Decision Support to Enable Sustainability in Development Projects

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Abstract: A number of factors complicate the ability to deliver sustainably on development interventions. Multiple role players are involved, the performance of implementation agencies are measured over the short- to medium term and donors do not always take a holistic view of the long-term impact of interventions on beneficiaries.

The development process is often presented in terms of a logic model that consists of a chain of events from procurement of inputs, through translation of inputs to outputs, outcomes and impacts for the community. Along this chain, a number of implicit and explicit decisions affect the value that is ultimately delivered. These decisions are often uncoordinated, take place across multiple agencies and are guided by objectives that are not always explicitly linked to development outcomes. Throughout this process, scope exists to aid decision makers, through a simplistic set of decision models, to make better decisions. The emphasis is on decisions that support long-term value creation, and that enhance the sustainability of project outcomes. This paper focuses on the implementation of ICT interventions in rural South Africa, and explores the role of decision support for the long-term sustainability in rural education. It outlines the context of decision-making in rural education, the role and nature of technology selection decisions, and the value addition of conceptualisation of decision support tools for tablet selection.

Keywords: Decision analysis, education, development projects, technology selection, sustainable impact

Introduction

Sustainability and sustainable development are concepts that have been widely debated and defined, but that remain difficult to operationalise. In Information and Communications Technology for Development (ICT4D) projects, sustainability is further complicated by the need to establish a technology environment that must be maintained and sustained in rural areas, where technology delivery is complex, skills are limited and technical support is difficult to sustain.

Different organisational role players are involved in the deployment of ICT4D projects, including donors, implementation agencies (project owners), recipient organisations (problem owners) and the community as the ultimate beneficiary. Since these role players act independently and have independent objectives, their decisions are often uncoordinated and at cross-purposes. Furthermore, time scales are different. Funders have short-term project-driven time scales, while problem owners need to create environments that are sustainable in the long run.

Blenko, Mankins and Rogers (2010) argue that a company's value is ultimately no more (or no less) than the sum of the decisions that it makes and executes. In this work, we assume that the various role players form a virtual organisation that is making a continuous stream of decisions. It is assumed that sustainability can be influenced by understanding decisions in the broader organisational context and by reframing individual objectives to include a consideration for long-term sustainability. It is assumed that systematic mapping of decisions will assist with identification of opportunities and tools to improve decision making to enhance sustainability.

The decision-aiding work outlined here relates to a project that deploys technology for education in rural Eastern Cape schools in South Africa. The project is funded by Treasury through national departments, and is implemented by a parastatal organisation (the CSIR). This paper discusses decision-making within the broader organisational context, as well as in the project context. In the organisational context, thematic maps have been applied as a means of developing an understanding of the influence of multiple role players on a single decision that is made within an organisation (Bouchart, Blackwood and Jowitt 2002). This paper applies the concept of decision nodes, adapted from thematic mapping, to identify inconsistencies in decision-making across multiple organisations. It highlights areas where project-level strategies for intervening in uncoordinated, multi-stakeholder organisational environments can be developed.

The project-level map focuses on the decision-making of the implementation agency, and explores the implications of project-level decisions on for long-term sustainability. It is used to define and prioritise a portfolio of decision support tools that can be developed to support (project-level) decision-making. From this portfolio, a Multi Criteria Decision Making (MCDM) based tool to support tablet selection has been identified for development. In immature decision environments, the value of the decision tool often lies in the mere conceptualisation thereof, as is described here.

Value and sustainability in development projects

When considering the impact of development projects, the concepts of sustainability and value are often contemplated. Sustainability generally takes a view of leaving the community with something valuable that can be sustained over an extended period of time, while value is often expressed in terms of value for money, which normally represents a donor perspective.

Sustainability in Information and Communications Technology for Development (ICT4D) implementations has been defined as having environmental, economic, social and institutional components (Marais 2014). Other authors omitted environmental sustainability, but added political and technological dimensions (Pade-Khene, Mallinson and Sewry 2011). *Value for money* is a concept that is increasingly being used by development organisations to support decision making for project selection and evaluation. The OECD definition of value for money defines economy, efficiency and effectiveness as key elements (Jackson 2012).

