The Journal of Community Informatics, Vol 11, No 3 (2015)

Design for Sustainability: Countering the Drivers of Unsustainability in Development Projects

Mario Marais and **Isabel Meyer**, Council for Scientific and Industrial Research, South Africa. Email: mmarais@csir.co.za

INTRODUCTION

The vast majority of development projects, and in particular Information and Communications Technology for Development (ICT4D) projects, fail to reach their objectives and only a small number of projects effect change that lasts (Heeks, 2002;Toyama, 2010). The sustainability of a project is an important but ill-defined concept. Sustainability has been defined from various perspectives, but many of these definitions remain at the concept level, and are not useful in terms of pointing projects towards sustainability.

Sustainability is important from a number of different perspectives. Firstly, it relates to the usefulness with which funder money is spent. It is a key measure of investment success. Projects that fail, or that deliver benefit only for a limited period of time, represent lost investment as well as the opportunity cost associated with investing the money in a project that could have made a difference. Aid fatigue is often the outcome (Zoomers, 2005). Projects that fail to sustain benefits represent interactions with beneficiaries where the hope of change was raised, without delivering on that expectation. A case in point is the history of telecentre failures in India, where enthusiasm was replaced with disappointment (Rao, 2008). Finally, sustainability and sustained benefit is important in the sense that it creates an environment within which beneficiaries can enable their own growth, given the assurance that the newly realized benefits will remain accessible as catalysts of further change.

In this article we focus on developing an understanding of sustainability as a key measure of investment success. We specifically focus on the aspects that drive unsustainability and how to counter them. The intent is to provide practical mechanisms by means of which design for sustained benefit can become one of the key project objectives. These mechanisms could inform structured approaches to development projects, such as the Logic Framework (W.K. Kellogg Foundation, 2004). Also, they could assist the conceptualisation, design and execution of projects in order to meet the objectives of development organisations, for example the OECD DAC criteria for evaluation of development assistance (OECD, n. d.).

Our approach is to take a systems view on change, and to differentiate between the donor system and the beneficiary system. The beneficiary system comprises the community as well as the system(s) that are delivering services to the community, for example the South African government departments such as the National Department and Provincial Departments of Education. The donor system comprises the funding agency as well as the implementing agency. We consider sustained benefit as something that will result when the relationships that support sustained change in the beneficiary system have been enabled to the extent that benefits will continue to be generated.

Fundamental drivers exist to counter sustainability in the donor system as well as in the beneficiary system. For example, in the authors' experience, funding is typically available over relatively short time scales, leading to project reviews and project termination before sustained benefit could be realised. Also, the beneficiary system may not have the inherent capacity to absorb and manage the intervention, which would lead to a natural decay over time of the benefits that were realised.

These examples point to fundamental elements that need to be in place in order to ensure sustainability. The drivers of unsustainability need to be understood, and projects need to be designed to include processes, systems and feedback loops that will counter the drivers of unsustainability.

The challenge in ICT4D initiatives is for the donor system to engage with the beneficiary system in such a way that the benefits demonstrated by the project are adopted and sustained, and that value is delivered while dealing with numerous project-level operational complexities. In practice, this ideal is difficult to achieve. However, in order to work towards sustainability, projects can be designed to probe and understand the beneficiary system and to react appropriately - much more so than is typically the case.

This article explores the above concepts relative to ICT4D implementations. The theoretical departure point of this research is the adoption of a systems approach to understand the drivers of sustainability. This approach enables the authors to address the fundamental fact that a project is a mechanism that could initiate long-term sustained change and sustained benefit within a beneficiary environment. The focus is to inform project design to demonstrate the practical ways in which sustained benefit can be supported. The research approach was to translate existing literature on sustainability concepts into practice, and to demonstrate the use of the concepts through a project-based case study. The learning from the case was developed into a generalised framework.

This article firstly explores the practical, project-level meaning of sustainability. Possible drivers of unsustainability in ICT4D projects are then presented, at systemic as well as at project level. This is followed by an outline of the characteristics and project-level mechanisms that will promote sustainability. The focus is on the *design for sustainability,* and on project level mechanisms that will facilitate this approach. Finally, the concepts are contextualized relative to the ICT for Rural Education Development (ICT4RED) implementation, which entailed the deployment of tablet technology as part of the development of a 21st Century teaching and learning environment in all 26 schools of one education circuit in a rural area of the Eastern Cape Province of South Africa (Ford, Botha and Herselman, 2014).

THE PRACTICAL MEANING OF SUSTAINABILITY

The very first question to consider when talking about sustainability is whether or not it is indeed necessary for a project itself to be sustainable. Some projects are merely intended to demonstrate that change in a system is possible, and this needs to be clear to project owners and beneficiaries at the outset of the project. However, if sustainability is indeed to be effected in practice, project owners need to be able to interpret the implications thereof in practical and executable terms.

Sustainability is often defined at a conceptual level, without consideration of the interaction between the project and the environment. For example, the OECD calls for the following question to be answered when evaluating sustainability:

> *"will the benefits of the project continue after the funding has been withdrawn?" (OECD, n.d.)*

While this question intuitively sounds applicable and plausible, it does not reflect the need to modify the fundamental relationships within the beneficiary system in order to realise sustained change. It is proposed that the question be rephrased as follows:

> *"Have the fundamental characteristics of the system been modified in such a way that the system will continue to sustain the benefit that has been introduced by the intervention?"*

Answering either of these questions requires that a number of specific questions be defined at project level. For ICT4D implementations, we could argue that the following

questions are relevant for sustainability:

- Is there a real need for the benefits to continue once funding has been withdrawn?
  - Is this project intended to be sustainable, or should it merely demonstrate that change is possible?
- What is the scope and nature of the benefits?
  - Do benefits refer to access to the technology that is deployed, or to the benefits that result from access to the technology?
- For how long after the funding has been withdrawn should the benefits be realised?
  - Are the benefits required to last over the short, medium or long-term?
  - Are the benefits interim in nature, i.e. are they only required to last long enough in order to catalyse the realisation of other benefits?
- Does an inherent demand for funding exist, that should be sustained by the system?
  - Is the intervention inherently financially unsustainable, i.e. does it require continued external funding?
  - Do the benefits justify the cost thereof?
  - Should the intervention demonstrate how long-term benefit may be realised in the environment, in order to ensure continued support and funding once the initial financial aid has come to an end?

