Supporting the ARIS community system in Mozambique

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This paper discusses the ideas behind community informatics (CI) and documents the need for bottom up approaches in ICT4D endeavors. It connects community informatics with software development, and proceeds to describe the experience with the ARIS project in Mozambique. It discusses the democratic nature that the ARIS project has developed in integrating the stakeholders and designing the system in order to enable local adaptation. We investigate how community participants have been empowered during the North-South collaboration. Based on these experiences we show how CI ideas can form a framework for a supportive organization to sustain the information system after the end of the North-South cooperation.

Some propositions are specific to the domain of Higher Education, while others are more generic and may be relevant to the development and implementation of other community systems in less developed countries.

Keywords: North-South cooperation, ICT4D, community informatics, software development, information systems, higher education

Introduction

The development and implementation of information systems (IS) is a complex endeavor, even more so in the context of less developed countries (LDCs). The complexity is partly related to technology - or the absence of technological infrastructure -, but in a more holistic sense also to the social context of the IS and its community. In this paper, we reflect on our experiences in the ARIS project in Mozambique, which we consider from the viewpoint of a community system, which, according to Bieber et al. (2007), not only includes technology, but also encompasses people, knowledge, processes and support. From this analysis we derive a supportive organization structure and a set of empowerment methods for the community participants. This is based on the notion that the "owner" of the IS is rather the community than a particular organization as in traditional Management Information Systems (MIS) research (Gurstein, 2007).

In this paper we investigate ways to provide support to the community consisting of stakeholders having a shared interest concerning the effective and efficient administration of academic information. The study is motivated by the need to resolve the real-world problem to facilitate sustainability of the "ARIS" project. This project is a North-South cooperation project with the aim of providing an electronic Academic Registry Information System (ARIS) for Mozambican universities. The practical orientation of this study corresponds to research practices in the field of Community Informatics (CI), which according to Gurstein (2007) typically relates to specific outcomes or actions in the world of practice.
CI ideas have been found useful during the development and implementation of the project in the context of a development country, even though the project may be classified as a traditional MIS project rather than a typical CI project. However, we show that the application of CI practices to the given project empowers local stakeholders by increasing their skills and enabling effective use. Furthermore, we want to stress that CI activities do not substitute IS development activities. Instead, they complement each other, and the integration of CI with traditional MIS shall prepare the Southern partner better to gain local ownership and control over IS endeavors.

This study is part of an action research project which consists of a research cycle and a problem-solving cycle that mutually inform each other (McKay and Marshall, 2001). We reflect on the practical action taken to empower the ARIS community during the North-South cooperation, and use this experience to plan further action by designing empowerment activities of a local supportive organization for the time after the cooperation. The actions taken so far as well as the planned actions have been results of discussions between community participants in the South as well as in the North.

The structure of the paper is as follows. First we consider theoretical aspects of communities relevant for information system projects in LDCs. These aspects are used in the following chapter to describe and analyze the ARIS project and our experiences about empowering the ARIS community, by taking a close look at the different stakeholders. This leads to the design of support activities for Mozambican institutions of higher learning, with the goal to provide a long-term solution and malleability to both the administrators, as well as users and future users.

Communities

In this chapter we look into concepts related to communities, which form the basis for the analysis of the ARIS community and the design of a supportive organization in later chapters. We consider community development and community informatics, particularly in the context of LDCs, and methods to empower communities. Finally we outline the basic processes that need to be carried out by a community related to information system development and implementation.

What is a community?

The term "community" has no single definition in the social sciences (Hamman, 1997). Therefore it is necessary to define the term in every paper that uses it. Here, borrowing from Hamman, "community" refers to (1) a group of people (2) who share ongoing social interaction (3) with some common ties between themselves and other members of the group and (4) who share an area (common space) for at least some of the time. This definition encompasses both physical and virtual communities. Moreover, communities exist in different contexts such as in family or work group contexts, as well as in different intensity of involvement. In any case communities have the function of enhancing the well-being of its participants (Bieber et al., 2007). Virnoche and Marx (1997) state that "community is constituted by individual identification of and involvement in a network of particular associations" (p. 86), hence within a community there typically exist groups formed by individuals by e.g. working together on a project, sharing knowledge, making decisions or socializing.

