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The different roles of 'Design Process Champions' for digital libraries in African higher education

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Abstract The concept of design stakeholders is central to effective design of digital libraries. We report on research findings that identified the presence of a key subset of stakeholders which we term 'design process champions'. Our findings have identified that these champions can change interaction patterns and the eventual output of the other stakeholders (project participants) in the design process of digital library projects. This empirical research is based upon 38 interviews with key stakeholders and a review of documentary evidence in 10 innovative digital library design projects (e.g. mobile clinical libraries) located in three African universities in Kenya, Uganda, and South Africa. Through a grounded theory approach, two different types of the 'design process champions' emerged from the data with varying levels of effectiveness in the design process: (i) domain champions and (ii) multidisciplinary champions. The domain champions assume a 'siloed' approach of engagement while the multidisciplinary champions take on a participatory engagement throughout the design process. A discussion of the implications of information specialists functioning as domain champions is highlighted. We conclude by suggesting that the multidisciplinary champions' approach is particularly useful in supporting sustainability of digital library design projects.

Keywords Digital library designs · Multidisciplinary design stakeholders · Design process champions · African digital libraries

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1 Introduction

Generally within the design of digital libraries, the notion of design stakeholders is increasingly becoming central to effective design processes for these systems (e.g. [11,25,30]). This is a departure from traditional 'siloed' design approaches that are often framed within specific domains, thus restricting design roles and relationships which means that some concepts of these roles and relationships have not changed for decades. However, repercussions from new digital technologies are changing perceptions of multidisciplinary stakeholders and their participation in the design process.

Initially within Human Computing Interaction (HCI), who design stakeholders were and what role they played in the design process was proposed by participatory design advocates [13]. More recent HCI literature (e.g. [23,26]) is explicit about these participatory design stakeholders and what they do in the design process. They are seen as (i) system users who act as informants providing information about user needs and system requirements, and who must be involved as equal design partners throughout the design process, and (ii) professional designers or design partners, whose role is to partner with the users and elicit design requirements. The user-centered designs have also involved end users as stakeholders but their focus has been mainly on usability of the designed systems. Users have therefore been involved in providing their user needs and in the usability testing [5,6]. However, this all-encompassing concept of stakeholders lacks the details required to support different types of stakeholders' roles especially within multidisciplinary educational digital library projects. We therefore need a deeper understanding of (i) who the different stakeholders are, and (ii) what they do collaboratively in the design process.

This paper presents findings of an in-depth investigation of stakeholders and their roles in the design of several

educational digital libraries. Among the design stakeholders (project participants), we identified a key subset whose crucial role was different from the rest and whose contribution had a profound impact on the successful design outcomes. The paper presents projects' details and frames these within a background of existing literature before presenting the research findings. Finally, a discussion is presented on the implications for developing successful design roles and engagement for stakeholders when identifying and supporting the role of design process champions.

2 Related work

Although end users are noted as having an important role in digital library design (see [11,30]), literature about their specific roles and activities in digital library design is limited. Therefore, to situate our work within existing related work, we have reviewed previous literature that has used multiple stakeholders in the design process, analyzing who they were and what they did within that process.

Most of the studies reviewed show that the concept of stakeholders is broadly used across the field of design. For example, most participatory design studies define stakeholders as intended system users whose work in the design process is to provide system requirements. They also include, as part of the process, design experts or professionals who provide systems knowledge as well as design guidance. For instance, [11,30] who focused on designing digital libraries for children based on participatory design methods included children as stakeholders and co-designers. The role of these children was to provide system requirements and participate in design decisions with the system design experts. In Lustria et al.'s [16] study on participatory design of a health information system, they included as design stakeholders, health practitioners and breast cancer survivors who were the intended users of the system being developed. Their role was also to provide systems' requirements based on their user needs.

Some participatory design researchers have extended the stakeholder base to include others whose participation is similar to that of the users. Flechais and Sasse [14] for instance in their study of design of usable security in e-Science included multiple stakeholders in their four case studies. Besides the end users and developers, they added owners of the systems, security experts and a data provider. One of the conclusions of this study was that these multiple stakeholders provided a very effective means of identifying systems needs, raising awareness and knowledge of security issues in the system. This resulted in the design of a system that was well suited to its intended users. Gil et al. [15] also included informal carers and physiotherapists besides the intended users (i.e. the elderly) and the design experts who were the technologists and researchers. They found that these different stakeholders provided different perspectives and expectations which helped clarify system requirements.

Other participatory design studies have identified different stakeholder roles besides the conventional ones in system requirements. For example, a study carried out by Puri et al. [24] identified a 'mediating agency' role among stakeholders. In order to acquire user participation in the development of a health information system, a partnering university was included as a stakeholder. This approach sought to break down the bureaucracy that existed within the organizational structure—with one of the other stakeholders (i.e. the Ministry of Health). The university in this project facilitated interaction and communication between the ministry officials and the health fieldworkers in the provinces and districts. The result was that the project facilitated users to participate in design decisions and provided valuable input to the design process.

Studies that have a more user-centered design nature tend to consider end users as design stakeholders, although their involvement is usually restricted to the beginning and end of the design process cycle (i.e. requirement elucidation and final testing). Some projects may include other stakeholders to clarify requirements as noted in Newell and Dickinson's [19] work focusing on designing a portal for older users. This project did not just focus on users who were the elderly (over 60 years) and the designers who were commercial developers. They brought in academic researchers who represented the interests of users to appropriately articulate their needs and wants. In addition, they brought in the client (i.e. department for education and skills), represented by a usability engineer. By including these other stakeholders, conflicting issues were clarified and understood. For instance, the academic researchers were able to underscore the need for simplicity in the design. This approach also ensured that the end-users were present to demonstrate their level of technology skills and needs. Design experts were then able to empathize with the users' system needs and requirements and understand why it was important to keep the system simple.

