none of which are fully verifiable across all sites. The aggregation of all viewpoints is the source of the robustness of science.*

Underscoring the collaborative creation and knowledge sharing between multiple social worlds through boundary objects Puri (2007) argued for the need to create knowledge alliances enabling multiplicity of both technoscientific and indigenous knowledge systems to work together and complement each other. Boundary objects can be used to initiate a dialogue between different communities characterized by different knowledge traditions creating synergy between them. For instance, planning and design experts used paper maps and scale models as visualization tools to draw out community expertise and local knowledge concerning issues of community development (ibid). In Ethiopia, a software tool was used as a boundary object bringing public health officials, medical doctors and the software development team to initiate and engage in a dialogue facilitating mutual knowledge sharing and learning between different knowledge traditions (Shigaw 2009).

Looking at how boundary objects are created before they can be used Christiansen (2005) in her paper titled 'boundary objects, please rise..' she argues that standardization seems to be the precondition for a boundary object to rise. This is underscored by Turnbull (2000) who discussed the need for making connections and negotiating equivalences between heterogeneous components for both traditional and scientific knowledge to be assembled and moved. Traditions move knowledge and assemble it using arts, ceremonies and rituals while science does it through building instruments/technologies, standardizing techniques and writing articles. Boundary objects are therefore created over time from ongoing collaboration between different social worlds or communities of practice, as a way of resolving different definitions of things, situations, problems etc within the respective social worlds. Once a visible representation (in form of a template, drawing, tools standards, 'best practices' etc.) of knowledge of an individual actor, site or node is made available for analysis and communication, it becomes a boundary object (Puri 2007). Star and Griesemer (1989) in their study identified different types of boundary objects including repositories such as databases, libraries or museums; and standardized forms created as methods of common communication across distributed work groups.

Taking the HISP network as a case study which consists of objects with seemingly universal characteristics shareable across sites, we intend to draw generally on the concept of situated knowledge and the boundary objects to first show how these knowledge assemblages are local by looking at their originality and how they were standardized making them mobile and shareable giving them the seemingly universal characteristics. We also show how the involved multiple social worlds characterized by different knowledge practices, cultures etc. participate and contributes in the process of creating and using different boundary objects shareable in the network. Furthermore, we will also argue that boundary objects created and shared within the network have played an important role in sustaining not only the network but also the involved partner countries through synergies.

4 RESEARCH METHODOLOGY

The empirical material presented in this paper have been gathered through variety of qualitative research methods ranging from review of various HISP publications, participant observation, and interviews and through experience garnered through actual engagement in the HISP activities. All the three authors have worked in different countries where they were involved in the actual work of initiating and sustaining collaboration through adoption and adaptation of the HISP standards.

The first and second authors have been members in the HISP network for more than five years and the third author is among the main pioneers of the programme and has worked in a number of countries for more than a decade. This actual engagement of the authors in the network have played major role in providing insiders' view concerning the issue of situated knowledge and knowledge sharing across countries in the HISP network. As participant observers and members of the 'global' HISP team, the three authors attended in a recent (March 2010) workshop which brought together participants from India, Vietnam, Tanzania, Ethiopia, Djibouti, South Africa and Norway where different progress and innovations from these disparate countries were presented and discussed.

Figure 1: DHIS2 Collaborative Workshop in UiO, Norway

The composition of the team ranged from those specialized purely in informatics, health informatics researchers, and medical doctors doing research on health informatics to epidemiologist working with HISP in their respective countries. The diversity of the disciplines involved, account for the collective and collaborative nature of knowledge making and sharing both across different knowledge traditions and participating countries in the HISP network.

5 THE CASE OF THE HISP NETWORK

What is today called global collaborative Health Information System Programme (HISP) spanning a number of countries from Africa, Asia and Europe started as local initiative in a remote district in the northern part of the Eastern Cape Province, South Africa. The district management team found that the data collected by the clinic staff seemed inappropriate for the adequate management of services (Shaw, 2005). Data had been submitted to the head office with no feedback and the data collection requirements had been determined by the top level and had not been revised to accommodate priority recent changes in the health services. To resolve the problems to ensure a more locally oriented data collection and use, the district embarked on a process of reviewing the data elements and collection tools.

