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THE STOF MODEL AND A DEVELOPMENT-ORIENTED MOBILE INNOVATION

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Abstract

Service innovations in modern economies are driven by the need to gain competitive advantage, technology advancements, market demand and organizational innovation. Uniquely, the need for social development presents opportunities for service innovations in developing nations, particularly in the delivery of social services. The thriving mobile industry in the continent provides new possibilities for development practitioners to design services that might fill gaps in social service delivery for poor communities. The challenge facing development-oriented innovations is sustainability. Sustainability is attained through continuous value generation for users and service owner(s). Proposals to developers of these innovations have therefore focused on business model application and evaluations to ascertain their ability to generate value. The complexity however of service innovation in the modern mobile industry requires a unique perspective of service design and evaluation. This paper introduces the STOF model, a business model framework for mobile service innovations in modern economies to an existing development-oriented service innovation in Uganda. The framework uses the model's four domains (Service, Technology, Organization and Finance) and their relational Critical Success Factors (CSF), to define and evaluate the innovation. These CSF were defined from web publications on the innovation. The evaluation discovered that some of the CSF, due to poor design and strategic decisions, where poorly defined and formulated, which in turn caused an imbalance in the overall business model and therefore value generation.

Keywords: STOF model, Service Innovation, Sustainability

1 Introduction

A major driver for Information, Communication and Technology (ICT) innovation in Africa is development. Under the umbrella term of ICT for Development (ICT4D), pilot projects are continuously implemented in healthcare, agriculture, education and the public sector with the intention of enabling the development process at national and community levels. These development – oriented innovations however, continuously experience sustainability failure (initial success registered, but are abandoned after a year) (Best, 2008; Dada, 2006; Heeks, 2002; Heeks, 2009; Schuppan, 2008) unlike innovations in a market driven environment (Heeks, 2002; Tongia and Subrahmanian, 2006). It is generally agreed that if the number of users and service providers increase from the initial pilot project, the scope of activities or functionality evolves, evident increase in efficiency, and there is visible local and national institutional support, then sustainability has been attained (Bailur, 2004). In a business perspective this is viewed as economic and customer value generation. Economic value is the positive difference between price and cost (price – cost), resulting in sustained profit (Porter, 2001). Customer value is achieved when the needs of a targeted market segment are satisfied. This is measured as the difference between customer perceptions after using a product or service (perceived value) and what they hoped to achieve before consuming the service or product (expected value), resulting in sustained delivered value (perceived value – expected value = sustained delivered value) (Bouwman, Vos, Haaker, 2008). Combined, the economic and customer value create a balanced value chain between end-users / customers, and the ICT4D service providers. ICT4D sustainability therefore means a visible growth and maturity of the solution, supported by its ability to continuously generate value for the users and providers.

The documented reasons for the breaks in the value chain in these innovations are summarized by (Heeks, 2002) as "design – reality gaps". He identifies three areas where gaps are commonly found. Hard and soft gaps which are evident in technology designs not applicable to social contexts of users. Private and public sector gaps experienced when innovations developed for a market-driven private sector are expected to produce the same results in a development-focused sector. Country context gaps exist when innovations designed for developed nations and are transferred and expected to function in developing nations with differing social, institutional, and infrastructure set-up. These gap scenarios are partly attributed to the implementers. ICT4D implementers have been accused of accompanying their creations with "hype" rather than practical evaluations to ascertain value creation (Heeks, 2009, Mecheal et al, 2010). Without an indication of their investment worth, private sector interest in ICT4D is none existent (Labelle, 2005; Warnock and Sarkar, 2004). Their investment interest is necessary for service expansion, both geographically and client/user-base. So far, private sector participation has been limited to obligatory contributions to ICT development funds for rural and poor communities under the universal access regulation objective (Labelle, 2005; Warnock and Sarkar, 2004).