Community Informatics

Community Informatics (CI) is the application of information and communications technology (ICT) to enable and empower community processes. CI is a framework for systematically approaching information systems from a community perspective, where the
community is the "owner" or operative agent. This is an alternative to the traditional view that information systems are owned and operated by organizations (Gurstein, 2007).

McIver (2003) expresses the need for CI in contrast to MIS, which has established best practices that generally assume an abundance of resources and expertise to which communities often do not have access. According to McIver the "grand challenge" in CI is to develop technological solutions for communities that are economically, socially, and culturally appropriate and that are operationally and economically sustainable. This is especially true for developing countries, where resources and training may be even scarcer than in most communities.

**Community Informatics and ICT4D**

Conventional approaches to ICT4D tend to be dominated by a western, donor community set of values and priorities. ICT4D policies often follow a top-down philosophy that starts by defining national policy plans, followed by creating enabling conditions in the market, and finally creating projects that follow policy guidelines. This macro-level oriented ICT4D strategy does not necessarily give access within the information society to individuals and groups on the micro level, and may thus prevent development opportunities in LDCs that could only be possible by more inclusive bottom-up approaches. This technocratic ICT development discourse has been emphasized by organizations such as the World Bank. It has received critics such as by Thompson (2004) who outlined that this approach excludes alternative views of technology and development. Vaughan (2006) positions CI as an alternative by referring to best practices and lessons learned from a plethora of case studies in the ICT4D field that suggest methods of CI, even though some do not explicitly mention CI.

Community Informatics is an alternative to the common top-down approach. CI attempts to embed ICT in existing community structures, utilizing existing social capital in those structures. Rather than to impose externally designed ICT solutions, ICT is introduced with the objective to help the community identify and meet its needs and to target effective use. Gurstein (2007) outlines the similarity between the CI approach to ICT and the design and deployment of information systems in industrial contexts, where the difference is that CI uses bottom-up processes for system design, whereas in industrial settings system design is guided by corporate management.

**Community Development, Informatics and Appropriation**

Community development (CD) seeks to empower individuals and groups of people by providing these groups with the skills they need to effect change in their own communities. For Stoecker (2005) in order for CI being able to empower communities, it needs to fit into an overall community development strategy. According to Gurstein (2007) ICT based CI activities and non ICT based CD activities often run parallel and depend on factors such as the skills and preferences of the involved community members. Community appropriation of ICT designates a situation where the community has become sufficiently comfortable with the technology to work both face-to-face as well as in technology enabled modes and decides on its own when ICT is appropriate or not.

**Empowering communities**

Schuflan (1996) gives a rough taxonomy of community development approaches and how they empower communities. He argues that CD actions are context dependent; the same action may sometimes be empowering, other times not. Rather than a single event, empowerment is a continuous process that enables people to understand, upgrade and use their capacity to better control and gain power over their own lives. Schuflan's taxonomy comprises the approaches service delivery, capacity building, advocacy and social mobilization. Table 1 summarizes these approaches.
Service delivery provides a usually structured set of services to defined beneficiaries and addresses actions directly related to the immediate causes of maldevelopment. Examples include health and educational services. On its own it tends not to be very sustainable.

Table 1: Community development approaches that empower communities (Schuftan, 1996)