These questions highlight the need for clear and careful definitions in order to engage with the concept of sustainability; inherent mechanisms need to be defined and understood at project level and systems level, in order to facilitate the achievement of sustainability.

Some authors have expanded the definition of sustainability in ICT4D projects to include environmental, economic, social and institutional elements (Marais, 2014), as well as political and technological dimensions (Pade-Khene, Mallinson, Sewry, 2011). This multi-dimensional view emphasises the fact that sustainability cannot be considered as dependent on technology only, but that it needs to be considered in the context of a system of influences.

One way of making sustainability useful at a practical level is to connect project elements to the various dimensions of sustainability, as was done by Pade-Khene (2011). This approach ensures that elements of sustainability are taken into account during design and implementation.

For clarity and ease of interpretation, we adopt the concept of *sustained benefit* rather than sustainability in this article, as used by Miller (2004). This approach serves to focus the attention on defining exactly what benefits the project needs to deliver, what should be sustained and by whom.

In this work our approach to operationalizing sustainability is to highlight inherent forces that counter sustainability within the donor as well as the beneficiary system, and then to identify project-level components for which mechanisms need to be developed to counter these forces.

Two lenses were adopted in seeking an understanding of inherent drivers of unsustainability. The first was to map decisions made at the systems level, as well as at the level of the project. The view was adopted that "the value that an organization creates is ultimately no more or no less than the sum of the decisions that it makes and executes" (Blenko, 2010). In any ICT4D project, a number of decision-makers participate to deliver the project and engage with the beneficiary system (Meyer and Marais, 2014). This combination of role players is then considered to be the "organization" that is making decisions that can either enable or disable sustainability. A focus on decision-making enables an understanding of the context (beneficiary system) within which the project is rolled out, and inefficiencies and lost opportunities within this context, as well as key decisions that could be used to enable sustainability and/ or unlock value (Meyer and Marais, 2014). The second lens was based on the experience gained by project teams of an ICT implementing agency in the roll-out of ICT4D implementations.

DRIVERS THAT COUNTER SUSTAINABILITY

For the purpose of identifying drivers that counter sustainability, we differentiate between systemic drivers and project-level drivers. The first refers to the inherent nature of the donor and beneficiary systems, and the characteristics of these systems that will oppose the positive or negative effects of change. The second refers to the characteristics of development projects that complicate the process of delivering sustainable change. In both cases the intervention needs to be cognizant of these drivers, and a solution should be designed that pro-actively aligns with or counters them. This shifts the focus from a donor system that is innovating on behalf of the beneficiary system, to innovation that is driven by the beneficiary system in response to its natural dynamics. This is a first step towards the concept put forward by Heeks, that ICT4D has been following an evolutionary path from pro-poor to para-poor (with the poor) to per-poor (by the poor) innovation (Heeks, 2008).

Systemic drivers

We argue that the inherent nature as well as the maturity or readiness for change of the beneficiary system determines the extent to which an intervention will be adopted, and hence the possible sustainability thereof. The following questions can be considered when thinking about systemic drivers of unsustainability:

Who Defines Change?

Donors and project owners may want to effect change that is not aligned with the objectives of the beneficiary system. In practice, required change and the associated objectives are often defined in response to political or other external pressures, without cognizance of the need for change in the beneficiary system. Objectives are sometimes defined unrealistically, and without consideration for the sustainability thereof. An intervention is unlikely to be sustainable if the intent of the funders or implementing agency is not aligned with that of the community and with the current systems that are providing services to the community.

What Level of Change is Possible, Now and In Future?

While adoption of an entire solution may be appropriate in the long run, the system may at any specific point in time only be ready for small incremental changes. This highlights the need for the intervention to be aligned with the capacity and readiness of the beneficiary system, and to meet the system at the current point in its development path. It may call for the development of modular interventions, parts of which can be rolled out as and when the system is ready for the adoption thereof.

Is Current Change in the Beneficiary System Understood and Utilised?

All systems are undergoing change (albeit at a very slow pace) and change agents are at work to effect change, either intentionally or unintentionally. An intervention into the system introduces new change and utilizes new change agents. This could create dynamics that are counter to existing forces in the system. This aspect calls for the alignment of the intervention and its change agents with the natural agents of change in the beneficiary system.

Is the Proposed Change Aligned with the Readiness of the System for Change?

The extent to which a system is able to respond to an intervention depends on the maturity or readiness thereof to engage with the intervention. For example, the deployment of a sophisticated text-based ICT solution will be of no consequence or impact in a community where people are functionally illiterate. Furthermore, an intervention that demands a large amount of management capacity from a community organization that is already overloaded is unlikely to receive the required focus and attention. This aspect demands that the readiness of the beneficiary system be understood from multiple