The review process was done under the framework for reconstruction of the **new** South Africa after the fall of apartheid, which within the health sector targeted among other things on decentralization to ensure local support of actions at the health facility and district level of the health system. The district then identified data elements and indicators for monitoring of services. A minimalistic approach was chosen where only the data and indicators linked to actions were collected. Data collection tools were developed based on the agreed sets of data elements and indicators (ibid). Until this stage the work brought together district public health officers and medical doctors.

Following implementation, adjoining districts came to learn about the new data sets and its efficiency. This led to introduction of a pilot project starting from 1996, in three districts in Cape Town which was done as a collaborative research and development effort between University of the Western Cape, University of Oslo (UiO), and University of Cape Town – giving birth to HISP. HISP brought together public health activists from the health sector, NGOs and public health universities staff, and informatics researchers. Two areas for research and development were identified: first was to develop an Essential Data Set (EDS) and standards for primary health care data, the second was to develop a district health information software (DHIS) to support implementation and use of the data sets (Braa and Hedberg 2004). Following intensive negotiations driven by local public health managers, in collaboration with HISP team, after nine months the first essential data set was implemented in Western Cape Province. Open source database application software developed through participatory prototyping was implemented for handling the data sets. The software inscribed organizational changes which were taking place in the health sector, including decentralization, local flexibility and user orientation, empowerment of local management and support of horizontal flow of information and knowledge.

Following successful implementation in the Western Cape and Eastern Cape, in 1999 the national health department endorsed the strategies, best practices, processes and tools as national standards. The roll out of the data sets and the software standards were preceded by a standardization process based on a 'hierarchy of standards' where the national level came up with its minimum EDS with a flexibility to be adapted and extended at any level of the health system to include data elements for local use. Included in the EDS design as best practices were to ensure comparable and compatible health data; feasibility in terms of data collection; and ensuring collection of useful information (ibid).