DL designers also obtain system requirements including digital library by conducting user studies, i.e. surveys, ethnographic studies, focus groups, etc. Agosti et al. [4] report on how they used a comprehensive user survey to understand user requirements and preferences in their design of The European Library Web portal. In this study, they combined both explicit user feedback and implicit usage data which provided them with an in-depth understanding of users' experience with the portal, i.e. engagement and reluctance to use this service. They used these findings to refine and improve the portal.

Zimmerman et al. [32] provides a useful account of the different stakeholders that should be involved from the perspective of the interaction design process. In their model towards interaction design research, they provide a map of

different stakeholders and how they contribute to interaction research. These include domain people (i.e. behavioral scientist), field people (i.e. anthropologists), technologists (i.e. engineers) and instructional designers. Each of these contributes towards the process. Such a model is important in helping us understand the different types of stakeholders involved in design processes. However, there is need to understand more about the facilitation of interaction taking place among these stakeholders.

Some relevant African digital library studies reviewing concepts of multidisciplinary stakeholders include the VeSeL project in Kenya [31] and the UHIN mobile digital library in Uganda [22]. Both projects were identified as 'good practice' under this study's criteria and provide further exploration into the roles of stakeholders in the design process (see Sect. 3).

2.1 Design champions as stakeholders

A review of literature also highlighted a certain key type of stakeholders identified as design champions. These according to the UK's Design Council [10] are design leaders who drive the development of a company's design function ensuring its recognition internally and externally. Downs and Chen [12] have highlighted that design champions are a key stakeholder in the design process whose main role is to provide project leadership. The UK's Commission for Architecture and the Built Environment (CABE) [7] and the UK's Department of Health [9] have both been campaigning for the inclusion of design champions in design processes. The notion of a champion in the field of technology is not new. For example, the Decision Support System [8] depends on implementation champions for the successful introduction of these innovations in companies and organizations.

Whether implementation champions or design champions, what these concepts seem to share in common is the description and roles of champions. For example, the Design Council identified design champions as leaders who drove the development of design functions and its recognition internally and externally. They were noted as charismatic and passionate people who shared an interest in the development of talents amongst team members. They were also highlighted as being skilled in the design subject. This profile is similar to that of the Curley and Gremillion's [8] description of their system's champions. They too saw them as leaders who actively and enthusiastically promoted the development and adoption of the system. They were knowledgeable in the system's operations and the organizational functions it supported. They demonstrated commitment and enthusiasm for the system. They also acted as internal change agents and missionaries influencing the attitudes of others towards the system whilst helping other stakeholders to understand and use it. A more recent report on champions for integrated design solutions [29] also concurs with previous studies that these champions are change agents who are enthusiastic and passionate about the technologies they support. These roles and descriptions distinguish champions from general stakeholders commonly present in participatory design and user-centered approaches.

Our paper will identify across several best practice case studies of African higher educational digital libraries, detailed accounts of champions' characteristics and their role in the design process. These details can support other system designers in developing effective collaborative design teams and how to engage them in the design and implementation process.

3 Digital libraries case studies

We reviewed ten digital library projects based in universities in South Africa, Kenya, and Uganda. These were multidisciplinary and represented examples of best practice based on criteria that considered presence of: (i) technology innovation in library and learning programs, and (ii) collaborative activities within the projects. The inclusion of the three countries, though not adequate representation of the entire Africa continent, was necessary in order to provide a variety of different contexts of Africa. These too were selected based on a carefully developed set of criteria that included presence of innovative technologies within universities and presence of collaboration between learning designers and information professionals.

The level of system design process differed across these projects, ranging from designing a whole system to tailoring an existing system to situational needs, and finally to designing processes for using an existing system. A range of system design approaches were reviewed so as to aid in understanding the different design stakeholders and how they engaged in these different design processes. Project 1 belonged to Kenya case study. Projects 2, 3, 4 came from South Africa case study, and the remaining projects 5-10 came from Uganda. These are briefly described as follows.

3.1 Project 1: Community based agricultural knowledge management system

A UK's Engineering and Physical Sciences Research Council funded research project called VeSeL (Village e-Science for Life) was designed from scratch using a participatory design approach to create an agricultural digital library system for rural farming communities in Kenya using innovative mobile technologies. The design team consisted of UK researchers and technologists, local experts at the case study university and two farming communities (end users). These were involved right from the onset of the project and worked

collaboratively. They collected and posted data from their farms as a simple blog posting using mobile devices.

3.2 Project 2: Digital library supported by Web 2.0 applications

The level of the design process for this project was primarily focused on tailoring existing designs (i.e. web-based online resources). It involved the use of innovative technologies i.e. Web 2.0 resources including a virtual game intended to help the library reach out to their younger users who were active on the virtual social spaces i.e. Facebook but used less of the digital library. Information specialists designed digital resources around these innovative applications, i.e. creating library catalogue widgets and encouraging users to link then to their Facebook pages. Stakeholders (students) were included to provide input and test an information literacy program designed around a virtual game.

3.3 Project 3: A digital library within (a) virtual learning environment (VLE)—South Africa

This focused on utilizing existing systems that design processes merged together. The VLE comprised e-learning resources and digital library resources seamlessly integrated into one system and developed jointly by librarians, academics and e-learning technologists (stakeholders). This collaboration process was facilitated by e-learning experts who ensured mutual engagement amongst stakeholders.

3.4 Projects 4 and 5: Institutional repositories

These two projects were similar; project 4 belonged to South Africa while project 5 was in Uganda. They were part of the Open Access Movement which is a technology innovation of providing barrier-free online access to scholarly literature. The design process focused on using existing digital information technologies and tailoring them to universities' own requirements. Information specialists developed the system and invited other stakeholders (academics and students) to collaboratively contribute and upload their research output into the system. The system was based upon the DSpace Open Source Software providing a foundation which allowed the system reuse to be more accessible by developers with varied skills.

3.5 Project 6: Digitized music collection

The digitized music collection was collaboratively designed by library digitization experts and music academics and hosted in the institutional repository using DSpace application. Each of these stakeholders had different skill sets and roles which they engaged throughout the design process. The library experts provided digitization and organization of digitized music files while academics provided music descriptions for Metadata development.