<table>
<thead>
<tr>
<th>Service delivery</th>
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<tbody>
<tr>
<td>• to use local human resources whenever possible,</td>
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<tr>
<td>• to involve community representatives in the choice of delivered services,</td>
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<tr>
<td>• to train local staff with the aim of behavioral change,</td>
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<tr>
<td>• to assure a continuous flow of information between providers and end users of services enabling the latter to be equal partners in planning, delivery, management and evaluation of the services.</td>
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<tr>
<th>Capacity building</th>
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<tr>
<td>• enabling individuals, communities and organizations to continuously upgrade their ability to know, analyze and understand their situation and their problems.</td>
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<tr>
<td>• increasing people's awareness of what is permissible and fair to do</td>
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<tr>
<td>• capacitating people to use explicit assessment-analysis-action processes</td>
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<tr>
<td>• emphasizing skills that lead to community ownership of the interventions undertaken</td>
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<tr>
<th>Advocacy</th>
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<tr>
<td>• convincing and persuading people</td>
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<tr>
<td>• increasing people's demand for, access to and utilization of services and their access to the means of production</td>
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<tr>
<td>• promoting a more local control of resources</td>
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<tr>
<td>• improving the access of end-users and facilitators to reliable community development-related information</td>
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<th>Social mobilization</th>
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<tr>
<td>• articulating people's felt needs into concrete demands</td>
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<tr>
<td>• networking with others, striving for achieving a critical mass of concerned people locally and externally</td>
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<tr>
<td>• operating in complete assessment-analysis-action cycles, thus collectively identifying problems, searching for solutions and implementing them</td>
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<tr>
<td>• giving people power over decisions, thus increasing their self-esteem and self-confidence</td>
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Capacity building raises people's knowledge, awareness and skills to use their own capacity and that from available support systems to solve local problems. It strengthens the Assessment-Analysis-Action process in the community and therefore leads to more sustainability.

Advocacy is about setting in motion a dynamic process of developing a consensus and a mandate for action. It brings together like-minded allies with a common goal.

Social mobilization is the community development approach that gets people actively involved in development assessment-analysis-action processes. It engages them in actions to fight for their rights and to gain more control over needed resources. It aims at networking, placing concrete demands and mobilizing resources.
Effective use

Gurstein (2003) in his analysis of the digital divide proposes "effective use" as the goal to be achieved rather than simply access to ICTs and the information society. Access on its own ensures opportunities to "consume" ICT enabled systems such as information systems, but it is a passive mechanism. It needs to be extended with or embedded in a greater context. In addition to access as such, it is significant to have the knowledge, skills, and supportive organizational and social structures to make effective use of that access in order to achieve social and community objectives. For development to occur, access is a precondition, but the focus has to be on the whole "development process" including infrastructure, hardware, software, and social organizational elements. Local communities need to train the capabilities to be producers, not only consumers, so that end users can do locally significant things with technology tools to which they have access.

Effective use occurs in social settings such as work groups and larger communities and is hence context dependent. What is appropriate in one context may not be in a different one. An example of a community informatics approach to support local effective use is participatory design, where application design is done with full participation of the end users and the local community. In this way, an application is directly linked to local needs and creates local ownership and local champions who can provide feedback on its development and evolution.

Effective use is thus a goal of support and empowerment of communities because it fosters active community participants who increase their knowledge and become productive in the continuous improvement of the ICT systems they use to meet their needs.

Supporting and enabling communities

The "effective use" concept is the basis for a framework developed by Bieber et al. (2007). The framework, called "Supporting and Enabling Communities framework" (SEComm), refocuses information systems towards communities and collaborative decision and design processes. It emphasizes system design that supports community members to become active participants in order to realize both collective and individual goals. It provides a model for reflecting on community support at all levels of the so called "Enabling Community".

Community systems include (1) technology, (2) the people, (3) knowledge, (4) processes and (5) support. The design of community systems should specify people's roles (both those participating in the system's activities and those using its resulting outcomes or services); the kind of data and knowledge that should be acquired, stored and shared; the steps of the processes for accomplishing the system's purpose; and the support the system requires. Ideally, all participants should have access to the community's data and knowledge in a manner they can understand and utilize.

The SEComm framework consists of two elements: First, the Participant Support System (PaSS) encompasses processes, people, knowledge and technology in order to provide desired services and products. These elements are further influenced by environmental factors such as policies, constraints and the shared goal or purpose within the community. The second element, the Community Participant Levels (CPaL), reflects the multi-level characteristic of communities and distinguishes between individual, group, community and supportive organization level. The different levels influence each other. At each of these levels a PaSS can be applied, and a PaSS at one level can influence another as environmental factor.