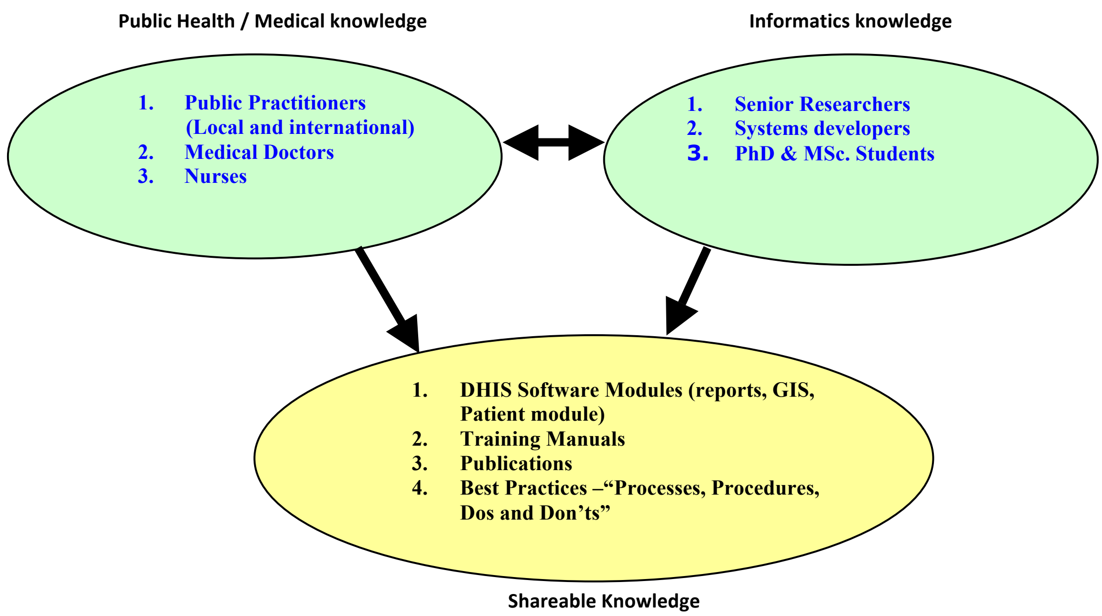

Figure 2: Collaborative knowledge making and sharing

The achievements in South Africa represented a "best practice" case in Africa and from 2000 software and approaches have been customized and further developed in a number of other African and Asian countries (Braa and Muquinge 2007). Mozambique have been involved in HISP since 1998, India since 2000, Malawi since 2000, Tanzania since 2001, Cuba since 2002, Mongolia since 2002, Ethiopia since 2002 and Vietnam since 2004. The way of entry into the different countries has been through two major entry points; through university collaboration, and attempting to build alliances with the health authorities through pilot implementations meant to instigate dialogue and negotiations. For instance in Tanzania, collaboration was initiated in 2001 with the University of Dar es Salaam through masters' students studying informatics at UiO, who acquired a permission to adapt the software and the HISP approaches in two pilot districts. Results from these districts initiated a dialogue with the MoH. The dialogue involved workshop presentations and attendance of MoH into HIS training programmes which opened door for knowledge sharing and learning between the MoH public health officials and the HISP team members leading to national endorsement of HISP software tools and approaches in 2007.

The adaptation and further development of the software and approaches in the other countries led to synergies through sharing of new software modules, training manuals, and best practices distributed through scientific publications written by Senior University Lecturers, Masters and PhD students operating as HISP team members. For instance, DHIS1 was adapted for use in Mozambique after being translated into Portuguese. Lacking separate module for translation, DHIS1 was translated through hard-cording, leading to difficulties in incorporating new software changes from SA to the 'Mozambique version'. This sparked development of an independent language module in Mozambique, which could be adopted and adapted in other countries contributing to HISP network (Braa et al. 2006). On the other hands in India development of new reporting, presentation and data use functionalities was done feeding back to the network. For instance a GIS module for data presentation was developed in India and adapted for use in Mozambique. Mechanisms for reporting and data use were adapted for use in Zanzibar through an Indian DHIS1 expert.

Apart from development of new modules into the network, other countries led to software version shift from DHIS1 to DHIS2. In Mozambique and India, DHIS1 which was developed using Ms Access, was considered low-tech by political figures arguing for a high-tech Java based open source software. This led to the development of DHIS2 using Java framework, by building on DHIS version1 data structure and approaches. Unlike version one which was developed by one country – SA, version two involved a number of countries coordinated by the University of Oslo. The first prototype version of DHIS2 was implemented in India and later in Vietnam. Other countries from Africa such as Sierra Leon, Mali, and Tanzania started implementation of DHIS2 in their respective countries. These sites provided a test bed for DHIS2 by creating feedback loops from public health officials, medical doctors and data collection staff.

The structure of DHIS2 is modular such that, it consists of one core module which is less likely to change across countries. On top of the core module are the modules which are adaptable to specific site requirements. India saw extensive implementation of DHIS2 in a number of states. This sparked developments of new modules such as reports and data presentation mechanisms which could also be shared in the network. In Vietnam similar developments of different modules took place contributing to the global HISP network. This multiple site development and innovation is challenged when the new module requires changes to the core module. The core module as amplifier for making collaboration possible and continuous, by allowing collaborating parties to develop country specific modules on top of it. Therefore changes to the core module are done through coordination.

For modules from specific countries to be shareable the work done by the coordinating country is worth mentioning. The HISP team in UiO plays a coordinating role to ensure new innovations within the network are standardized and made part of the shareable objects. For instance, India and Vietnam came up with two report modules which were meant to save respective local needs (see Appendix section). The two modules were different in terms of simplicity and easy of adaptability to new contexts etc. The UiO HISP team in collaboration with the countries of development workout the modules which are hitherto strongly structured for individual site use and make them weak structured weakly structured and more generic for relatively common sites use.

The work of sorting out the objects is sometimes done through meetings and workshops where different developments from various countries are presented, discussed and ultimately incorporated in the network. Examples of such meetings is one that took place at the UiO from March to April 2010 with representation from Vietnam, India, Djibouti, Tanzania, Sierra Leon and Mali (see Figure 1). Apart from the shareable developments in terms of Modules, the workshop provided an arena for exchange and knowledge sharing based on localized experiences from various actors in the network.