Proposals and activities in the field are now focused on three general areas in developing sustainable innovations; technologies (mobile phones, radios) and applications (SMS and voice communication) that are already in use, greater attention given to the application process and development of business models, and the evaluation and assessment of applications/innovations (Heeks, 2009; Mecheal et al, 2010). The need for theory application has also been a point of focus. In longitudinal studies on ICT4D, the University of Manchester's Development Informatics Group, have attempted to demonstrate to ICT4D researchers areas theory can guide and support the overall field; creating competitive advantage within the IT sector using the Competitive Advantage theory (Heeks, 2006), successful implementation of ICT in the public sector with the Actor-Network theory (Stanforth, 2006), understanding who stakeholders are and assessing what has been done with them using the stakeholder theory (Bailur, 2006) and providing an information-centred understanding of ICT and obtaining a broad and systematic understanding of poverty using the livelihood framework (Duncombe, 2006).

With the mobile industry boom in Africa, the hope in this device has spurred service innovations in the public and social service sector, especially in the late-2000s (Heeks, 2009). Mobile applications have been used by farmers in making inquiries on food market prices, reminding HIV/AIDS patients' times for their daily dosage intake (Heeks, 2009), administrative and academic support in distance learning education for university students, lecturers and

administration staff in South Africa (Brown, 2003), and reporting violence confrontations. However, sustainability still remains elusive even for this widely used technology (Mecheal et al, 2010). This paper will therefore apply two of the proposed suggestions. Using a business model framework, the paper will map out and evaluate the economic and customer value or lack of in a current innovation. This will be attempted in two phases. In the first phase, the STOF model will be presented. Its four domains (Service, Technology, Organization and Finance) will be used as a framework to present an ideal value generating service innovation. In the second phase an existing mobile service innovation in the healthcare sector that has experienced sustainability failure will be analyzed, using the CSFs as the criteria "touch stones" for evaluation. This process will trace the intended and delivered economic and customer value and the existing gaps. A conclusive discussion will suggest how these gaps might be closed. First however, the methodology used is described below.

2 Methodology

Publications on the innovation are the main source of data that are used to define and evaluate. Web searches included search engine Google Scholar, and academic publishers and online databases like Wiley Online Library, Springer, Sage, Oxford Journals, Emerald, EBSCO and Jstor. The search process began with trying to identify a specific mobile innovation. So search terms included "mobile applications in developing nations", mHealth, e-health, e-government. On identification of a specific innovation, the Uganda Health Information Network, an mHealth solution in the Ugandan healthcare system, the search narrowed down to publications on the innovation. The search process was then directed to the IDRC website and publications, because the innovation is funded by the organization. This search produced the evaluation report by the designers and implementers of the innovation, the Academy for Educational Development (AED) AED – SATELLIFE and Uganda Chartered HealthNet (UCH). However, independent publications were necessary, and the search produced four (4) publications that specifically evaluated or included the innovation in their analytical discussions (including Haines, Kuruvilla & Borchert, 2004; Lucas, 2008; Rashid & Elder, 2009; Mechael et al, 2010). These findings combined were used to describe and define the CSFs of each domain of the innovation's business model and the independent articles together with related literature were used to evaluate the CSFs. In the next sections, the evaluation process of the innovation is presented.

3 Phase I - Service Innovation and the STOF model

To introduce a business model to an ICT4D artefact requires a business perspective of the ICT4D its self - viewed as a service innovation. A service is a process containing intangible and interactive activities between customers and employees of an organization. These interactions may use resources, goods or systems of the organizations and the processes or service as a whole are provided as a solution(s) to customer needs (Gallouj, 2002; Bouwman, Vos, Haaker, 2008). An ICT4D as a service provides solutions to a rural community and / public service facilities / organizations' service needs. Innovation in the modern economy is viewed more than just creating wealth through new products, methods of production, sources of supply or markets in a closed organization, but in an open, dynamic and complex environment with and across organizations. It involves sharing of knowledge, resources and capabilities (Bouwman, Vos and Haaker, 2008; Chen, Tsou and Huang, 2009; Dorner, Gassmann and Gebauer, 2011). This definition of a service innovation in today's economies provides background knowledge of the complexity of service design. The ICT4D innovations are operating in complex environments. An ICT4D service innovation is not solely in the hands of an NGO, a government department or organization, but depends on a mobile network for access, donor organizations for initial funds, developers and implementers for design decisions and strategies etc. The actors and stakeholders have multiplied. It is important to use a business model framework that will accommodate the current complexities experienced.