Software development processes

A traditional model of computer system development is the Software Development Life Cycle (SLDC). The SDLC outlines the basic phases of the development and implementation of software systems. It comes in many flavors (see for example Brandon, 2005). The phases are:

1. Definition: Determine the goals, scope and requirements of the system
2. Design: Resolution of technical issues, selection of architecture and standards
3. Construction: Realization of the design, typically by programming and testing; Documentation of the system.
4. Installation: roll-out of the services offered by the systems to the end-users, training.
5. Operation/maintenance: problem solving, user support, and incremental improvement through monitoring and evaluation focusing on the use of the services by the end-users.

The SDLC exhibits the processes that need to be carried out for the development and implementation of ICT based systems. It is not tied to the Waterfall model, but a number of variations have evolved. Many of these approaches break down large projects into smaller, more manageable pieces. We do not prescribe a particular variation of the SDLC, but use it in this study to associate empowerment methods to certain SDLC phases.

To clarify terminology, we understand the term implementation in accordance with Walsham (2009) in a "human and social sense, so that the system is used frequently by organization members or that it is considered valuable for work activities or coordination" (p. 210).

**Learning from project experience**

In this chapter we describe the empowerment approaches that were used during the North-South ARIS project. At the moment of writing this study, we have run through the complete software development life cycle and we describe the tools and methods used and our experiences in applying them. This reflection shall not only be an inspiration for similar projects in the future structure but also guides the design of a not yet existing supportive organization for the ARIS community in the next chapter. We first give a description of the community system during the project, followed by a reflection on empowerment methods that were used.

**ARIS community overview**

To give a brief description of the ARIS community system we follow Bieber et al. (2007) and outline technology, people, knowledge, processes and support.

The common interest of the ARIS community is to manage academic data at institutions of higher learning utilizing appropriate electronic means. This academic data includes studies, students, exams and marks, taking into account the specific Mozambican reality and requirements.

People actively involved in this data management process are the academic registrars at universities and faculties in Mozambique. There is usually a "chief" academic registrar who can be characterized as a functional administrator for the area of academic registry at the respective institution. Other interested stakeholders include the university managers who need a data basis for decision making at faculty and university level, and the Education Ministry with similar intentions on a national scale.

Academic registrars in the ARIS community have different backgrounds and experiences regarding the use of computers and administrative work. This heterogeneity means that learning and work progress vary strongly between users when computer based tools are introduced. For those with more difficulties in making sense of the new system it can be a motivation to be aware that others use a certain computer system and consider it helpful.

Another observation is that time plays an important role in establishing a system. When difficulties arise and assistance is not (anymore) available, users tend to give up on new systems and go back to previous solutions. The relevance of time is further illustrated by the diffusion of innovations theory and its concept of adoption rate of different adopter types, which states that innovators are much faster to adopt innovations than laggards (Simpson, 2005).

On the support side the ICT staff is important for the technical maintenance of the system. Furthermore, a help desk is useful for users to ask for assistance in case of any difficulties,
and a software development unit is inevitable in the long run to develop the information system and adapt to upcoming changes in requirements (Lehman and Ramil, 2001).

ARIS has been designed as a client-server architecture and built on Open Source components. Data is stored in a central database. The application logic runs on an Apache Tomcat server providing HTTP content to clients. The clients use a web-browser to access the server. Each user has a separate login and password, and an associated user role to limit the user's privileges in the system. Furthermore the system has a modular architecture which comprises a kernel, a reporting module, a scholarship module, a fee module and university specific extension modules.

One of the implementing universities leased a virtual Linux server from a provider in the United States on which ARIS is deployed. This allows client access from any Internet connected computer via a web browser. The hardware requirements on the client side are limited to a computer with connection to the Internet. All users have used Microsoft Windows as an operating system, although this is not a requirement.