6 ANALYSIS AND DISCUSSION

In this section we draw on the concept of situated knowledge and boundary objects to analyze the case. First we start by the analysis of situated nature of knowledge and the multiple knowledge traditions which forms the basis for collaborative knowledge creation and sharing within the HISP network. Secondly, we use the concept of boundary objects to discuss knowledge sharing across sites and show the importance of these objects in facilitating collaboration between multiple local sites.

6.1 Situated nature of Knowledge in the HISP network

The HISP network represents a typical case where different 'local' knowledges are made to work together collaboratively. The network represents an arena with multiple countries characterized by multiple knowledge practices and visions where there is no one universal knowledge or solution fitting to all sites. Instead, 'objectivity' within the network has been through collective knowledge creation and sharing from the specific locations with their respective visions and practices (Suchman 2003). The argument is that the knowledge shared within the network is locally produced, packed up using social and technical devices which treats instances of the knowledge practices equivalent or generic enough enabling it to move across sites (Turnbull 2000).

The originality of the network with the involvement of local knowledge practices geared towards locally situated problem solving gives a foretaste of the 'localness' of the knowledge produced, used and shared. The HISP 'global' collaborative network resulted from local efforts in a remote district in South Africa to resolve problems related to data collection and use. The efforts brought together public and medical related officials in the districts to review and standardize data elements and tools for data collection. The review was shaped by the country's motto of rebuilding SA supporting decentralization and local action (Shaw 2005). Based on this, the ensuing data and tools standards were minimized collecting only those which support local actions at the decentralized unit of the health system. The principle of minimum data and indicator sets supporting local action built into the standards made the district successful, which were later adopted by other three districts for pilot. HISP then started in these three districts bringing public health university experts, district public health medical officers and health informatics researchers. The team represented varieties of knowledge traditions and practices with two main goals; to develop essential data and indicator sets and development of software to support the new standards. Both the data sets and software standards inscribed local knowledge practices. Being successful in the pilot sites, the HISP approaches were implemented in two Provinces and later adopted as a national standard for the whole country.

The knowledge from one district to three districts and from three districts to two Provinces and later to the whole country was done through standardized packages of best practices inscribed in data and software tools. For instance the concept of minimum data set was later built into the essential dataset developed in the three districts. Moving from three districts to provinces, a concept of hierarchy of standards was developed based on the minimum and essential data set principles, and inscribed in the data and software standards adopted for the whole country. At each site and stage, the knowledge is modified but without losing its originality which accounts for it's locally situated character. The knowledge created at one remote district has been standardized and made generic enough making it possess seemingly universal characteristics. The work of adapting the knowledge for particular local use further accounts for the situated attribute of the knowledge produced. Adaptation of the best practices from one district led to formation of an essential data set and a software tool in the three districts, which when adapted for use in an entire Province gave birth to the principle of hierarchy of standards, which was later applied in the entire country. This approach conforms to Turnbull's (2000) argument that in research, we obtain a practical mastery of locally situated phenomena, where the problem rest on how to standardize and generalize that achievement so that it is replicable in different local contexts. This is the generic challenge in any collaborative and collective knowledge making and sharing where diverse multiple local contexts are involved in the process.

The observation is further strengthened by looking at the countries which adopted and adapted the standards and approaches from South Africa. After seeing the success of HISP, other countries joined through adoption of the principles, best practices, and software standards from SA. However, the adaptation was made possible through making connections and negotiating equivalences between the country of origin and the destination countries, by creating 'similar' environments. For instance, in SA HISP was formed as alliance of University public health officials, district and national health officials, NGOs and Health informatics research experts to enable knowledge sharing. Most countries which adopted the approaches from SA strived to create 'similar' environment. However, in places where it was hard to create such an environment, adoption and adaptation of the approaches and standards from SA faced challenges. In some other countries, the approaches from SA were in conflict with the organizational structure and way of working of the destination country leading to failure. For instance, the SA approaches and standards were built based on a bottom-up approach supporting decentralized structures of the health system. Meeting the strongly centralized structures in Cuba, implementation of the approaches from SA failed (Braa et al. 2004). This again, challenges the view of universality and the possibility of having one uniquely correct ordering of the natural phenomenon of the world (ibid). The need for making equivalences before knowledge can become mobile is captured in Haraway's (1988) argument that it's not about a 'view from nowhere' while claiming to be everywhere equally but it's about a 'view from somewhere'.