The STOF model was an outcome of modern research in the area of telecommunication, specifically, in the mobile industry and open innovation. Its purpose is to provide a foundation for design of successful mobile service innovation (Bouwman, Vos and Haaker, 2008). Recognizing that innovation in the modern economy is not a closed affair of a single organization, but collaboration between several organizations, the STOF model was developed to provide a framework that accommodates this new complex and dynamic development. Four interdependent domains (Service, Technology, Organization and Finance) each presenting Critical Success Factors (CSF) with a cause/effect

relationship guide service designers in developing a viable business model for a new or existing service. Below is a generic presentation of the STOF model with a summary of the CSF.

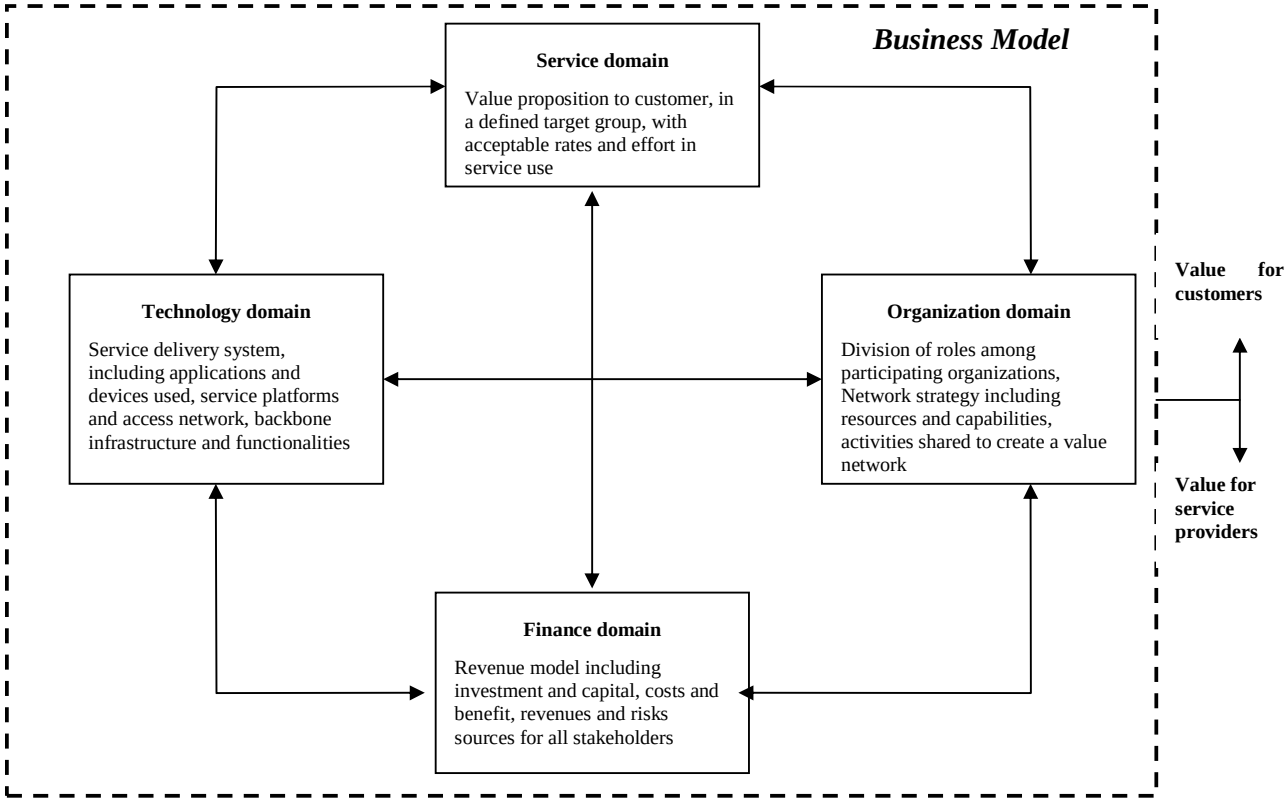

Figure 1: A generic STOF model framework, demonstrating domain CSFs that influence value creation (Bouwman, Vos and Haaker, 2008).