The challenge remains to operationalise these concepts, and to design development projects that will in the long run enable sustainability. Pade-Khene et al. (2011) defined 19 critical success factors for development projects, and linked them to sustainability elements:

	Categories of sustainability[1]				
Critical success factor	**S**	**I**	**E**	**P**	**T**
Simple and clear project objectives	x	x	x	x	x
Approaching the project in a holistic way	x	x	x	x	x
Using ICT to enhance existing rural development initiatives	x	x	x		
Cultivating an enthusiastic influential project champion	x	x	x	x	x
Incorporating socially excluded groups	x				
Incorporating / awareness of specific ICT policy influencing the project		x		x	
A good understanding of the local political context				x	
Significant participation of community target groups in the project process	x	x		x	
Focusing on local / demand-driven needs	x	x			
Building on local information and knowledge systems	x				
Appropriate training and capacity building		x			
Facilitating local content development	x	x			
Existing motivation and incentive for ICT job placement in the community	x	x	x		
Focus on economic self-sustainability – business development			x		
Encouraged local ownership		x			
Building local partnerships	x	x	x		
Choosing the appropriate or right technology	x		x		x
Building on existing public facilities	x				
Ongoing monitoring and evaluation of the project	x	x	x	x	x

Table 1 Linking critical success factors to elements of sustainability

[1] Social (S), Institutional (I), Economic / financial (E), Political (P) and Technological (T)

The above approach is an example of an attempt to operationalize the concepts of sustainability. The factors have been applied to ICT4D implementations in different contexts, including education, with the purpose of indicating the components of sustainability to which attention should be paid, from a project design and project management perspective.

Decision-making as an enabler of sustainability

In the context of this project, decisions are made in an uncoordinated, multi-stakeholder environment. A number of role players, such as national and provincial government departments, make (or do not make) decisions that influence the enabling environment. These include decisions regarding strategies, budgets, standards, curricula and the technology environment. Multiple role players are involved, and the extent of coordination and agreement on goals determine the maturity of the enabling environment. The project team makes decisions that include technology, content and change management. Their ability to make good decisions is determined by the extent to which they understand influences on the project, and its objective within the larger context. Also, multiple organisations fund the project, and funding time frames are not aligned with the length of time that is required to show sustainability.

Given this random and uncoordinated approach to decision-making, sustainability is very difficult to attain. The organisational environment within which the project is rolled out could be considered to be virtual, fragmented and characterised by silo behaviour. The "garbage can" model, as discussed in Turpin and Marais (2004), can be used to describe this environment. In this view, "a decision is an outcome or interpretation of several relatively independent streams in an organisation" Cohen, March and Olsen (1972) as cited in Turpin and Marais (2004). This emphasizes the fragmentedness and random nature of decision-making. The decision environment also includes multiple-perspectives, which are often conflicting *(ibid*).

The view that value is ultimately the sum or outcome of multiple decisions, as cited earlier, is assumed when analysing this project (Blenko et al. 2010). It is assumed that a shared goal of sustainability would be an appropriate objective, and that sustainability can be improved by aligning goals of individual role players and by supporting their decision-making relative to this objective.

A decision-making framework for rural ICT projects

A *decision* can be defined as any conclusion or resolution that is reached after consideration (Oxford University Press 2010). In the context of this work, a decision has been defined as a resolution that has any bearing or influence on the project, made by any role player that is directly or indirectly associated with the project. Decision mapping has been used to understand the nature of individual decision-making, and has also been applied to understand decision-making within organisations (Bouchart et al. 2002). In this case, the aim is to understand the role that decisions made across organisations have on the sustainability of the project and on its impact in the community.

Decision maps have been developed, the aim of which was to identify what decisions are made by whom, and to understand the relative importance of the decisions for sustainability. Maps were developed at the level of the organisational environment, as well as at the project level.

The organisational-level map was developed through facilitated discussions with project team members of the implementing agency. Participants included the stakeholder manager, the strategic manager: ICT for Education, the project manager and the M&E coordinator.

The discussions focused on eliciting their experiences in terms of interactions with the various role players that affect the project, the constraints that they experienced with respect

to implementation of the project and limitations of the enabling (organizational) environment within which the project was implemented.

The map that emerged was used to describe the project implementation environment, and to define inconsistencies in decision making. The map, with associated decision nodes, is outlined in Figure 1 below.