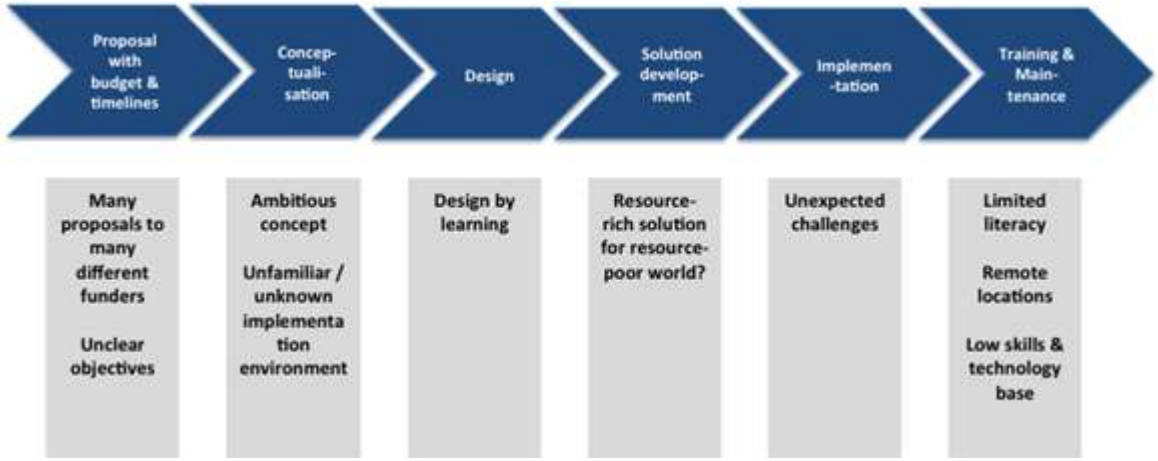
perspectives, and that the intervention is aligned with the readiness for adoption by the beneficiary system.

These questions are by no means complete, but call for the owners of an intervention to be aware of the problems that are associated with intervening in a complex system, and to include means of mitigating these problems during project planning and implementation.

Project-level Drivers

Development projects have specific characteristics that cause them to be different from engineering or ICT projects. This leads to complexities throughout the project cycle, which affect the ability of the project to deliver sustained benefit. An understanding of these differences and complexities creates the opportunity to design projects that counter these effects proactively, and as such reduces the risk of investing in a project that will not deliver sustained benefit. Figure 1 outlines a typical project life cycle, as is applicable to engineering or ICT projects. Elements that characterize development projects are included as contrast to the typical project life cycle.

Figure 1. Characteristics of Development Projects

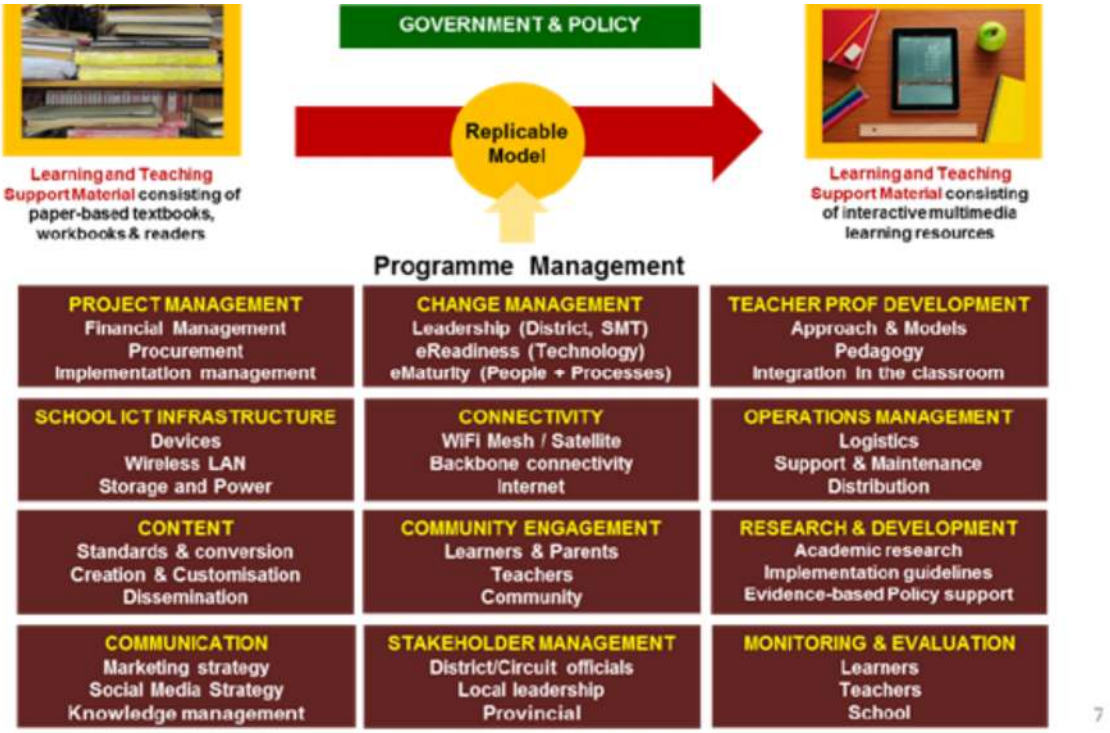


In the next section this description of the characteristics of development projects is used to identify and analyse the project-level drivers, using a project as a case study.

Using the ICT4RED Case Study to Identify Project-Level Drivers

The ICT4RED project is used as case study in this research. The project was aimed at creating a 21st century teaching and learning environment while at the same time deploying tablet technology (Botha and Herselman, 2013). ICT4RED forms part of Technology for Rural Economic Development (TECH4RED), which is a joint initiative between the Department of Science and Technology (DST), the Department of Basic Education (DBE), the Department of Rural Development (DRDLR) and the Eastern Cape Department of Education (ECDoE). The initiative aims to contribute to the improvement of rural education via technology-led innovation (Ford, Botha and Herselman, 2014). The deployments, which ranged from ICT, nutrition, health, water, sanitation and energy, focused on the 26 schools of the Nciba Circuit of the Cofimvaba School District in the rural Eastern Cape Province (Ford, Botha and Herselman, 2014).

Figure 2. Twelve Essential Components of the ICT4RED Project



A Design Science research approach was used by the project team to develop the conceptual framework out of which these components evolved (Ford, Botha and Herselman, 2014). Design science research is aimed at design "to change existing situations into preferred ones" (Hevner and Chatterjee, 2010). Each of these essential components represents a specific focus and was assigned to a champion within the project team to lead.