In the service domain, the model provides a set of CSF to ensure that service design defines the service according users' needs, does offer value to a specific target group at an acceptable price. These then influence, selection and architectural design of the technology domain. Appropriate functionality design to match service definition, selection of devices and applications that match functional needs and are familiar to or can be easily adopted by the target group, service platforms and network access providers that accessible and affordable to the users and new service owners are some of the design decisions made in this domain. Identification of appropriate organizations that can provide and support the service, leads to formation of the organizational domain. These may be selected depending on their capabilities and available resources to support the service and the technology domain. Collaboration is thereafter agreed upon by the selected organizations, specifying the contribution (resources, activities) of each member, as well as the sharing of costs and benefits. The design activities of these three domains (Service, Technology and Organization) then help to formulate the revenue model. A designer is able to determine who the long term investors will be, the cost of investment - technology, where revenue will be generated from – who will pay for the service, and acceptable risks that the investors might anticipate. The following section will use the logic of the framework to trace the relational effect of some of these CSF on an existing mobile innovation's ability to generate value.

4 Phase II – A development-oriented innovation in the STOF model

4.1 Service: Service Description, Service Context, Market Segment, Value proposition, Service experience, Rates and Effort

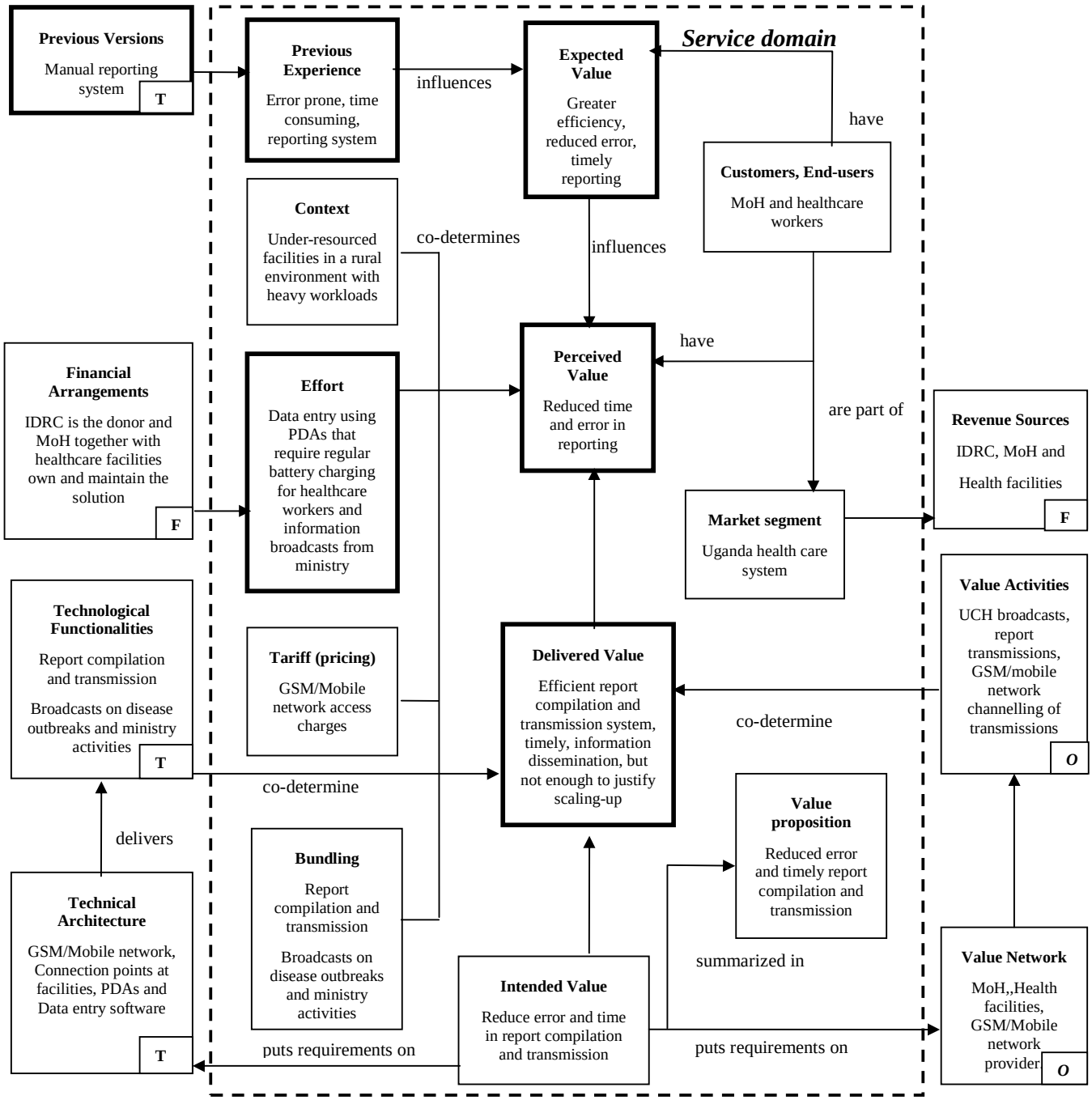

Figure 2: Service Domain Model for Value Generation (Bouwman, Vos, Haaker, 2008)

Figure 2 above provides a detailed description of the Uganda Health Information Network (UHIN) service, a joint project between SATELLIFE, The Uganda Chartered HealthNet (UCH), the International Development Research Centre (IDRC), and the Ministry of Health (MoH) (AED-SATELLIFE & UCH, 2007; Lucas, 2008; Mecheal et al, 2010). The service was implemented in two district healthcare facilities (Mbale and Rakai) (Lucas, 2008) in the first