3.6 Project 7: College knowledge management system

This was collaboratively designed by academics and digital librarians who used their different skill sets and roles to engage with each other. The digital librarians applied their knowledge management skills and expertise on the DSpace to create the system and academics provided project facilitation as well as contributing their academic resources as part of the system's content.

3.7 Project 8: Clinical mobile digital library

This involved design of a health digital library accessed through innovative mobile technologies for rural clinicians. Design stakeholders comprised of university academics, digital librarians, rural clinicians, Ministry of Health and project sponsor and staff. They all had specific roles in the development process, e.g. clinicians and Ministry of Health (end users) provided system requirements, the university provided information resources and advice; the sponsor provided financial support and project tools, project staff provided technical expertise and coordinated stakeholders' activities.

3.8 Project 9: Problem-based learning (PBL) digital resource support system

This was a system specially developed to support students following a PBL curriculum. It comprised a digital collection partly supported by DSpace application redesigned for the project's specific needs. Stakeholders were librarians, academics and students. Students and academics provided information needs while librarians provided appropriate information resources, an enabling technology infrastructure and an intermediary to support the information inquiry.

3.9 Project 10: A digital library within (a) virtual learning environment (VLE)—Uganda

This involved development of a learning platform containing e-learning educational resources that were integrated with digital library resources. E-learning specialist engaged academics and librarians through a series of design sessions to develop information interaction pathways to appropriately utilize the VLE and produce learner centered educational resources of learning content and appropriate digital library resources.

4 Methodology

Due to financial and pragmatic constraints, most research projects focus on a particular context and digital library project. This approach can provide useful insights into design procedures but can be limited in its relevance across contexts. Traditionally this limitation for most research has been overcome through reference to other published accounts. However, within an African higher education (HE) context, the practices involved in digital library design and development are frequently not published and even less frequently researched. There are a few exceptions within this context, i.e. the UHIN mobile library [22] and the VeSeL project [31]. African HE digital library design and development is, therefore, understandably limited in how reflective it can be. This research sought particularly to overcome this issue through two novel approaches to the research. First, a retrospective review of digital library design projects across several African countries was conducted and secondly from this review and reference to prior research, a set of criteria for selecting 'good practice' case studies was constructed. This review and the criteria took several years to construct and verify through other documentation such as national and institutional policies and strategic plans, project implementation reviews, government accounts (see Ngimwa [21]). The criteria for selecting the case studies was also important in increasing the validity of this research and its ability to accurately reflect digital library design approaches and advancements in these institutions. Below is simplified account of how this was constructed.

Our selection criteria were largely informed by two pilot studies (one in a Kenyan university and the other based in a UK university) that had been carried out prior to this main study [21]. These were aimed at providing some background knowledge of the study setting, i.e. the status of digital library design issues, in line with Maxwell [17] who advises on the importance of carefully deciding where to conduct a study and what to include. He particularly emphasises the need to have considerable knowledge of the study setting when making selection decisions. Thus, the two pilot studies provided considerable knowledge of what to expect within this type of research setting, i.e. what were the factors supporting or affecting collaboration between academics and librarians in the design of educational digital resources. For example, the Kenyan pilot study highlighted the importance of two main aspects that had potential to shape collaboration between learning designers and information professionals. The first aspect was the presence of pockets of technological innovation in library and learning programs within the mainstream university functions. This was also underscored by the UK pilot study that had shown how academics and students were collaborating to create shared information content processes using social bookmarking tools. The second aspect related to policy support in educational related projects. The Kenya pilot study highlighted the relationship between policies and collaboration between academics and librarians in the university. Consequently, these two aspects (i.e. presence of innovative technologies and policies) were used as a measure of 'good practice' in understanding collaborative design process, and formed the criteria applied to identify the projects.

We retrospectively reviewed the identified 'good practice' digital libraries that were already completed systems with the exception of one using a participatory design approach (i.e. project 1). Our research question was: What are the characteristics of design stakeholders and the roles they play in the collaborative design process for educational digital resources? We conducted 38 in-depth interviews over a period of four months with academics, digital librarians, e-learning technologists, community project staff and students. Interviews lasting between 40 and 60 min were structured around the following four areas:

(i) nature of existing collaborations in the design process of digital libraries;
(ii) nature of participants' engagement;
(iii) participants' perception of their engagement; and
(iv) factors influencing the engagement. Interview questions were semi-structured in order to allow for some flexibility for data to emerge from the interviewees rather than being influenced by the interviewers, thus reducing scope for bias. To triangulate and verify data, relevant documents were examined and used as supporting evidence of emerging themes in the data. These documents included national and institutional policy documentation, directives and strategic plans; specific institutional and departmental documentation (i.e. reports, emails and blog printouts); national reports such as those from national quality assurance bodies; and finally projects related documents such as implementation and monitoring tools as well as donor reports.

The different types of these documents are summarized in Table 1:

In addition, observations were taken on how participants engaged with each other in the design process. Much of the observation was non-participative. However, as mentioned earlier, project 1 used a participatory design approach and hence researchers were able to participate in the design sessions and make observations of how stakeholders were involved in the process.

Participants (summarized in Table 2) were purposively sampled on the basis of their participation in the projects and ability to provide relevant information to answer the research question. Some participants, i.e. digital librarians were involved in more than one project. We collected key

Table 1 Summary of documentation reviewed

Documents	South Africa	Kenya	Uganda
National policy and related documentation	Republic of South Africa's white paper on e-education	Republic of Kenya ICT Policy	Republic of Uganda Universities and other Tertiary Institutions Act
	National quality assurance reports	Republic of Kenya Ministry of Education, Science and Technology sessional paper no.1	Republic of Uganda Health Sector strategic plan
Institutional policy and related documentation	University strategic plan	University strategic plan	University Library strategic plan
	Library strategic plan	Library strategic plan	University research and innovation policy
	Open access mandates		University intellectual property management policy
	Education principles		University ICT policy
Institutional documentation	Library email communication and blog prints	–	Library-related projects reports
Project reports	–	Project implementation and monitoring tool	Project implementation report

Table 2 Summary of projects participants

Study participants	S. Africa	Kenya	Uganda
Digital librarians	4	0	6
E-learning technologies	1	0	1
Academics	4	2	6
Students	3	2	7
Projects staff	0	1	1
Total	12	5	21

background information immediately relevant to the participants' engagement in the projects. Information about other stakeholders in the projects was obtained from these participants and related to key project information.