However, as knowledge moved across countries where it was adapted for local use, new knowledge practices came to play from the respective countries as was the case in SA, contributing further to the shared knowledge objects in the HISP network. In the subsequent section we draw on the boundary objects concept to discuss this aspect of knowledge sharing across countries and show the importance of the objects in facilitating collaboration within and across countries.

6.2 Knowledge Sharing and Creation – The Role of Boundary Objects

The collective creation and sharing of knowledge in the HISP network consisting of multiple sites with diverse cultural, political and social practices is better captured in the boundary objects concept. In the preceding section we have argued that the knowledge shared within the HISP network is locally produced. The social and technical devices used for treating instances of knowledge practices similar or equivalent from different local sites accounts for its mobility and its seemingly universal characteristic (Turnbull 2000). Standardization in a particular local site as was the case in SA, resulted into knowledge shareable across countries in form of boundary objects such as best practices, software tools, publications, user manuals etc. These objects are plastic enough to adapt to local needs and constraints of the several parties employing them, yet robust enough to maintain a common identity across sites (Star and Griesemer 1989).

The objects play crucial role for knowledge sharing both within and across countries. Within countries, the boundary objects such as the software tools creates platform for dialogue and negotiation between people from different knowledge traditions as aforementioned about the case in Tanzania and Ethiopia. As countries are adapting the existing boundary objects in the network, new objects from different local sites emerges in form of modules, best practices templates, training and user manuals which are then standardized and made part of the shareable objects.

The work of adapting existing objects and emergence of new objects accounts for the difficulties of having one uniquely correct ordering of the natural phenomenon of the world and the existence of a set of procedures sufficiently powerful to determine what the orderings are (Turnbulll 2000). This is epitomized by what happened when DHIS1 from SA was adapted for use in Mozambique at a time where language translation module was none existence. Was this an error in the Software? No, DHIS1 was made to meet 'local' needs in SA, not for Mozambique. For it to work, it had to be translated through hard coding where the resultant 'Mozambique version' being too different from SA version led to difficulties in incorporating new features from the SA team. This challenge led to the local efforts in Mozambique to develop a language translation module which later became part of the shareable objects within the HISP network.

Building on the translation module from Mozambique, DHIS1 was adapted for use in India where a number of new modules were developed related to reports and data presentation using GIS. These new modules were made part of the boundary objects in the network for other countries to adapt for use. The GIS module for instance was adapted for use in Mozambique, and the principle behind the report module was adapted for use in Zanzibar via an Indian HISP expert. This reveal the involved messiness of the work that goes into making the objects work in particular local site (ibid), which in turn sparks the emergence of new shareable knowledge across the network.

The collaborative knowledge making and sharing within the HISP is manifested further through the emergence and development of the new software version - DHIS2. By strongly building on the existing knowledge based on DHIS1 (the concept of hierarchy of standards, the need for modularity, the need to support local use of data etc), development of DHIS2 started, partly as a way to meet particular countries 'local' demands. Mozambique and India officials demanded for high tech software based on open source Java Framework, with an argument that DHIS1 being built on Ms Office was low tech. Through coordination from the UiO HISP team DHIS2 development involved a number of countries, unlike DHIS1 which was first developed in SA and evolved through collaboration. Upon implementation of the first prototype of DHIS2 in India and Vietnam, new modules were developed as they were triggered by specific local needs. As more countries joined in the use of DHIS2 new modules and improvements in the existing ones was made possible through feedback from the context of use.