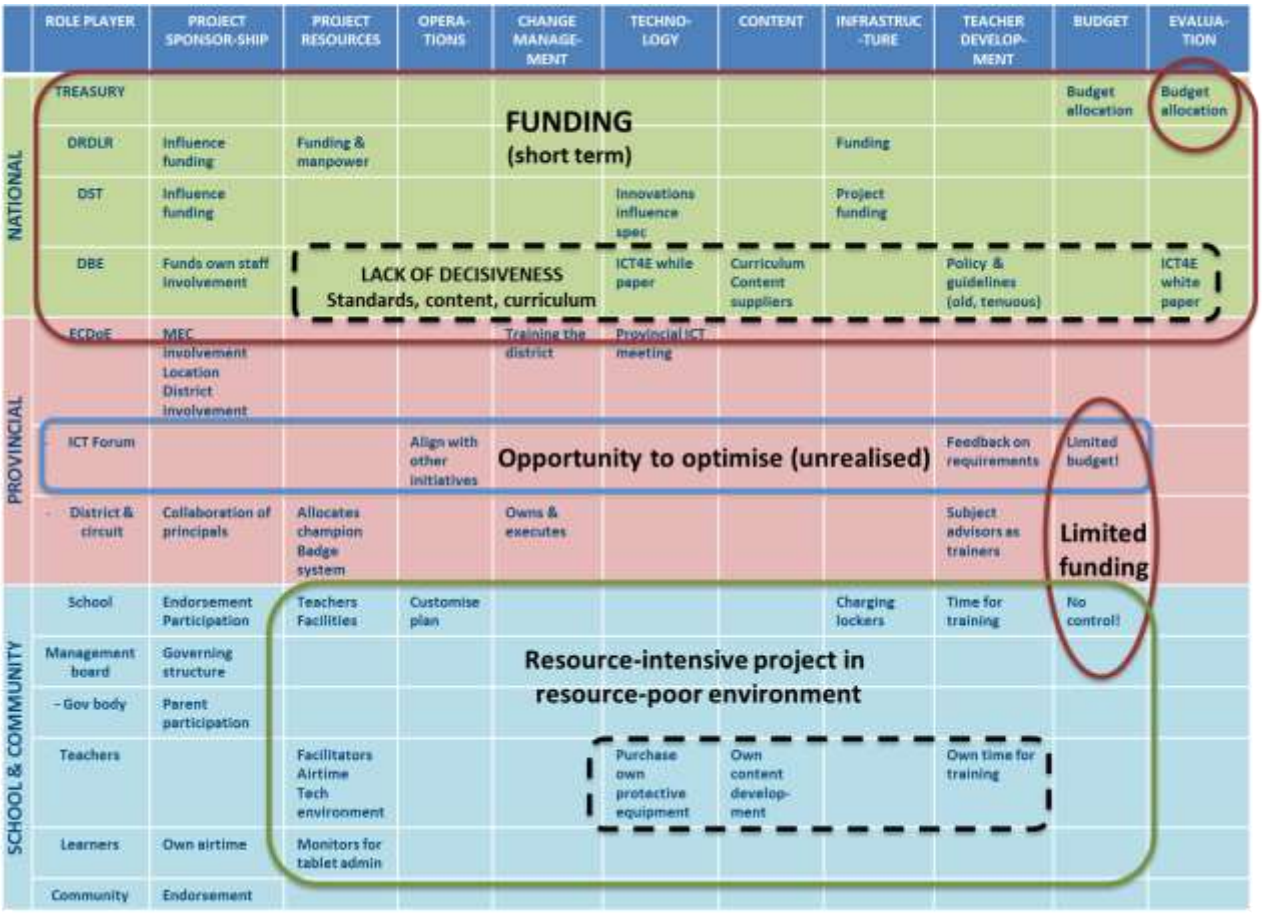

Figure 1 Organisational-level decision map

The map indicates all role players that have an influence on the project (rows), differentiated into role players at school and community, provincial and national levels. The implementation project was structured around 12 different components, and a selection of these provided a means of identifying project areas that are affected by decision making (columns). For each project area, significant effects of role players on the execution of the specific project component were identified. This representation, based on experience and knowledge of project team members, was then used to identify key themes and inconsistencies that affect sustainability.

The development of this decision map served to determine aspects outside the control of the project, which should be managed in order to enhance long-term sustainability. These include:

Inflexible and unsustainable project funding

Sustainability implication: financial, operational

Project funding is allocated at a national level, from a strategic perspective. It has a short-term (three year) focus on implementation rather than on long-term sustainability. The project requires commitment of resources at district and school level, but there is a disjunct in school- and project funding. Funding of the educational system is controlled within pre-defined

budgets, with limited flexibility for re-allocation. The result is that the resource-poor school-, teacher- and learner environment commit some of their own resources for the project to be successful.

Requirement to participate without decision-making power

Sustainability implication: operational, social

The above situation is exacerbated by the fact that end-users and solution owners have limited decision-making power, in terms of project participation and in providing inputs with respect to user requirements. While schools, teachers and learners are expected to participate, they are resource-poor and therefore cannot customise the solution for their specific environment.