The ICT4RED project was planned in four phases (Ford, Botha and Herselman, 2014):

- Phase 0 - Desktop research (2011/2012).
- Phase 1 - A test of the project design at one school (2012/2013).
- Phase 2 - Redesign to implement learning from Phase 1 in 11 schools (2013/2014).
- Phase 3 - Final redesign, implementing learning from Phase 2 around process and scaling in 14 schools (April 2014/March 2015).

The authors were involved as part of the multi-organisation ICT4RED project team, in the investigation and development of models aimed at understanding and promoting sustainability.

As indicated at the start of this section, some of the elements that differentiate development projects from commercial ICT projects are contrasted and discussed below, using the ICT4RED project as a case study.

Proposals, Budgets and Strategic Intent

The origin of a development project and the resulting source of funding is an important determinant of sustainability. We differentiate between top-down and bottom-up approaches.

Funding is often made available due to political pressure to solve a specific societal problem. The focus is to solve a very concrete problem within a short period of time, which is not necessarily an unreasonable demand in reaction to a real and pressing problem. However, this "top-down" approach is not taking a holistic, systemic view on the problem and is not designed to bring about sustainable change. Furthermore, it leads to funding that has a specific "label" or definition, and that forces projects to reflect a specific intent. Implementing agencies may have a more practical and holistic view of what is required by beneficiaries, or may want to further a specific agenda, e.g. a technical agenda. This leads to the definition of projects that have multiple (often conflicting) agendas.

For example, in the technology deployment project that is used here as a case study, funding was made available under the banner of technology innovation, with the intent to solve the logistics issues with paper textbook distribution to rural schools by providing access to digital textbooks and tablets. There was also a concomitant drive to demonstrate that digital textbooks could influence educational outcomes. The implementing agency redefined this strategy in order to create a realistic opportunity for achieving positive outcomes in a three year project through the improvement of 21st century skills and the creation of a 21st century teaching and learning environment. Teacher professional development, rather than a narrow technology focus, was the main objective.

The creation of a teaching and learning environment did lead to engagement with the local and provincial educational system. In this context there were many problems which materially affected the project, such as poor school infrastructure and dysfunctional schools, as well as a skills shortage and unfilled posts at school, circuit and district level. This led to an attempt by the project to compensate for these multiple problem dimensions through the creation of the 12 components shown in Figure 2. The implication thereof is that the project complexity increased dramatically. Another consequence is that the beneficiary system was engaged from multiple angles. This led to key resources being inundated by project requests, such as school principals and a particular district official (as the local coordinator of the project). The capacity of the beneficiary system was stressed. In the project, dependencies were created between the delivery and repair of infrastructure and the roll out of teacher professional development programmes. Furthermore, both technological skills and teaching skills were developed simultaneously, which complicated the capacity to meet people at an appropriate point relative to their development needs. A favourable outcome was the ease with which tablets were adopted, which lowered the barrier to technology skills development. In response to these dynamics, the project defined a modular approach to project roll-out and implementation, which would allow for the definition of more achievable project objectives within a specific implementation environment.

In some instances, development projects need to be funded from multiple sources, with potentially conflicting objectives. This dilutes the focus of the project, and complicates delivery thereof. In the case of this project the national government funder is not in the education domain. The direct benefit is delivered to a Provincial Department of Education which had limited opportunity to shape the project. However, this Department is ultimately directly responsible for maintaining the various support and education systems. A tenuous and complicated government relationship structure was therefore created, which did not have the focus to provide the necessary support for the translation of project level learning into strategies for creation of a long-term sustaining environment. This dynamic also plays out in "bottom-up" approaches where an implementing agency needs to source funding from multiple sources in order to implement a solution that is considered to be useful to the beneficiary system. In addition to managing conflicting objectives, the project owner often also does not have sufficient influence over the multiple role players that affect project success. There is no joint vision and no coordinated strategic intent, and the project success is at the mercy of a number of uncoordinated and contradicting influences that affect long-term sustainability.

The final and important source of unsustainability associated with project funding relates to the time scales over which funding is available, and after which funding priorities are reviewed. Many funding cycles are over a three-year period. This places pressure on delivery, and leads to the definition of resource-intensive projects that are rolled out over a compressed period of time. A more appropriate scenario where engagement with the beneficiary system has a longer duration would allow for the deployment of temporary capacity to fulfil the resource requirements of the project, and for the development of capacity and skills in the beneficiary system for transfer of the implementation.

Design by Learning

Solution design in development projects is complicated by the unfamiliarity of the environment, the large number of unknown factors that influence implementation success and the difference in maturity of the problem environment and the solution environment.

Furthermore, comprehensive funding is not necessarily available at the outset of the project.

The implication of these factors is that solution design should take place incrementally. Learning should take place with the beneficiary system, and project planning should be adaptable and flexible enough to allow for an incremental design phase. The concept of bricolage is very relevant. Bricolage, as referred to by Ciborra (cited in Ali and Bailur, 2007) is the "... tinkering through the combination of resources at hand. These resources become the tools and they define in situ the heuristic to solve the problem". This approach reflects the use of the limited resources at hand in an incremental fashion in order to reach a solution.

In the case of the ICT4RED project, design by learning was reflected in the evolution of an initial 6-component solution to a 12-component solution (Ford et al., 2014), and the introduction and expansion of gamification to engage and motivate teachers, which was highly successful (Botha, Herselman and Ford, 2014). Furthermore, design by learning prompted the question of what would be a minimum design that would be sufficient to make the first manageable and sustainable incremental change in the system. It prompted the related question of what modular design should look like for this implementation, and what level of modularity would be appropriate for different levels of maturity of the implementation environment.