The structure of DHIS2 as a collection of modules that are different in nature in terms of their level of adaptability and change is worth noting here. DHIS2 consists of the core module which as a boundary object remains stable across countries. This 'immutable' mobile object is used as a platform where other mutable mobile objects are built. These are the objects which can be adapted / customized for local use which includes reporting modules, data presentation modules, etc. The existence of the core module which allows more mutable mobile objects to be locally developed, amplifies the collaborative knowledge making based on local experimentation and tinkering. In this case, diverse work in the multiple worlds proceeds in parallel except for the limited exchanges of standardized sort (Star and Griesemer 1989).

However, for the exchange of knowledge in form of boundary objects to take place in a collaborative network, the role played by the coordinating country is indispensable. For instance the use of DHIS2 in India and Vietnam led to development of new report modules which are different in terms of ease of use, adaptability, etc. So, to sort out what is to be shared across countries from one local site, the work done by the HISP team in Oslo, Norway is important. The coordination is done through meetings and workshops where new developments from different countries are presented and sorted out (e.g. see figure 1 &2). It is therefore suffice to argue that collaboration through boundary objects will necessarily lead to emergence of new objects, which further account for the evolving nature of knowledge in different scientific communities. As asserted by Star, each scientific community has a viewpoint, a partial truth consisting of local beliefs, local practices, local constraints, and resources, none of which are fully verifiable across all sites. However, aggregation of all viewpoints is the source of the robustness of science. The aggregation of 'local' experiences through scientific publications, best practices and software modules is the strength of the HISP network which accounts for its increasingly growth in size as more countries join. The network growth can also be accounted for as being routed and grounded in the very concept of knowledge sharing through boundary objects where countries build on existing knowledge built in other place. This creates opportunities for synergy, which in turn sustain local initiatives through active engagement and collaborative learning across disciplines and countries in the network.

7 CONCLUSIONS

In this paper, we have presented the case of the HISP network where we have shown that though the network is a ‘global’ phenomenon the knowledge shared across the network is locally situated. Rather, what gives it the seemingly universal attributes revolves around the social and technical devices which treats instances of knowledge practices equivalent or generic enough enabling it to move across sites. Moreover, we have discussed how collaborative and collective knowledge creation and sharing is amplified through boundary objects. As boundary objects are more generic not including ‘all’ the aspects of particular local site, rather than that being counted as a weakness it conversely triggers processes for local innovation and emergence of new boundary objects shareable in other contexts. In that, every specific local site contributes knowledge which cannot be verified fully across sites but rather needs some tinkering and bricolage to get it work in other ‘similar’ sites.

This creation of shareable knowledge for multiple sites characterized by different knowledge practices, cultures, visions is captured in Suchman’s (2002) argument based on partial perspective that the only possible route to ‘objectivity’ is through collective knowledge of the specific locations of our respective visions. This approach is imperative not only for creating robust solutions shareable across countries and disciplines but also vital especially in developing countries where the necessary capacities in terms of technology are not readily available. The collective boundary objects play significant role in creating synergies which in turn sustains the involved partner countries’ local initiatives.

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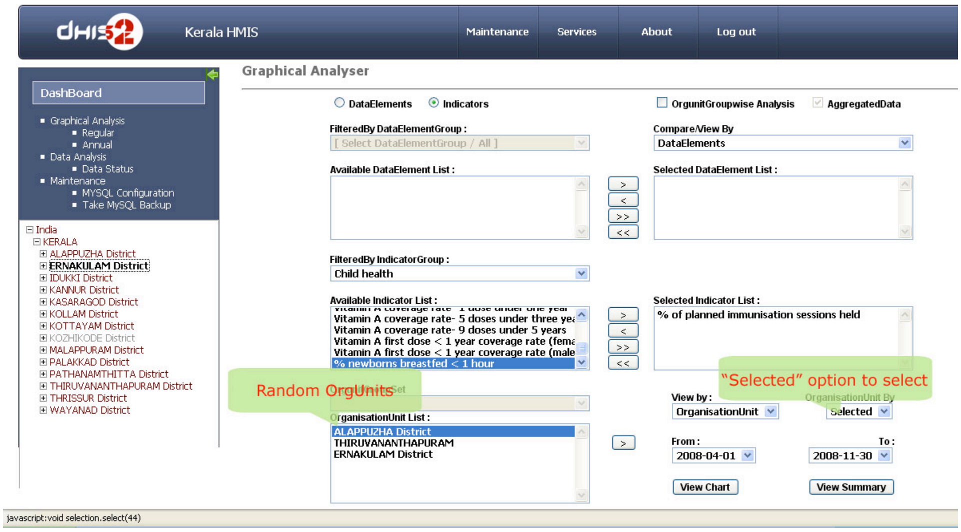
Appendix - DHIS2 modules developed in different countries