All the interviews were audio recorded and later transcribed. A grounded theory approach [3,28] was used to analyze data. This methodology is particularly suited to developing theories around phenomena of interest as the analysis procedure supports a systematic emergency of theory which is grounded in the data. Through a systematic merging of methods that support quantitative and qualitative data an emphasis is given to validity rather than just reliability in the data collection process. Key to this approach is the concept of 'theoretical sensitivity' which highlights the importance of reducing priori theory that could bias the analysis process. Selection procedures being randomized is a very important part of the methodology ensuring the credibility of the data and the analysis procedure. This same analysis procedure has been used successfully for over 10 years on digital library research and documented in digital library publications ([1,2]) .

In this study, transcribed data was first coded line-by-line using the NVivo 8 software, which also served the purpose of managing the huge corpus of data. Codes were initially stored as 'Free nodes' but as the coding progressed and data was re-evaluated, more codes emerged, while some of the 'Free nodes' were combined and stored as 'Tree nodes'. Initially the data collected was open coded throughout so that key concept emerged from the data. This initial coding resulted in key codes which were considered in the next stage of selective coding. Within this stage of coding relationships between concepts were identified and how those concepts related (e.g. A produces B, X happens in conjunction with Y, Z is a condition effecting A, B and C). To facilitate this selective coding, a series of brainstorming sessions between several researchers were held thus increasing inter-rater reliability for the coding process. This brainstorming exercise consequently helped to clarify emerging categories and theoretical ideas. This also served the important role of checking researchers' bias and hence reducing scope for subjectivity. Next analytic memos were developed to further clarify the emerging theoretical ideas and more brainstorming was conducted to clarify and confirm these emerging ideas. Ambiguities and gaps were also identified and additional data obtained. For example, a lot of documented evidence was obtained at this analysis stage and used to facilitate and verify conceptual coding relationships, theory development and gaps in the data collected.

Table 3 Summary of the different design stakeholders

Projects		Stakeholders		
		Project participants	Design process champions	
			Multidisciplinary champions (MC)	Domain Champions (DC)
1	Agricultural library	Students	Researchers/academics	–
		Community-based collaborators		
2	Digital library supported by Web 2.0	Students		Digital librarians
		Academics		
3	VLE (South Africa)	Digital librarian	E-learning specialist	–
		Academics		
4	Institutional repository (South Africa)	Students		Digital librarians
		Academics		
5	Institutional repository (Uganda)	Students	–	Digital librarians
		Academics		
6	Digitized music collection	Digital librarians	Academics	–
		Students		
7	College knowledge management	Digital librarians	Academics	–
8	Clinical mobile library	Academics	Projects staff	–
		Government officials		
		Projects donor		
9	PBL digital resources	Students	Digital librarians	–
		Academics		
10	VLE (Uganda)	Digital librarians	E-learning specialist	–
		Academics		

The findings reported below have points illustrated with verbatim extracts from the participants who are only identified by their roles. Attempts to anonymize individual, social groupings and institutions were made to reduce potential for privacy invasion.

5 Results

The findings from all the 10 projects identified the presence of design stakeholders (project participants) with a subset defined as design process champions. We further identified that there were two types of the design process champions, namely: (a) Multidisciplinary champions; and (b) Domain champions.

A key issue that emerged from the data was the differentiation between the general project participants (design stakeholders) and the more specific role of design process champions. This revealed different ways in which each role applied their various skills in the collaboration process. While the general project participants contributed their specific skills in the collaboration, the design process champion facilitated the use of these skills in others. The champions were taking on more of a facilitation role. This is illustrated in the following presentation of findings, and a breakdown of these different stakeholders depicting them in their specific job roles is summarized in Table 3.

A further analysis of the two design process champions' roles identified that their ways of engagement differed, producing different practical and affective outcomes with the rest of the team. The sections below describe and discuss each of these stakeholder categories and how they affected the different outcomes.

5.1 Design stakeholders (project participants)

These were participants in the various digital library projects who represented a range of disciplines and job positions. They included academics and students from different disciplines with varying levels of DL/online expertise; e-learning technologists, librarians and related information professionals, design experts, policy makers (government bodies and funding agencies/project donors), project administrators and the general public (farmers, clinicians, school teachers and pupils).

Some of these stakeholders were system users whose role was to provide user needs, design ideas and reflections on system specifications (e.g. in the Kenyan community based agricultural based library). Within some projects, these stakeholders' role in the design process was to populate the library with digital content (e.g. within the two institutional repositories, i.e. projects 4 and 5).

Among these stakeholders, there were sometimes high profile participants such as project funding agency and government officials (e.g. in the Clinical mobile library project). These had the role of decision making and influencing the direction of the project such as enforcing collaboration between the stakeholders as noted below:

> ... it was a requirement for us to use that approach [monitoring and evaluation method from the donor]...a participatory planning, monitoring and evaluation methodology where all the stakeholders including the primary beneficiaries meet in a workshop environment together with the donor and implementers and agree on results and how they will be attained. (Proj. 8 project staff)

As will be seen in the subsequent sections, the nature of participation by these stakeholders depended heavily on the facilitation provided by a subset of these stakeholders who we have referred to as design process champions.