phase (AED-SATELLIFE & UCH, 2007). The innovation is intended to overcome the tedious and untimely report compilation and transmissions of MoH data forms by the health workers at the district and community level and to allow information dissemination on disease outbreaks and ministry activities to the healthcare workers from the UCH (Lucas, 2008; Rashid and Elder, 2009). The healthcare facilities are geographically isolated not only from each other, but also from the central MoH offices in Kampala. They do however operate in a Primary Health Care (PHC) referral structure (WHO, 2010). This structure is arranged starting with the most basic healthcare services at the village with Village Health Teams (VHTs), Health Centres at parishes and sub-county level, and hospitals at county and district level. Health Centres and hospitals together with VHTs are expected to report to the central ministry offices, while expecting communication and information to flow back. The project solution therefore provides a two-way timely channel of communication for the participating districts and the ministry headquarters (Rashid and Elder, 2009). In figure 2, the CSFs within the boundaries of the diagram are the core of the service definition. The CSFs on the left and right of the diagram are the CSFs belonging to Technology, Finance and Organization domains that will affect and be affected by the core service CSFs.

Within the service domain boundaries we see that health care workers as the primary data entry actors and recipients of broadcasts are defined as end-users of the solution. The MoH together with the healthcare facilities are both the customer (charged for use of the service) and owners / service providers (maintain the service). Although the innovation's designer and driver was SATELLIFE and IDRC's donor support initiated the implementation, MoH is expected to maintain and scale-up the service to other districts. The facilities and healthcare workers are expected to operate this service in a highly unstable environment. Existing literature on the service does not indicate user - context evaluation on the project. However, general literature on work-environment and social/cultural conditions of rural healthcare facilities in Africa indicates an overworked, under-resourced and understaffed context (Mecheal, 2009). The facilities also operate in impoverished communities with limited infrastructure (roads, electricity, water, telecommunications etc). These conditions contribute to overall inefficiency in the healthcare system (Lucas, 2008; MoH, 2010). In figure 2, the inefficiencies of the reporting system are the only documented perceptions represented in the CSFs Previous Experience and Expected Value. These influenced a technological design based on two service functionalities; data entry and transmission, and information broadcasts.