Unfamiliar Implementation Environments: Conceptualization, Implementation, Training and Maintenance

A solution is often designed without the benefit of understanding all the practicalities of deploying the solution in a specific environment. In the tablet project under consideration, a number of aspects became known during implementation. As mentioned in the previous section, the project team devised various strategies to reward teachers for their commitment. These included gamification and an earn-as-you-learn model where teachers ultimately became the owners of the tablets. Principals were eager to participate in-project, and in general maintained a high level of enthusiasm. However, in one case a principal was overloaded by the project demands and fairly or unfairly blamed the project for demanding too much and defocusing his attention. According to him, this led to the poor performance of the grade 12 class in the second year of his school's participation in the project. This reflects the reality that a project such as this one is only one of the many demands on an educator. It may lead to an increase in an educator's diffusion of focus, which affects the attention that will be provided to the project as well as to other priorities. It affects the ability of the project to deliver sustained benefit, in the short as well as the long term.

For example, the remoteness and physical inaccessibility of schools due to poor road infrastructure affected the ability to deliver continued operations support. Exposure to computers and ICT skills were lower than expected, which affected sustainability by placing a higher than expected demand on developing teacher's technical skills (in using applications such as email and presentation software). This required the introduction of an additional training module to reinforce technical skills, which in turn had budget implications. Furthermore, the capacity of teachers were stretched more significantly than what was anticipated. The teaching load was high, and teachers had limited capacity to take on any additional projects.

Resource Rich Solutions for Resource Poor Environments

Development projects work at the interface between resource-rich and resource-poor environments, and this interaction in itself generates complexities that counter sustainability. The design of an intervention from the perspective of a resource-rich environment leads to solutions that demand and assume the availability of resources that are not necessarily available in the resource-poor environment. The unintended consequence thereof is that the intervention demands resources from an already resource-poor environment in order to be sustainable. For example, the lack of infrastructure in rural environments (reliable electricity, physical security) and the limited capacity or availability of principals, teachers and district officials to engage with the intervention affect sustainability. Furthermore, the design of the ICT4RED initiative

included a full time project management capacity, which complicates the ability to hand over the initiative. The project must respond to these demands and accept the responsibility to develop capacity or to find strategies to ensure long-term access to such capacity.

Solutions to this dilemma can be reached within the realm of project design. For example, a resource hungry intervention that is too "rich" for the beneficiary system to maintain and use, could be more sustainable if a modular implementation programme is planned for and followed. Such a modular programme would allow better fit between the solution and the context within which it is deployed.

Furthermore, project design should be cognizant of the disjunction between resource-rich and resource-poor worlds, and should ensure that the capacity is brought in to enable the resource-poor environment to be ready for the resource-rich solution, even if temporarily. This requires an assessment of resources that are available in the beneficiary system, a definition of the interim resources that are required and the design and *timeous* implementation of a transfer and exit strategy. Timeframes for gearing resources from key role players in the environment are typically long, and execution of this plan needs to be initiated at the start of the project. For example, the creation of specific project-related positions, that are to be funded by the Department of Education or any other government department, is dependent on budget cycles and therefore slow.

INTERVENTIONS THAT PROMOTE SUSTAINABILITY

Our discussion above serves to provide examples of some of the drivers of unsustainability that need to be countered at project level, in order to promote sustainability (see Table 1 below). This section now identifies mechanisms aimed at countering drivers of unsustainability.

These mechanisms consist of project-level policies, processes, systems and structures that promote sustainability. The premise is that such mechanisms need to create interactions with the environment that will enable and catalyse long-term sustainability. In order to achieve this, project-level requirements need to be identified and the project needs to be designed in such a way that these requirements are met. Also, the requirements need to be structured in a way that focuses the attention on the overall goal of sustained benefit, and that deals with the inherent conflict and complexity that is created by different role players.

In the ICT4RED project case study, the sources of unsustainability, the corresponding drivers and the resultant key design requirements were identified, as summarized below (following the line of argument presented above, in Section 3.1, when discussing systemic drivers).

Table 1. Drivers of Unsustainability and Associated Project Design Requirements

Sources of unsustainability	Driver of unsustainability	Requirement
Impetus for change	*Who defines change?* Reactionary approaches to external pressures define project and nature of funding *How is it funded?* Many proposals, different funders, unclear objectives	Ensure joint vision development Counter uncoordinated decision making Ensure alignment of the objectives of all role players, including that of the beneficiary system Create mechanisms to bridge the funding gap
Status of the system	*What level of change is possible, is the beneficiary system ready and is current change in the system understood?* Complete solutions are designed, for which the beneficiary system may not be	Understand change readiness and current change drivers Develop solutions aligned with the readiness and the change drivers Develop (modular) solutions that meet the beneficiary system at the appropriate point in its development path

	ready	
Project environment	*Unfamiliar implementation environments and limited funding forces design by learning*	Ensure modular project design, that is flexible and adaptable (e.g. by means of a pilot phase) Align the maturity of the solution with the maturity of the beneficiary system
Project environment	*Unfamiliar implementation environments pose practical challenges*	Ensure that implementation readiness is understood Create feedback loops that promote continuous learning, improvement and adaptation of project design
Nature of the interface	*Resource-rich solutions for a resource-poor world*	Ensure that project resource demands are understood Ensure that resource constraints are understood and designed for Ensure that capacity for uptake is enabled in the beneficiary system (funding, focus, attention) Create a micro-environment that ensures (temporary) sustainability Create a sustainable strategy to exit from this micro-environment

The above requirements, in response to systemic drivers of unsustainability, need to be captured in project structures, processes and systems that will create a project environment that will interact with the larger environment to foster and catalyse long-term sustainability.

When defining the mechanisms to promote sustainability, we take a view of the entire system (i.e. beneficiaries as well as donors), and we consider mechanisms that will foster sustainability from a strategic, tactical and operational perspective. We selected this view because it creates an awareness that the behaviour of the system is the result of decisions and actions that are taken at different levels of organisational function that influence each other. The levels differ in terms of scope, extent and time horizon of planning and of decisions made. This view also serves to illustrate the importance of aligning these various levels with the overall goal of creating sustained benefit.

Definitions of mechanisms in support of sustainability from each of these perspectives are proposed below. For each of the perspectives, project-level mechanisms are defined.