Dependencies and risk factors

Sustainability implication: operational, institutional

Project success is dependent on (and at risk in terms of) resources that are contributed at district and school level, especially in terms of reallocation of resources and personal time that teachers commit. The risk of non-participation is increased by the limited involvement of the district / school level in project design and budgeting.

Immature supporting environment

Sustainability implication: institutional, operational, technical

The project is executed in an environment where limited guidelines exist in terms of content creation, technology standards, etc. The project is executed within short time frames, while the supporting environment evolves at a slower rate. Short-term sustainability is dependent on the school and district implementation environment, while long-term sustainability is critically dependent on involvement of the province for the development of a supporting environment. While this provides the project with the opportunity to pro-actively influence the long-term environment (e.g. via technology selection models), it also leaves the environment vulnerable to project-driven agendas, and may result in unsustainable and costly technology ecosystems.

Ad-hoc drivers of decision-making

Sustainability implication: institutional

Decision-making is driven by the agendas and objectives of individual organisations, and of individuals within organisations. A single view of sustainability, and a joint set of objectives for decision-making, does not exist to drive behaviour.

Node for integration and optimisation not functioning optimally

Sustainability implication: institutional, operational, financial

The provincial ICT forum is positioned as a potential node from which to optimise project activities across the province. It has the role to coordinate activities, and to provide feedback in terms of technology and learning requirements of teachers. However, this forum is under-resourced, and hence cannot function effectively to execute this critical role.

The project-based decision environment

Project-based decisions were mapped for each project area. Facilitated discussions were held with project team members and, for each project area, team members were asked to identify decisions that were made, the decision makers, the information on which the decision was made, and the implication of the specific decision. This information was then used to identify the element of sustainability that would be influenced by the decision, and the relative impact of arriving at a "better" decision. This was done subjectively. Decisions that could possibly be enhanced by decision support tools, and that would impact sustainability, were then identified. These are summarised in the Table 2 below.

PROJECT DECISION AREA	WHAT IS DECIDED	POSSIBLE DECISION MODEL	ELEMENT and DURATION OF SUSTAINABILITY			IMPACT
			SHORT TERM	MEDIUM TERM	LONG TERM	
INFRASTRUCTURE	Internet vs. internet-like experience	Total cost of ownership	Operations	Financial	Social (use)	High
TECHNOLOGY	Which tablets to use?	Technology selection (multiple criteria) Total cost of ownership	Financial	Operations (supplier ecology)	Social Institutional	Medium
TEACHER PROFESSIONAL DEVELOPMENT	What training is done at district, school and provincial level respectively?	Cost-benefit Scenario development		Financial	Institutional	High
CONTENT	Internet-like experience? (local content server)	Cost-benefit	Financial	Operations	Social	Medium
	Which content provider to use?	Supplier selection (multiple criteria)	Financial Operations	Operations (supplier ecology)	Supplier ecology	
	Open vs. proprietary content	Cost-benefit Total cost of ownership	Financial Technological	Financial Operations (supplier ecology)	Financial	Medium
OPERATIONAL MODEL	What should the technology support model look like?	Evaluate alternative strategies against total cost of ownership	Financial Operations	Institutional	Institutional	High
	Service Level Agreement – performance parameters	Cost-benefit of different service levels	Financial Operations	Financial Operations Social (use, uptake)	Financial Operations Social (use, uptake)	Medium
RESOURCE ALLOCATION	Number of tablets per school	Resource allocation for optimal impact	Financial Operations	Financial Operations	Institutional Social (use, uptake)	High

Table 2 Project-level decision analysis

The analysis outlined here assisted in identifying project-level decisions that could be supported by decision making, and in the prioritisation of the development of decision models.

Supporting technology selection decisions

The project-level decision map highlighted a number of aspects that could critically influence sustainability. These include technology and supplier selection decisions, as outlined above. Technology selection decisions are central to project- as well as to longer-term sustainability, by its influence on short-term financial sustainability and long-term (social and institutional) sustainability of the project. These decisions also influence the ecosystem of technology that needs to be supported in the long run, as well as issues pertaining to uptake and use of the solution.

Technology decisions require various trade-offs. For example, cost, quality, usability and durability are important. Technology selection is in reality also the selection of a supplier and its associated support environment. This has important implications for total cost of ownership as well as for sustained maintenance. Different criteria have different levels of importance, and an overall definition of sustainability needs to be made explicit when making technology choices.