5.2 Design process champions

5.2.1 Multidisciplinary champions (MC)

This category of design process champions was present in most of these best practice projects (7 out of 10). They represented different disciplines and domains (as seen in Table 2 and 3) e.g. academics (i.e. music, health), digital librarians, HCI researchers, e-learning specialists, project administrators. These champions were usually initiators of design projects but they often brought into the design process varied stakeholders to collaborate with them. For example, in the Digitized music collection project, the music academic (MC) was the initiator of this project, but she worked collaboratively with the librarians:

> I felt that we needed to do something...and I wrote this grant and established collaborations with them [library staff]. (Proj. 6 Academic)

This type of champion was also identified as a facilitator for collaboration amongst all the stakeholders, e.g. by creating collaboration spaces as noted in this excerpt:

> We have instructional designers that help create templates for a virtual classroom in which the lecturers can go in and put the learning resources that they have for the students. We also collaborate with the library people where we create a library page and the library people work with the lecturers in defining which resources should be put on that library page. . . (Proj. 3 E-learning specialist)

Another example of how the MC facilitated collaboration amongst stakeholders was identified within the creation of networking between the stakeholders as seen in an email exchange between two collaborators where the e-learning coordinator was the MC:

> I am from Vet faculty ICT committee. We are currently undergoing training in use of e-learning in teaching in Vet faculty. We are supposed to cover use of e-resources as well.[e-learning coordinator name] advised me to contact you whether you would give us an appointment when a couple of people in Vet can be exposed to one of the trainings by your Dept. (Proj. 10 Academic)

Those that took on this MC role also acted as coordinators of ongoing collaboration activities as seen below:

> ... if we have contact with lecturer that wants to put things onto [VLE] we will refer them to the librarian and if they have links from the library they will talk to us, so that we can create that environment for them, so we have a very good link between us and the library to support the lecturers in that environment.(Proj. 3 E-learning specialist)

These MC had the ability to pull people together to collaborate and remain motivated. For example in the VLE project in Uganda, the MC observed that the librarian remained motivated and never missed any opportunity to collaborate and train the other stakeholders as part of the design process:

> But the librarian has been very faithful; she has come to all my training. Every unit where I have trained she has been there. (Proj. 10 E-learning specialist)

Similarly, a stakeholder in the College knowledge management design project in Uganda noted how they were motivated to collaborate in the project despite high workloads:

> ..., we appreciate it. There is a time he [MC] wanted me to do something, I told him am busy but am going to do it, I told him to avoid going to the faculties when we can do it. Recently they launched this college and when they were giving speeches, they emphasized collaboration with the library to ensure that it supports research, teaching and studying. This is very good. (Proj. 7 Librarian)

We also established that all these seven MC had visionary traits. They saw beyond the present project and wanted to move other stakeholders onto further projects development. For example in project 6, the MC had a vision for the project which she saw expanding beyond the university:

> It's a very big ambition ... I thought that this would be something not only for the university but also for Uganda. So we are beginning at this very small level but my ambition is to have a bigger one for Uganda. ..At first they did not believe me, I wanted to show them what I had in mind, it's a very small room, at the centre is where I call the listening room and the inside part is the processing room. (Proj. 6 Academic)

5.2.2 Domain champions (DC)

This category of champions was identified as having characteristics that retained the project within one particular domain whilst still involving multidisciplinary teams. They were identified in three projects and all happened to be digital librarians (see Tables 2, 3). Although they shared some common characteristics and roles with multidisciplinary champions, they retained some crucially distinct differences as described in the subsequent section.

Our findings showed that these champions were also initiators of the design projects. They saw the need for the projects and took the initiative to start them. For example, in South Africa, digital librarians (DC) saw the need to initiate Web 2.0 applications to support their digital library when they realized that they could use these technologies to connect with their younger clientele who were more active in virtual social spaces:

> We felt that many of our library users are involved in all these web 2.0 applications, ... they are using less and less the library databases ... we said we have got to reach them. Take the library databases, the library articles, library tools to them by using these web 2.0 tools ... (Proj. 2 Librarian)

It is important to note from this example that the DC were also proactive, enthusiastic and committed to the design process and its successful completion. For example in project 2, the DC were also keen to utilize their skills with the Web 2 applications:

> ... we found out that the people had developed far more tools than we initially planned, people got involved in many more tools, they were using much more tools to engage the clients, to get the clients involved. (Proj. 2 Librarian)

In Project 3, the DC exhibited such personal commitment to the excellence of the project that she was recognized by her institution and given an international leadership award for her specific role in the development of this institutional repository.

5.2.3 Comparisons between the MC and the DC

A further comparative analysis of these findings showed that beyond the descriptions of these two types of design process champions, there were key differences in the way they facilitated the collaborative design process which led to interestingly different project outcomes. First, there were differences in the way each type of design process champions engaged with the other general stakeholders. The MC tended to use a collaborative engagement style with these stakeholders throughout the design process. For example where they initiated the projects, they brought in the other stakeholders at an early stage in the process.

> We initially called a stakeholders workshop with users of health information, and people from the Ministry of Health... So people brought in their ideas and we said we shall go now to the grassroot and engage those people ... (Proj. 8 Project administrator staff)

This approach was very different from that taken by the DC in similar digital library projects. We noted that often the DC were driven by their domain specific goals and interests and only brought in the participation of other stakeholders much later in the design process. For example the initiation of the digital library in South Africa that used Web 2.0 applications was driven by the library's need to engage some of its clientele. These stakeholders were then brought in at an evaluation stage after the systems had been developed. Similarly the two institutional repositories that were developed as part of the Open Access movement were initially part of library initiative. Academics and students were brought in after the initial system (i.e. DSpace) was designed to collaborate in populating the system and engaging with its later usage.

Another way that the MC collaboratively engaged with stakeholders was through their ability to focus primarily on the identification and utilization of stakeholders various skills and expertise whilst allowing this to remain for the mutual benefit of everyone. For example, in the design of the College knowledge management system, the MC identified knowledge management skills of librarians and supported all the stakeholders valuing these skills within the project design process:

> The library has the expertise in how to handle information ... Because the librarians have benefitted from training in information management which we as academics do not have. ... (Proj. 7 Academic)

The DC's approach was to use their domain knowledge such as their own skills as a focus for the project, e.g. in the content management system projects (i.e. DSpace for organizing institutional repositories).