Figur 3: Report Module developed in India

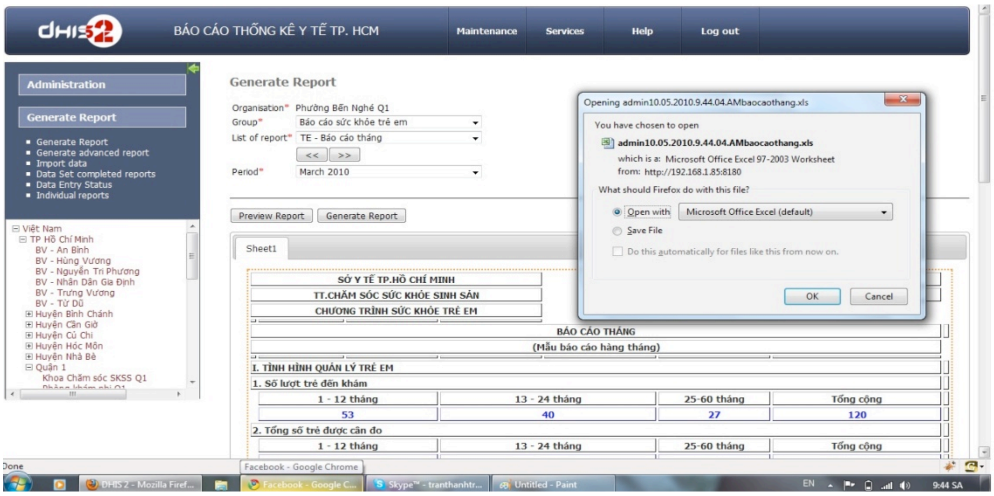


Figure 4: Report Module developed in Vietnam

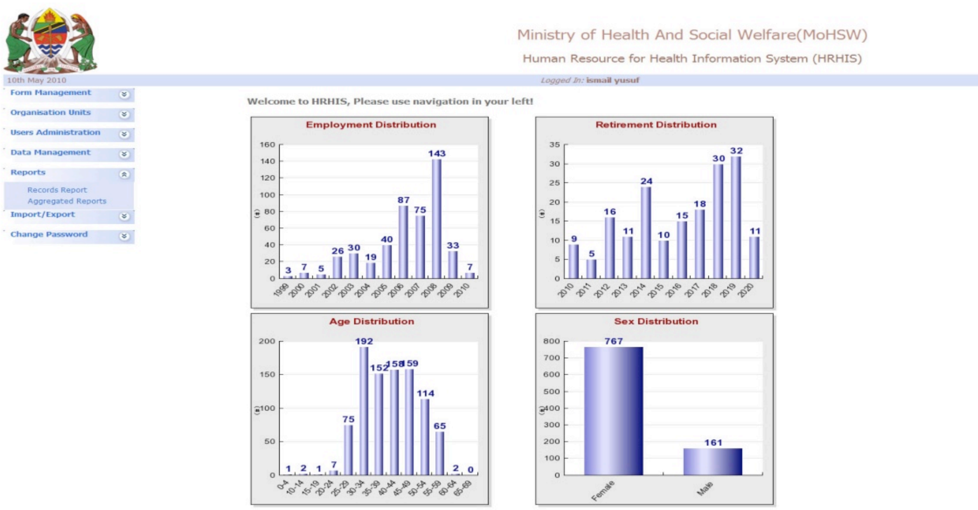


Figure 5: Human Resource Module developed in Tanzania