The Delivered Value CSF reported a 100% compliancy rate in disease prevalence reporting and 25% more benefits of the service in comparison to the former manual reporting system (AED-SATELLIFE & UCH, 2007). MoH however demonstrated an unwillingness to support the expansion of the service to the remaining districts. A possible explanation for this probably falls in two areas; cost and perceived value. The service experienced high recurring communication and transmission costs that were twice more expensive than previous service cost (Lucas, 2008). The initial implementers SATELLIFE, UCH and IDRC have continued to support and expand the service (AED-SATELLIFE & UCH, 2007). In addition, despite well-documented inefficiencies, designing a two functional system does not demonstrate a well though out systems design. (Mecheal et al, 2010) argues that such designs limit the potential and benefits the innovation can provide. It is also important to note that the healthcare workers' role as end users is in reality passive, as the system requires them to pass on data and receive data only. A thorough analysis of needs and processes (Previous Version) at the healthcare facilities might have produced more functionality and therefore more value to the system and service design. These would in turn have justified MoH including expansion and scaling up of the service in its budget in the Revenue Sources CSF. It becomes more evident that the user context was not thoroughly examined when charging of PDAs was cited as a challenge for end-users in an environment with limited access to electricity infrastructure (Lucas, 2008; Mecheal et al, 2010).

4.2 Technology Architecture Description, devices, applications, access network and backbone infrastructure.

The service uses the GSM/mobile network as the backbone infrastructure that transmits communication between health facilities and the central MoH office in the Kampala city. This network is accessed using wireless access points at the healthcare facilities called "Jacks" that provide connectivity for 200 Personal Digital Assistants (PDAs) with customized software for data entry and transmission of softcopy forms. The "Jacks" were later perceived to be inadequate and were replaced by more expensive equipment. Figure 3 presents within the boundaries of the diagram,

CSFs that make up the technology design and architecture. On the left and right of the diagram are the influencing CSFs from the Organization, Service and Finance domains. The direct influence the Technology Architecture CSF has on the Cost CSF in the Finance is presented here, and the heavy influence SATELLIFE had on design decisions such as the device, service platform (Lucas, 2008; Rashid and Elder, 2009; Mecheal et a, 2010) is evident in from the Actor CSF on the left. A single CSF within this domain is allocated to MoH and the health facilities concerning Data entry and reception.