Another contrasting approach to the design process between the MC and the DC was identified from their different methods of facilitating stakeholders' motivation to collaborate. The MC appeared to grow stakeholders' motivation towards collaboration organically throughout the design projects' lifespan. As already pointed out, these stakeholders remained motivated and enjoyed getting involved. Ultimately, although often with high workloads, they did not need to be coerced into ongoing participation within the project.

In contrast, the DC used a number of methods to get the other stakeholders to remain motivated to collaborate within the project. One method they appeared to use was one of institutional reinforcement of practices. In South Africa, the DC introduced a policy (The Open Access Mandates) that was institutionally approved which enforced the academics and students to collaborate with them by depositing their academic outputs in the institutional repository.

Another method used by the DC to increase stakeholder engagement was through active persuasion. They enthusiastically marketed their projects among stakeholders where they encouraged them to get involved and explained the institutional and individual benefits of collaborating. For example in project 5, the DC took the advantage of an on-going discussion in a blog to talk about the project and encourage participation.

However, an interesting difference between the two types of design process champions was that whilst the MC facilitated collaborative ownership of the project, the DC took the approach of marketing designs that were perceived by all to be owned by the DC.

6 Discussion

In this research, we reviewed retrospectively design processes across 10 'best practice' digital library projects in three different African countries. System design process approaches varied in complexity across these projects. Some designed a whole system from beginning to end, other projects tailored existing systems to their specific needs, and others designed processes for utilizing existing systems in a different way. This retrospective review of a spectrum of design levels enabled us to (i) gain a very comprehensive understanding of the different design stakeholders that were involved and (ii) identify their similarities and differences in terms of their nature and roles in the design process.

Through the research and analysis, a subset of the general stakeholders emerged as champions who facilitate these design processes. In general, their characteristics and roles appeared to mirror those detailed in previous literature about design champions [7–10]. For example they appeared to portray what Curley and Gremillion [8] called personal effects in the support of design processes which were critical to the success of the stakeholder collaboration within the process.

However, further analysis to try and understand how these were different from the other stakeholders revealed that these design process champions were of two types. There were some similarities but also some important differences between these two categories in their approach to the design process and stakeholder involvement. One category, the domain champions (DC), took a more traditional 'siloed' approach that was driven by the goals and interests of a specific domain. These DC were initiators of projects and developed them on their own, only inviting the other stakeholders to join in at different stages. To increase engagement, they used diverse set of tactics such as enforcement and proactive marketing. Such strategies could be seen as unsustainable because they often depended upon the personal initiative of the DC. Proactive marketing also required time and effort on the part of the DC and was thus costly. Ultimately, the process became so reliant on the DC that if they left the institution the innovation left with them. The other category identified, the multidisciplinary champions (MC), was more inclusive of other multidisciplinary stakeholders right from the beginning of the projects and throughout the process. This in turn generated a more organic engagement where these stakeholders were motivated to participate and hence did not require extra resources to win this participation.

From an analysis of the participants' backgrounds, we identified that the DC were digital librarians operating within library-initiated projects. In contrast, the MC were not necessarily librarians (only one librarian out of the seven MC) but rather represented different disciplines that included the library. Their projects too were non-library related, with one exception. Following on from similar DL design and evaluation projects we did not collect socio-economic background data (e.g. age, sex) of those not interviewed. It could, however, be argued that there are some interesting issues regarding these factors, and that identifying this information in further research might help us to understanding these findings in a new light e.g. men or older participants tend to be one type of champion. Further research is required to review these issues in more depth.

This comparison of the two design champions brings out interesting insights that are relevant to the design of successful and sustainable educational digital libraries as well as the multidisciplinary participation within modern digital scholarship [27]. First, within this research, the DC role was identified in these studies as primarily digital librarians. Although these librarians were actively seeking to engage stakeholders in the design process, it appears that the approach they were taking caused them to work in isolation for most of the design

process. These "siloed" librarians were motivated and creative in their design and development of new resource. They initiated successful projects and saw them through the design process. However, these projects were solely reliant on them maintaining this innovation. The projects these DC were involved in focused upon traditional library functions (institutional repositories and the digital library that utilized Web 2.0 applications). It could be that the librarians leading these projects felt comfortable working in ways that they knew and enjoyed and only brought in multidisciplinary participation when there were ready to engage others in their developments? This would then give them a concept of control and ownership within the design and development process? In contrast, it could be argued that the DC project setup and maintenance was quicker and more flexible as the project relied only on one individual making coordination simple and thus being quicker and more cost-effective to initiate. Both style of projects management utilized novel applications and applied them in interesting ways but it appears that when analyzing the design process. The DC took a focused approach to this process, making it quicker and more flexible in its initial application. Within this approach the library retained primary ownership of the process and the system and utilized stakeholders to market and evaluate (i.e. review and sell) the system. The MC, in contrast, allowed ownership to be joint throughout the design process so that marketing was not required to ensure further engagement by the stakeholders. This enhanced stakeholder ownership and ultimately project sustainability, beyond the engagement of the primary DC.

An important point that appears to emerge out of these two different approaches is that both yielded successful and innovative projects. However, stakeholder participation and project sustainability for the DC required extra effort in terms of marketing and enforcement while the MC approach generated participation from the stakeholders as they owned the projects. This is an invaluable insight worth consideration when designing similar projects especially in contexts that are often under-resourced, a characteristic present in most African institutions of higher learning. Indeed under current budget cuts in public projects, its worth considering which approaches can support less costly and sustainable designs of educational digital projects. In the current world economy, where ownership and accountability govern engagement and funding, further research is required to see if these findings from the developing world transfer to the contexts of the developed world.