Multi-criteria decision-making (MCDM) has successfully been used to support technology selection decisions in various environments. These include selection of cloud services (Whaiduzzaman et al. 2014), manufacturing technology (Dhananjay, Kalbande and Thampi 2009) and computer equipment (Özkan, Başlıgil and Sahin 2011). Many applications focus on the role of the supplier as a key factor in selection (Tahriri et al. 2008), and highlight the need for accommodating both qualitative and quantitative criteria (Dhananjay et al. 2009). The full

spectrum of MCDM solution approaches have been applied with success (Whaiduzzaman et al. 2014).

A decision support tool for tablet selection

It is clear that decision-making in ICT4D projects is influenced by a number of role players, and takes place in a relatively *ad hoc* fashion. In the project under consideration here, the decision to procure tablets was driven by the procurement criteria of the implementation agency, which had a relatively short-term cost focus. No clear link was visible to long-term sustainability factors. For example, it was found that more expensive tablets did not necessarily deliver superior performance.

Given the limitations of a short-term focus on procurement, it was decided to explore the value of a multi-criteria approach to decision making (Belton and Stewart 2012). MCDM is considered to be largely concerned with the the deployment of systematic methods to help address problems characterized by incomparable objectives, multiple stakeholders and conflicting interests (Stewart, as quoted by Ondrus *et al* 2012). It therefore seems to be appropriate for technology selection in a multi-actor context where technological consensus is vital for success (Ondrus *et al* 2012). The process of conceptualising a multi-criteria approach to supplier selection proved to be invaluable to the project. A consultative process with the project team was followed, and a hierarchy of selection criteria was defined. The focus was on considering criteria other than cost and technology, and to define criteria relative to sustainability. This led to valuable discussions in terms of the inclusion of a comprehensive set of criteria, which included the following: financial, ecology, supply chain, quality and technical specifications.

The definition of criteria was followed by a process of assigning importance to the criteria, relative to each other. At the highest level, financial considerations and technical specifications were rated by the team to be equally important, making up 50% of the overall importance. The remainder of the categories were equally weighted to make up the balance.

A subset of tablets was identified, and project team members were asked to provide their opinions in terms of the ranking (performance) of the tablets relative to the various dimensions. Each tablet was scored using the ranking assigned by the project team, and the weights that were defined for each category. The relative ranking of the tablets were evaluated by the project team, as a means of validating the weights that were assigned to the various categories.

The value in this conceptualisation of the model was rooted in the fact that it shifted the technology selection decision from a focus on usable, affordable technology to a consideration of factors that influenced long-term sustainability, such as the fit with the ecology of tablets that are in use (which affects the ability to support and maintain the technology), and supply chain issues. The latter included viability and rate of innovation of the supplier, and the degree to which the client will be locked in to use the same supplier in future. Furthermore, the model provides a “screening tool” to protect the long-term sustainability of the project from dumping by suppliers (with the view of gaining free publicity). This in turn enables the problem owner (Provincial Department of Education) to maintain an easy-to-support technology ecosystem in support of long-term financial sustainability. Initially, the model would be employed by the project team to make tablet decisions. As schools increasingly make their own decisions, they would have a means of setting their own priorities and of justifying their decision making.

Conclusion

The implementation of development projects typically takes place within uncoordinated, multi-stakeholder environments. Multiple role players make decisions that influence short-term project execution as well as long-term sustainability. Uncoordinated decisions that are

made against role player goals that are not aligned create a disabling environment that adversely affects sustainability.

An approach was followed to map decisions at an organisational and project level, and to link them to their impact on various elements of sustainability. The project-level decision analysis led to the definition of a portfolio of decision support tools that could enhance sustainability. The conceptualisation of a technology selection tool demonstrated that the focus of project-level decision making can be shifted from a short-term cost focus to a longer-term multi-element sustainability focus.

The decision mapping process highlighted key aspects that adversely affect the long-term sustainability of the intervention in its context. Of particular interest is the dependency on (and inflexibility of) donor funding, as well as the important role of the supporting environment. The slow evolution of the latter creates a constraint relative to the dynamically evolving demands of technology interventions. In addition, the disjunct in resources between the project and its implementation environment results in a drain on an already resource-poor context.

In general, developmental initiatives take place in an environment where decisions at various levels, with varying time frames and scope, influence sustainability. Levels generally include a micro (in this case: community or school), meso (province) and macro (national) environment. The understanding of the interaction between these contexts can be improved by mapping decision making from a systems perspective, and by defining tools and frameworks that can be used to match contexts and support decisions that materially affect sustainability.

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