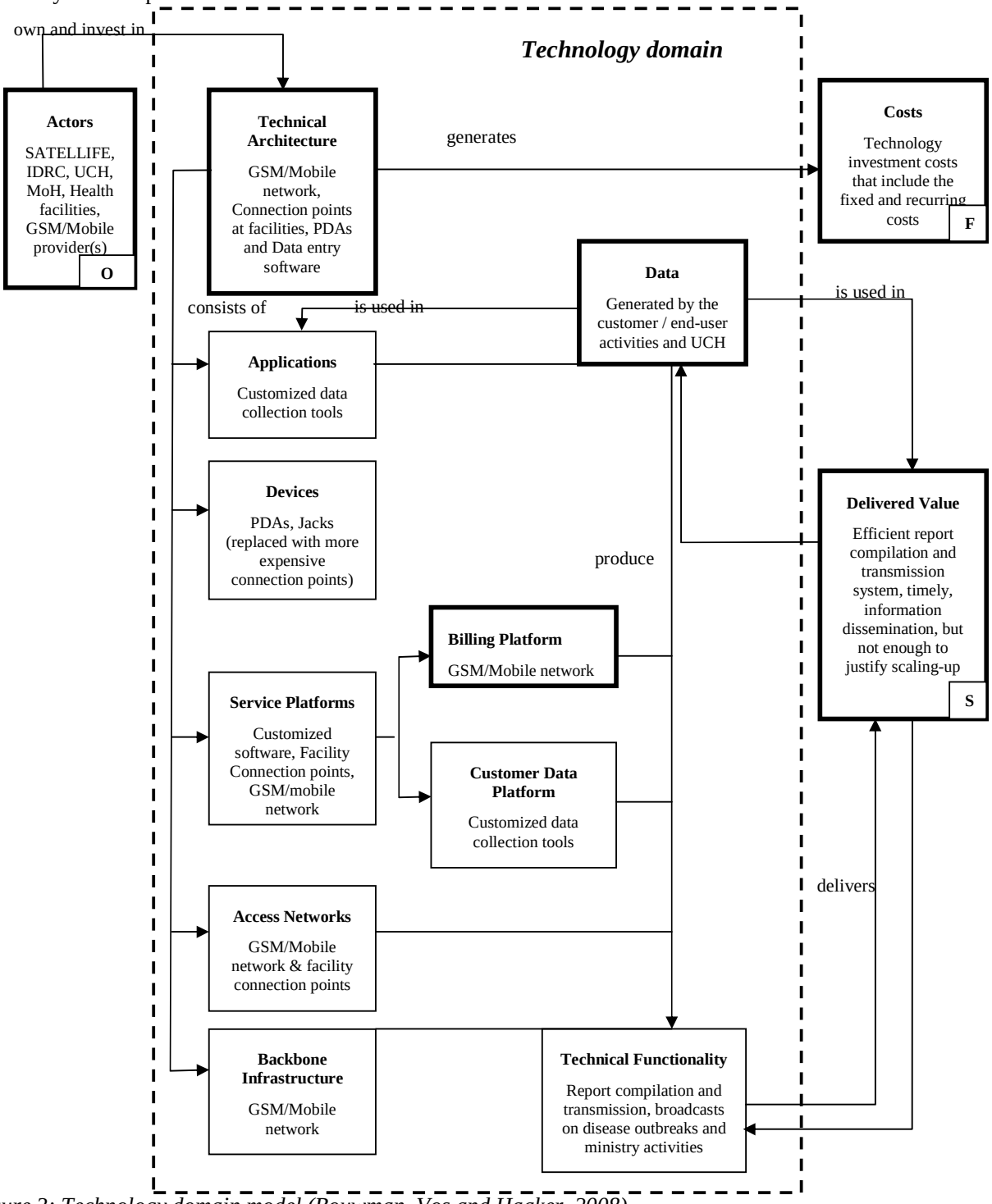

Figure 3: Technology domain model (Bouwman, Vos and Haaker, 2008)

The service owner's featured role in this domain is limited, and the dominant player seems to have made expensive technology selection for a development oriented solution and context. (Lucas, 2008) argues that one point of failure can lead to total failure of the entire project. This is especially significant for this project because, the technology was discovered as the highest source of financial risk and may have compromised the perceived value of the customer (Lucas, 2008). (Mecheal et al, 2010) points out that alternative mobile phone technologies (basic SMS and voice) have been tested although comparison has not been made to determine strengths and weaknesses. Further more, the mobile phone provider is also a passive player in the participating organizations, and yet the service depends on the billing platform of the same network. In the tests mentioned by (Mecheal et al, 2010) with mobile SMS and voice services, communication costs also were discovered to be prohibitive as they were in this project (Lucas, 2008). The Billing Platform CSF as is presented in figure 3 influences the Cost CSF in the Finance domain through the Technology Architecture CSF. It therefore follows, that it is necessary for designers of the ICT4D should consider including all participants in the organizational negotiations to balance out costs.