Table 2. Mechanisms That Counter Drivers of Unsustainability

Sustainability focus	*Definition*	*Project-level mechanisms (for example)*
Strategic	The project contains mechanisms and agreements that: ensure alignment between goals of multiple role players ensure alignment between readiness of the beneficiary and donor systems, and facilitate coordinated decision-making	Joint planning, goal setting, benefit definition and budgeting takes place Alignment between donor and beneficiary systems are assessed from multiple perspectives, as part of project pilot or conceptualisation phase Mechanisms are in place to facilitate communication between stakeholders, e.g. steering committees Mechanisms are in place to ensure affordability of project to beneficiary system Monitoring and Evaluation results inform strategic decision-making
Tactical	The project contains mechanisms that bridge the gap in capacity between the donor and ben-	Temporary capacity is provided to bridge the gap within the beneficiary system A comprehensive exit plan is initiated at start-up of the project, with local capacity develop-

	eficiary systems, and initiates mechanisms that will perpetuate desired outcomes	ment plans Phased handover of responsibility is planned Processes and systems are in place to secure continuous funding, if necessary Monitoring systems feedback into a continuous improvement process Participants identify opportunities to use project outputs to achieve different outcomes
Operational	Project initiates mechanisms that ensure that outputs are sustained, and contains mechanisms that ensure comprehensive handover to the beneficiary system	The management entity within the beneficiary system has the authority and means of ensuring that operations can continue Operational support procedures are in place and functioning Ongoing training processes are in place

In summary: the above analysis links the drivers of unsustainability to project design requirements that will have impacts on sustainability from strategic, operational and technical perspectives. These requirements are intended to counter systemic drivers of unsustainability. They are defined in the form of project-level policies, structures, processes and systems that collectively create the practical project execution environment that will promote sustainability in the entire system.

APPLICATION

We used the ICT4RED project in Section 4 to identify project-level drivers of unsustainability. This analysis is now used to illustrate how an understanding of selected elements of the drivers of unsustainability (as reflected in Table 1), as well as of the corresponding project-level mechanisms to counter these drivers (as outlined in Table 2) can be used to improve project design.

Drivers of Unsustainability

Resource-rich Solutions for a Resource-poor World

The requirement that capacity for uptake is enabled in the beneficiary system was addressed by training teachers from Phase 2 to be trainers of the Phase 3 teachers. This builds training capacity in the circuit and exposes the teachers to the management and operational side of training. Future training programmes can now be conducted by these trainers.

In Phase 2, teachers and district officials were used to administer a badge system of micro-accreditation for skills acquired. This system was designed by the project as a mechanism to recognise and reward the acquisition of skills (Botha, Herselman and Ford, 2014). This system made officials part of, and responsible for, an aspect of project operations. In practice the handover of this well-defined activity did work well. A similar aspect was handover of the project management of the training in Phase 3 to the District officials. This is an operational-level handover activity, that was intended to build local capacity. This met with limited success due to a shortage in project management capacity within the Department.

The requirement that resource constraints are understood and designed for was not met in the project. A Total Cost of Ownership (TCO) model was developed during the project, and was used to illustrate two different cost scenarios: one using project resources, and the other using resources from the educational system and contractors. The TCO model showed that the affordability of the project resource model was poor due to a large project management component and an expensive ICT operations support model. The ECDoE manages the constraints in terms of its project management capacity by outsourcing many projects (ECDoE, 2013). The ICT operations support infrastructure of

the Department is also very thinly spread with one ICT support person per district, compared to a project model that requires technical support to be based at the school and the regional level. TCO models can be one of the mechanisms put into place to ensure affordability, but should be developed during the conceptualisation stage of a project in order to inform the project design. In this project, Phase 0, the desktop study, should have contained resource assessment, which could include TCO model development.

Who Defines Change?

The scope of the project was defined by the agendas of the funding and implementing agencies. A dual focus of development of teaching and learning skills and deployment of technology was followed. In education systems with limited capacity, this could complicate project roll-out (see section 3.1).

Apart from the above, the requirement for joint vision development and the need to counter uncoordinated decision making was addressed at two levels. At the provincial level an ICT steering committee was created that was chaired by the head of the ECDoE in order to coordinate ICT interventions in the schools of the province. This committee has defined its brief and, at the time of writing, has just commenced operations. At the school level, each school was asked to develop its own acceptable use policy (AUP) as part of the training. This made it clear that the school has the authority to decide what would and would not be allowed in their school. A Technical Committee was also formed at each school with the principal as a member. The committee fulfils a management, training and coordination role. A prime example of operational decisions being made according to the AUP occurred at the Phase 1 school, where the committee made the decision to allow Grade 12 learners to take their tablets home since they judged the learners to be ready to do so. The technical committees function at varying levels of success in the schools. These committees represent the first phase of the establishment of structures that could define change within the system. In order to represent true sustainable change, these structures should ideally be integrated with current departmental eLearning and technical support processes. Furthermore, at least some multi-stakeholder structures that participate in defining desired change and creating a joint vision should ideally be engaged from inception of the project. The ICT4RED project steering committee included representatives from the funder and implementing agent, but not the beneficiaries.

It was realised that increased interaction between the various role players was required. This lead to an a change in the project design, with a resultant increase in its focus on community engagement and stakeholder engagement. Responsibilities were assigned to specific team members for these roles (Ford et al. 2014).

What Level of Change is Possible, Is the Beneficiary System Ready and is Current Change in the System Understood?

The requirement regarding understanding change readiness and change drivers was found to be very important. Engagement with the ECDoE regarding the TCO models brought to light the large year-on-year volatility of their funding. This volatility results in year-by-year planning which does not fit well with either the five year planning horizon of the TCO model or the three year project planning horizon. Practical mechanisms such as bridging- and long-term funding is required (see Table 2 - Tactical perspective).

As highlighted in Table 2, at a strategic level, mechanisms need to be in place to assess alignment of donor systems (implementing agent) and beneficiary systems. The project combines eLearning, mLearning, teacher professional development and content aspects, which are dealt with separately within the Department of Education. This represents ownership, management and budgetary challenges to the Department. This could have been investigated in Phase 0, the desktop study, so that the project design aligned as far as possible with the departmental structure.