This particular university has faculties in different cities in various parts of Mozambique. Each faculty has academic registry staff that is trained in common workshops and directly on the job. The process is further facilitated with the help of technical experts by importing existing academic data into the database of the ARIS application, so that the benefits of the new system are more obvious to users. These benefits include automatic creation of reports, certificates and statistics from data existing in the database.

**ARIS community levels**

We follow Bieber et al. (2007) to identify community levels in the ARIS North-South project:

- Individual level: Academic registrar (i.e. user), technician, functional administrator, IS project manager.
- Group level: Several individuals who support each other form groups, e.g. the academic registrars within the university.
- University level: All the individuals and groups within a university who work together to manage the university's academic data.
- North-South level: Several universities together with a local government coordination unit and the partner in the North.

![Figure 1: The project community levels during the North-South project](image-url)
academic registrar who is the functional administrator for this subject area. The community furthermore includes participants specific to the North-South cooperation and outside the universities who either come from the local government coordinating body or from the partner in the North. During the North-South project these different participants together engage in the processes of the SDLC such as requirements engineering and design as well as management of the project.

Empowerment activities during the project

Figure 2 gives an overview of activities to empower the community as they were used in SDLC phases. The activities were planned by the coordinators of the North-South project in collaboration with the participants of the universities. The definition phase began with awareness building with university rectors and handout of initial printed project documentation. A website was created for further documentation and information publication. The requirements engineering process was an important method to actively involve university participants such as the academic registrars. It proved to be a challenge to get the complete picture of requirements, possibly due to inexperience of the users with computer software.

In order to verify and adapt requirements throughout the design and construction process the incremental development approach (Davis et al. 1988) was used where the users reviewed the progress at regular intervals when participants from North and South came together. During later stages local software development was done at one participating university. This process was characterized by the proximity between developers and users which allowed to quickly react to the discovery of bugs and to improve the user interface. This local software development followed agile software development practices as described by Cockburn and Highsmith (2001), which involve users as part of the team, focus on incremental changes with short times between decision making and seeing the consequences of that decision and work best in a people-centered, collaborative culture.

The design of ARIS incorporates the need for working in local language, regarding both user data and user interface. The system's modular structure, together with a shared code repository and mailing list, enable the adaptation and improvement of the system by any participant in the community. This, in turn, is a possibility for local learning and local ownership through a two-way communication based technology transfer process between South and North (Rogers, 2002). To foster local involvement in the software development of ARIS an extensive developer training was provided. Our experience was mixed; the success of this method depends also on the continuous availability of the local software developers once they are trained, which was not always the case.
To address difficulties during the installation of ARIS at the universities the basic user and technician trainings were accompanied by visits of the project coordinators and developers to the participating universities. These visits also served to assess areas for further training in ICT, such as Linux and Samba.

Towards the end of the North-South project the universities needed to get more actively involved with the system. In the operation phase good experience was made with working face-to-face with users at their respective workplace. This time-intensive method did not only educate users how to use the system effectively and efficiently, but also identified difficulties with the system that were not obvious during earlier trainings, and cultivated a culture among users of actively pursuing support, which in some occasions lead to improvements of the system. A related method is the monitoring of the quality of data that is entered by the users, which increased users’ awareness of what is permissible and fair to do.

Table 2 gives another perspective on the empowerment methods used during the project, organized according to Schuftan's taxonomy of community development activities.

### Design of a Supportive Organization

As the ARIS project moves from a North-South cooperation to a self-sustaining project the activities and support given by the project partner in the North and the government unit in the South need to be organized in a different way. In this section we develop recommendations for a supportive organization to support the community participants at universities, including institutions that already use the system as well as those interested to use it in the future. The design of the supportive organization as presented here is based on experiences and discussions between project participants, and includes some activities that have been useful during the North-South project. With regard to the Action Research methodology it represents the step of action planning based on previous actions taken.

#### Empowering activities

For ARIS, service delivery includes activities concerning the optimization of the functionality of the system such as further system development, adjustment and data import, and basic training of users and technicians.
Capacity building in the case of ARIS involves activities aimed at an adequate transfer of knowledge and skills to enable effective use by users and university management.