Second, we would like to highlight that there were some digital librarians who were also identified as MC, e.g. in the PBL library project. Why did they take this different approach, when the other digital librarians did not? It is important to highlight here the importance of the project focus. PBL was noted as a new concept within the institution seeking to develop this system. In contrast, institutional repositories are traditionally library activities whose main function is to make scholarly resources more accessible. Do digital librarians need to incorporate diverse pedagogical concepts as well as technologies into the design process? To incorporate radically alternative scholarship approaches to institutional repositories that are housed within a multitude of disciplinary domains might be a first step to advancing ideas that are different from what has traditionally been within the library domain. This could facilitate digital librarians reviewing alternative perspectives towards engaging with stakeholders. Related to this is the clear distinction in how projects under each champion type were initiated. While projects related to the DC were library-initiated, those under the MC were mainly initiated outside the library (with the exception of one). Reflecting on this distinction in light of modern digital scholarship which demands multidisciplinary engagement in our institutions of higher learning, should librarians be more aware of collaborative opportunities in order to increase impact and ownership of their projects.

Third, our findings have shown that within a diverse range of stakeholders one important category is the policy makers. These stakeholders by the nature of their position influence the way projects are initiated and implemented. Some of these decision makers are funding agencies, as was identified in the Clinical mobile library in Uganda. Their policies influence the level of participation. For example, in this particular case, they enforced a system that motivated the participation of all stakeholders, which ultimately resulted in a project that impacted greatly on health practice. Others were government ministry stakeholders which took over the running of the project after it had been designed, thus ensuring its sustainability. It could be argued therefore that design champions should be seeking to engage the participation of policy makers throughout the design process. In taking this step, their own role as design champions could develop positively. Nardi and O'Day [18] have carried out library studies and concluded that librarians can be keystone species in an information ecology analogy. They argue that librarians' various contributions are vital to the success of the library. Digital libraries provide exciting opportunities for information sharing and learning. They advocate an approach that encourages "mutual adaptation, fostering new relationships between the technologies and the practices of librarians and people who are trying to find information" p. 82. Hence the role of librarians as a design champion is critical but for them to be more effective as 'keystone species' and make a positive contribution to the success of collaborative design processes for digital resources, they should carefully review the drivers for the two approaches, quick and flexible as opposed to sustainable beyond the life of the champion.

In order for DL developers and project managers to review the key issues identified in this and related papers, a model

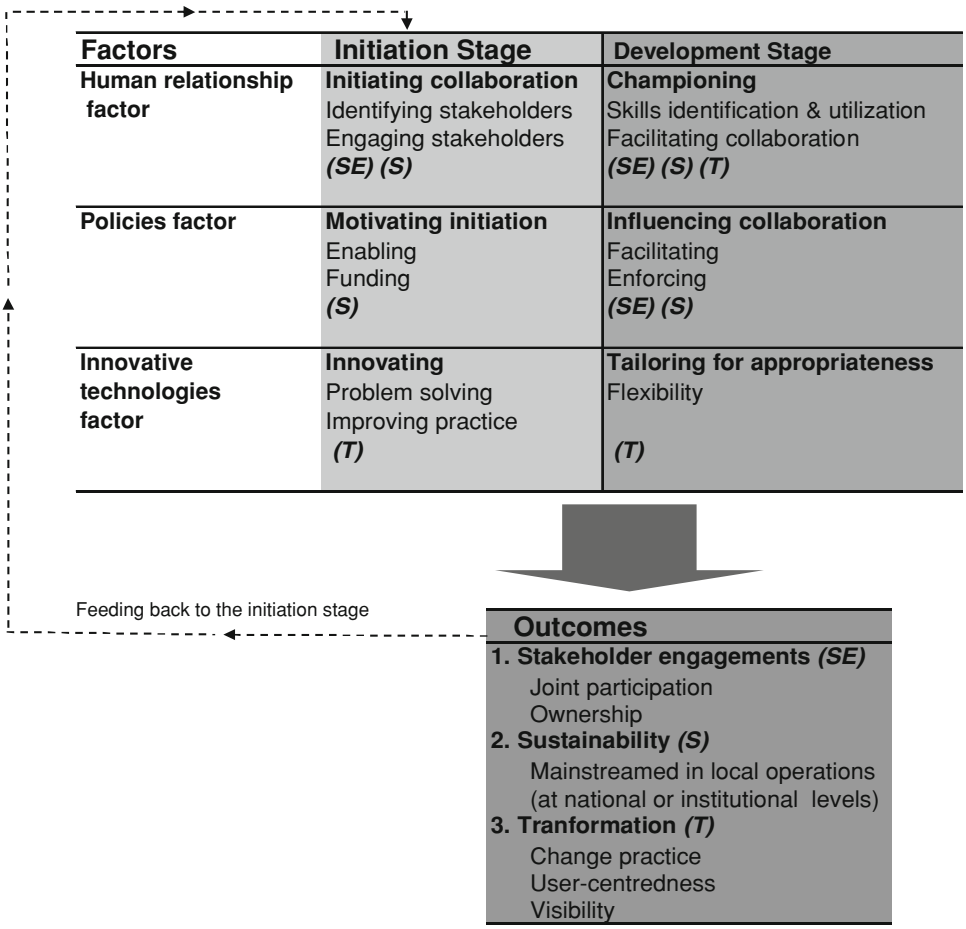

Fig. 1 Overview of the whole CERD (collaborative educational resource design) model

was developed with guidance documentation [21]. An adaptation of that model focusing specifically on the role of design champions is presented. Figure 1 presents a graphical representation of the how the design champion factors fit within the whole design and development process.

This model presents a collaborative design process that follows a linear[1] temporal path through three stages (see Fig. 1). These stages are as follows:

1st stage: technology project initiation
2nd stage: project development
3rd stage: project outcomes, which have defined indicators, namely:

- stakeholder engagement
- sustainability
- transformation

As can be seen from Fig. 1, the model has three major factors that affect directly the first and second stages along the temporal path, ultimately determining the nature of the project outcomes. These factors are (i) Human relationship factors, (ii) Policies factor, and (iii) Innovative technologies factor (a fuller account of these factors can be found in the thesis that this paper is based upon [21]). All the three factors support the initiation and development stages. They also interact with each other. This interaction and contribution at stages 1 and 2 is what determines the outcomes at the 3rd stage. In the following sub-sections, the actual contribution of each factor to each of the three stages and how it interacts with the others is described. The resulting nature of outcomes at the 3rd stage is simultaneously presented in this figure.