In terms of assuring alignment at a strategic level, the monitoring and evaluation (M&E) component of the project was intended to take an developmental evaluation approach (Quinn Patton, 2011), which was supposed to produce results in order to inform strategic decision making. However, the major focus of the M&E component was on evaluation of the implementation of the training, and not on evaluation of the intervention as a whole.

There was insufficient focus on the mismatches in alignment at a strategic level. Evaluation of the stakeholder management element should have received more attention, and the creation of more frequent feedback loops to the stakeholders was required.

Project-level Mechanisms to Counter Unsustainability

In Table 3 below, mechanisms that were used in the ICT4RED project to counter drivers of unsustainability are summarised and critiqued. Suggestions are also made on how to improve these mechanisms.

Table 3. ICT4RED Project Based Mechanisms That Counter Drivers of Unsustainability

Sustainability focus	*Definition*	*ICT4RED Project-level mechanisms*
Strategic	The project contains mechanisms and agreements that: • ensure alignment between goals of multiple role players • ensure alignment between readiness of the beneficiary and donor systems, and • facilitate coordinated decision-making	***Goal alignment*** • A provincial ICT steering committee was created during the project for future project coordination. The province should ideally have been involved in project planning, from the inception thereof. • Stakeholder management and community engagement project components were created during the course of the project. • A project steering committee meets quarterly with the funders, DST and DRLDR. The DBE, province and community should be represented at these meetings. ***Readiness alignment*** • The project's components should be aligned with the structures of the Department of Education. • Alignment between the CSIR and ECDoE capacity was assessed through use of the TCO models in mid-project discussions with the Department and not at the start. • TCO models showed the large gap between the affordability of the project and the departmental structures and budgets. Use of local teachers as trainers reduced costs, but affordability remains a challenge. ***Co-ordinated decision making*** • Monitoring and Evaluation focused mainly on implementation of training, neglecting strategic issues. Results should have been communicated to the province in a structured fashion.

Sustainability focus	*Definition*	*ICT4RED Project-level mechanisms*
Tactical	The project contains mechanisms that bridge the gap in capacity between the donor and beneficiary systems, and initiates mechanisms that will perpetuate desired outcomes	***Bridging the capacity gap*** • An exit plan was initiated in Phase 3 of the project instead of at the start of the project. Training capacity was built by training Phase 2 teachers to train Phase 3 teachers. • The handover of project management of the Phase 3 training to the District was planned, but was largely unsuccessful. • An operational budget was submitted

		to the province for the financial year after the project ends. The province should be trained to use the TCO model. ***Perpetuating outcomes*** • Trainers were brought in by the project in Phases 1 and 2 of the project. The project provided project management and technical support personnel based in the area. • Satellite connectivity was funded for a two year period after project end. Alignment with existing connectivity initiatives in the province should ideally be pursued. • Monitoring systems are in place for connectivity usage, but information is not yet used for continuous improvement. It should be shared with the Department. • Monitoring of teacher training by the project team has led to trainers being removed. This capacity needs to be embedded within the departmental structures.

Sustainability focus	*Definition*	*ICT4RED Project-level mechanisms*
Operational	Project initiates mechanisms that ensure that outputs are sustained during the project, and contains mechanisms that ensure comprehensive handover to the beneficiary system	***Ensuring comprehensive handover*** • Schools had to develop acceptable use policies to guide ICT use as part of training. Voluntary Technical Committees were initiated at each school. This places an extra burden on teachers and extra departmental support is required. • ICT Operational support is provided by the project. ECDoE should be involved. ***Ensuring sustained outputs*** • An Earn as you Learn approach was adopted whereby teachers earn equipment as they show progress (Botha, Herselman, Ford, 2014). Technology is given when users are ready. • Creation of a Community of Practice is planned to provide some ongoing support to the trained teachers. Engagement with the ECDoE regarding on-going training processes that is aligned with and embedded in their teacher professional development strategy is required.

It is evident from the above table that, while the ICT4RED project was implementing many of the required actions and approaches for sustained benefit, there was still significant opportunity for improvement in both planning and execution, especially with respect to early and ongoing strategic engagement with the beneficiary system as a whole.

PROMOTING SUSTAINED BENEFIT IN ICT4D PROJECTS

Our premise at the outset of this work was that the failure of the vast majority of ICT4D projects to reach their objectives can be addressed by a focus on project design for sustained benefit within the larger system in which the project is done. Exploration of the ICT4RED project from strategic, tactical and operational perspectives revealed project requirements at all these levels. In turn, it was possible to identify practical, project-level mechanisms at all three levels. The mechanisms that were identified were generic, and could be customised and applied in any ICT4D project.

Learning from this project, and from the nature of the derived project-level mechanisms, emphasises the fact that planning for sustained benefit should be done from the outset of the project. Early identification of factors that would ensure that uptake by the beneficiary system, such as affordability and capacity requirements, can significantly promote sustained benefit. Consultation and joint vision development between donor, implementing agent and beneficiary system would profoundly influence planning and execution to enhance the possibility of influencing fundamental changes in the beneficiary system so that benefit initiated by a project can be sustained.

A focus on an end-result of sustained benefit would inform the early development and continuous adaptation of an exit strategy that promote sustained benefit. A focus on sustained benefit would further serve to justify and validate investment in the project, from perspectives that are broader than the often-adopted donor-driven focus on efficiency, economy and effectiveness.

CONCLUSION

Sustainability was considered as a key enabler of investment success in development initiatives. An understanding thereof was elicited (in this particular project) by adopting a systems view on interactions between donor and beneficiary systems. A new definition of the concept of sustained benefit was adopted as being a result of the ability of the beneficiary system to sustain changes that increase the generation of benefits. A project is seen as having an increased probability of success when it has identified and engaged with the possible drivers of unsustainability in the donor and beneficiary system at both systemic and project level.