Advocacy includes activities to promote and create a positive attitude towards the system. This includes to raise awareness to potentially interested institutions who do not yet use the system.

Activities regarding social mobilization are aimed at creating interaction among system stakeholders. It is the basis for continuous system development, by involving end-users to collectively identify and address current problems and upcoming requirements.

<table>
<thead>
<tr>
<th>Table 3: Possible empowerment methods by the supportive organization</th>
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<tbody>
<tr>
<td><strong>Service delivery</strong></td>
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<tr>
<td>• User help desk</td>
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<tr>
<td>• Assistance with system installation</td>
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<tr>
<td>• Documentation such as user and technical manuals</td>
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<tr>
<td>• Website with project information</td>
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<tr>
<td>• Development of additional functionality / modules</td>
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<tr>
<td>• Hosting of the system on behalf of universities</td>
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<tr>
<td>• Data import of existing data</td>
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<tr>
<td>• User, technician and software developer training</td>
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<tr>
<td><strong>Capacity building</strong></td>
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<tr>
<td>• Face to face sessions at workplace</td>
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<tr>
<td>• Establish effective use of the system in the institution</td>
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<tr>
<td>• Collaborative agile software development,</td>
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<tr>
<td>◦ e.g. based on Open Source</td>
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<tr>
<td><strong>Advocacy</strong></td>
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<tr>
<td>• Keep community participants informed about system updates</td>
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<tr>
<td>• Maintain project website with news and downloads</td>
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<tr>
<td><strong>Social mobilization</strong></td>
</tr>
<tr>
<td>• User group meetings</td>
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<tr>
<td>• Steering group of community participants</td>
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<tr>
<td>• Collaborative requirements engineering for system improvements</td>
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<tr>
<td>• Mailing lists and on-line forums</td>
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</table>

Based on these observations, Table 3 gives an overview of possible empowerment activities by the supportive organizations. A particular method, which covers various community building areas, is Open Source. It creates capacity by giving community participants the possibility to learn and create local ownership. It advocates the system through clear license terms and free access to documentation and source code. It fosters social mobilization by allowing participants to get actively involved in assessment-analysis-action processes for system improvement. Agile software development methods are worth considering since they focus on the skills of individuals and improve the team's sense of community (Cockburn and Highsmith, 2001).

**International community**

The role of the supportive organization for ARIS in Mozambique is to assist local implementing organizations in local language, taking into account the specific Mozambican rules and regulations in the field of academic registry. In order to give qualified support to the Mozambican community, in some cases the supportive organization's staff in turn may find it helpful to be able to turn to a larger community. Thus, from a donor perspective, it is beneficial to nourish the further adaptations and implementations of the system in other contexts outside Mozambique. This facilitates social mobilization by creating a critical mass of concerned community participants and South-South collaborations.
Conclusions

The democratic nature of the project has lead to certain positive effects. Integrating local stakeholders from the beginning facilitated a system that corresponds to the needs of the universities. However, a number of challenges were encountered along the way that have threatened success. In the early stages, one of the five participating Mozambican universities acquired a commercial system. Not only did this particular university have little interest throughout the remainder of the project, but also advertised the commercial system to the project partners. Participants of another university received expensive training in software development overseas, but finally abandoned the system and never implemented it at their institution.

These setbacks, however, illustrate the possibilities of aligning such ICT4D projects with the “effective use” principle. Costly projects can be geared to higher success rates with the encouragement of active participation in activities such as requirements gathering and programming, and by nurturing those participants who show active interest. ICT4D projects face the latent danger that local participants stay passive during much of the project life time, waiting for the foreign experts to deliver solutions. The CI approach can be useful to avoid this pattern as early as possible.

The future of the project depends to a certain degree on the support given to the universities and on the maintenance of the system so that it can respond to emerging needs.

We have analyzed the community during the ARIS project in Mozambique and have designed the yet missing supportive organization which is supposed to take over certain activities from the North-South cooperation and give much needed support to community participants. Further research is recommended to evaluate the supportive organization once it has been put into reality.

References