A more detailed account of how these issues relate to the concepts of design champions roles of domain champions and multidisciplinary champions is presented in Table 4.

This relationship between policies and the design process champions' contribution to the design process is important to consider particularly when designing projects with an Africa focus. The influence of policies varied across the three countries, suggesting that policies are context-dependant and therefore design champions must become aware of these dif-

[1] This research acknowledges that system development is never linear or straightforward but is dominated by complex iterations between development stages. This linear path of the design process is a representation of the collaborative process which is the focus of the CERD model. Further research focusing on the iteration complexities with collaborative design process is necessary.

Table 4 Overview of the whole CERD (collaborative educational resource design) model

INITIATION STAGE : Design Stakeholders			
Design champions role	Initiating collaboration by:	*Example:*	
	identifying design stakeholders	The multidisciplinary esign process champion **(MC)** in the Clinical mobile digital library (Project 8) identified and immediately engaged multidisciplinary stakeholders, representing designers, policy makers (government departments, donors) and users. The aim was to utilize mobile devices (innovative technologies) to rural clinicians	
	engaging them collaboratively		
Issues	Domain design process champions (DC) may not support stakeholder engagement at this initiation stage		
Contribution to project outcome	*Stakeholder engagement*	*Sustainability*	
	Joint participation in system development	Policy makers among stakeholders can influence project continuity	
	Stakeholder ownership of project outcome	Multidisciplinary champion's ability to see beyond project life allows for sustainability	
DEVELOPMENT STAGE : Design Stakeholders			
Design champions role	Design process champions (both multidisciplinary MC and Domain DC) identifying skills among stakeholders and encouraging their utilization in the design process	*Example:*	
		Multidisciplinary design champion in ***Project 6*** identified that the librarian who was among the stakeholders could delivery her domain knowledge in digital resources for the benefit of the other stakeholders. This design champion managed to maintain engagement among the stakeholders	
	Multidisciplinary champions MC facilitating, coordinating and motivating organic engagement among the collaborating stakeholders		
Issue	Domain champions DC use other sources of motivation i.e. marketing and institutional reinforcement to keep stakeholders engaged in the design process. This is problematic as it can time consuming and takes away project ownership		
Contribution to outcome	*Stakeholder engagement*	*Sustainability*	*Transformation*
	Shared participation in system development among stakeholders	Policies initiated by design champions can ensure projects are mainstreamed within institutions	Stakeholders using domain skills on innovative technologies can lead to transformation in the form of changed practice
	Stakeholder ownership of project outcomes		

ferences across different countries. We have discussed in details the role of policies in the design process and the different ways they influence the process in a separate paper (see [20]).

7 Conclusion

This paper has identified, within three African countries, best practice case studies of higher educational digital libraries. Detailed accounts from these studies have identified design process champion characteristics and their role in the design process. Although it is impossible to generalize findings of a few library design projects to the rest of Africa, they provide useful insights that can inform system designers in developing effective collaborative design teams and how to engage them in the design and implementation process, in African higher education. It could be argued, from previous UK pilot research [21] and other related literature [30,11], that the design champion roles identified relate to digital library design processes outside of Africa. However, further research is required to verify in more detail how generalizable these findings are. In particular our research makes the following conclusions and contribution to the domain of educational digital libraries.

The two identified design process champions appeared to facilitate initiation and design process of digital library projects. Their efforts resulted in innovative projects. However, our findings have shown that the approach taken by the MC was more collaborative and thus motivated participation of all stakeholders throughout the design process. This reduced the need for marketing resources and enforcement activities. Furthermore, the MC's succeeded in involving critical/high-profiled stakeholders who contributed to sustainability of the projects. While DC's can also lead successful digital library designs and potentially engage high profiled stakeholders, the results of this study show that this did not occur across three countries and multiple projects investigated. This then would suggest that a more collaborative approach is favourable especially where resources are scarce. Hence, DC's, could enhance their impact and contribution by embracing the approach taken by the MC. The value of taking such an approach is seen when designed digital library projects become sustainable, less costly and successful in meeting intended purpose. However, in coming to this conclusion, it must be considered that pragmatically many DC could take the approach they do because it is quicker and more flexible. With limited resources for project set-up and management this could be the real issue that all DL designers and developers are fighting against. It could also be that these findings are primarily the results of a developing world context. Further research is required to identify if, in practice, within the developed world this premise holds true.

The second conclusion is that the multidisciplinary approach taken by the MC is pivotal in building bridges across multidisciplinary teams in teaching, learning and research, not only in the African HE but perhaps also globally. Traditionally, different disciplines within an academic institution worked in isolation. However, there is an emerging trend being facilitated by digital scholarship that underscores the value of multidisciplinary approach to project design and implementation. This creates positive synergies across the various disciplines as knowledge is shared and scarce skills distributed for the benefit of everyone. The library, because of its central position playing the role of 'keystone species', can make a powerful contribution in facilitating this multidisciplinary participation if librarians can embrace the MC approach. It could be argued that institutions should consider that funding issues restrict librarians from moving out of their domains to participate in these multidisciplinary projects and identify avenues for making their domain specific contributions within these projects. Conversely involving policy makers within these projects could institutionally solve these funding issues for the future. For by working in a multidisciplinary way, design champions can show their presence and invaluable contribution so that it is felt and valued across institutions.

Finally, these findings were evident from the study of selected 'good practice' digital library projects in an African context. Could these also apply in the rest of Africa and indeed in other parts outside the continent? For example, to what extent is the cost-effective multidisciplinary approach relevant in the design of digital libraries under the current economic recession being experienced globally? Further research to test these findings outside the African context is recommended.

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