The experience gained by the authors on sustainability modelling of ICT4D projects, as well as an analysis of the ICT4RED project in particular, was used in order to identify the drivers of unsustainability, translate them into project level requirements and use these requirements to define mechanisms that mitigate the drivers of unsustainability. These mechanisms are based on the principles of participatory approaches to defining, introducing and sustaining change.

The presence or absence of these or similar mechanisms could serve as an indication of the extent to which the project is *designed for sustained benefit*. The extent of application of these mechanisms was identified in the context of the ICT4RED project, and the links to sustainability was demonstrated. By reducing the risk of unsustainability and project failure, the implementation of these mechanisms could enhance investment success. The overall approach to engagement between the donor beneficiary systems can contribute to sustained benefit.

ACKNOWLEDGEMENTS

The officials of the ECDoE for their enthusiastic participation and the members of the CSIR ICT4RED project teams for sharing information.

ENDNOTES

i An example is the inability of a Telecentre to prevent water damage to property, since it did not own the building and could not influence the government-agency owner to fix the problem (Attwood and Braathen, 2010).

REFERENCES

Ali, M., Bailur, S. (2007). The challenge of sustainability in ICT4D - Is bricolage the answer? *Proceedings of the 9th International Conference on Social Implications of Computers in Developing Countries*, São Paulo, Brazil, 28-30 May 2007. Retrieved May 29, 2015, from http://www.ifipwg94.org.br/fullpapers/R0010-2.pdf.

Attwood, H., Braathen, E. (2010). *Telecentres and poor communities in South Africa: What have we learnt?* Paper presented at the panel "Comparative Experiences of Chronic Poverty and access to Information and Communication Technologies (ICT)", The Chronic Poverty Research Centre (CPRC) Conference, "Ten years of 'war against poverty'. What we have learned since 2000. What we should do 2010-2020", Manchester, UK, September 8-10, 2010.

Blenko, M.W., Mankins, M.C., Rogers, P. (2010). The Decision-Driven Organization. *Harvard Business Review*, 1-9. Retrieved May 29, 2015, from http://www.rich-kohler.com/wp-content/uploads/2010/09/making-better-decisions-blenko.pdf.

Botha, A., Herselman, M. (2013). *Supporting rural teachers' 21st century skills development through mobile technology use: A case in Cofimvaba, Eastern Cape, South Africa*. Proceedings of the 5th International Conference on Adaptive Science and Technology (ICAST 2013), Pretoria, South Africa, November 25-27, 2013.

Botha, A., Herselman, M., Ford, M. (2014). *Gamification beyond badges*. Proceedings of the IST-Africa Conference, Mauritius, May 6-9, 2014.

ECDoE, Private communication, 2013.

Ford, M., Botha, A., Herselman, M. (2014). *ICT4RED 12 - Component Implementation Framework: A Conceptual Framework for Integrating Mobile Technology into Resource-constrained Rural Schools*. Proceedings of the IST-Africa Conference, Mauritius, May 6-9, 2014.

Heeks, R. (2008, June). ICT4D 2.0: The next phase of applying ICT for international development. *Computer*, 41(6), 26-33.

Heeks, R. (2002). Information Systems and developing countries: Failure, success, and local improvisations*. The Information Society*, 18, 101-112.

Herselman, M., Botha, A., Ford, M. (2014). *Building a mlearning research framework through design science research*. Proceedings of the IST-Africa Conference, Mauritius, May 6-9, 2014.

Hevner, A., Chatterjee, S. (2010). *Design Research in Information Systems.* Integrated Series in Information Systems, 22, 9-22. New York: Springer.

Marais, M.A. (2015). ICT4D and Sustainability in: *The International Encyclopedia of Digital Communication and Society*, (IEDCS), Mansell, R and Hwa Ang, P (Editors-in-Chief). John Wiley & Sons, Inc. (ISBN 978-111-829-074-3). Available at Wiley Online Library http://onlinelibrary.wiley.com/book/10.1002/9781118767771. DOI: 10.1002/9781118767771

Meyer, I.A., Marais, M.A. (2014). *Decision Support to enable Sustainability in Development Projects.* Paper presented at the 11th Prato CIRN Conference, Monash Centre, Prato, Italy, October 13-15, 2014.

Miller, D. (2004). Building sustainable change capability. *Industrial and Commercial Training*, 36 (1), 9 - 12. Retrieved May 29, 2015, from http://dx.doi.org/10.1108 /00197850410516058.

Miller, D. (2011). *IOM Project Handbook*. Geneva: International Organisation for Migration.

OECD, n.d. *DAC criteria for Evaluating Development Assistance*. Retrieved May 29,

2015, from http://www.oecd.org/development/evaluation/49756382.pdf.

Pade-Khene, C., Mallinson, B., Sewry, D. (2011). Sustainable rural ICT project management practice for developing countries: Investigating the Dwesa and RUMEP projects. *Information Technology for Development*, 17(3), 187-212.

Quinn Patton, M. (2011). *Developmental Evaluation: Applying complexity concept to enhance innovation and use*. London: Guildford Press.

Rao, S.S. (2008). Social development in Indian rural communities: Adoption of telecentres. *International Journal of Information Management*, 28, 474 - 482. Retrieved May 29, 2015, from http://dx.doi.org/10.1016/j.ijinfomgt.2008.01.001.

Toyama, K. (2010). Can Technology End Poverty? *Boston Review,* Nov/Dec 2010. Retrieved May 29, 2015, from http://www.bostonreview.net/forum/can-technology-end-poverty.

W.K. Kellogg Foundation. (2004). *Logic Model Development Guide: Using Logic Models to Bring Together Planning, Evaluation, and Action.* Michigan: W.K. Kellogg Foundation.

Zoomers, A. (2005). Three decades of rural development projects in Asia, Latin America, and Africa: Learning from successes and failures. *International Development Planning Review*, 27(3), 271-296.