4.3 Organization Description of roles, Capabilities, resources and the value network

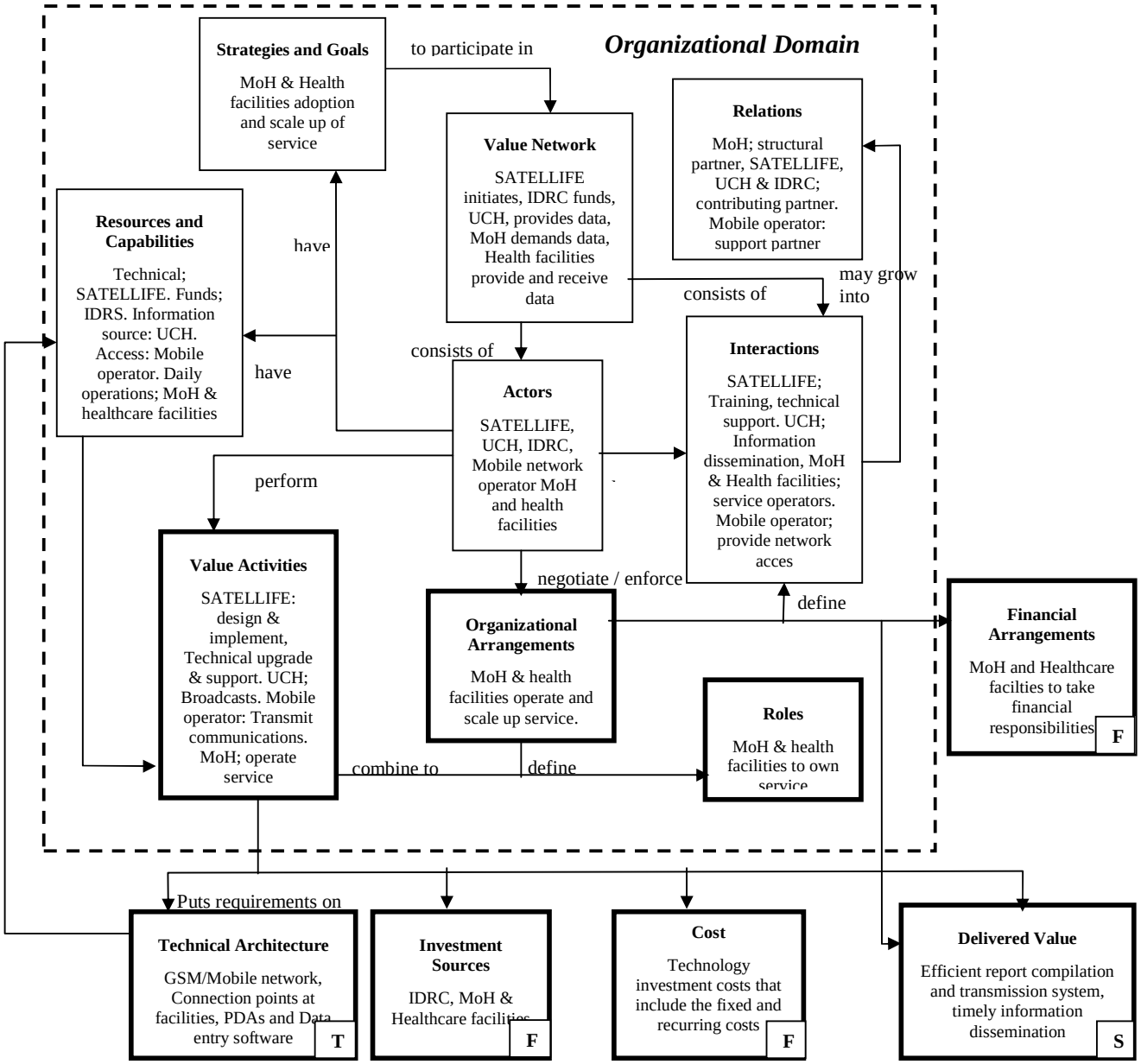

Figure 4: Organization model (Bouwman, Vos and Haaker, 2008)

Figure 4 demonstrates the core Organizational CSF and the Technology, Finance and Service CSF that influence or are influenced by the Organizational CSF. The figure demonstrates the effect the unbalanced roles and responsibilities of the participating organizations have had on the four-major CSF previously discussed; Technology Architecture, Cost, Investment/Revenue Sources and the Delivered Value. The central role of design and implementation done by SATELLIFE with financial support from IDRC (Lucas, 2008) is elaborated. SATELLIFE also took on the role of supplier, trainer and technical support (Lucas, 2008; Rashid and Elder, 2009). MoH together with healthcare facilities were assigned the role of service operators and owners, while the GSM/mobile operator(s) provides access to a network backbone. Imbalance in the organizational domain is evident with decisive CSFs (value activities, resources and capabilities) dominated by the contributing partners (SATELLIFE and IDRC), while the resulting CSFs are to be shouldered by the structural partner (MoH and Health facilities).

SATELLIFE has taken on the responsibility of making heavy financial decisions on technology selection, training, technology upgrades, while MoH and the facilities are expected to pick-up the long-term financial responsibility. A structural partner (MoH and the healthcare facilities) is central in carrying on the service long after design and implementation. This partner should be in the driving seat, making or contributing to the design decisions that they can comfortably sustain overtime. The facilities and MoH activities do not demonstrate a "sense of ownership" with core support value activities taken on by SATELLIFE. Reliance on SATELLIFE for the continued technical survival of the service creates risk for the customer who has no control over this technology. The healthcare facilities do not seem to posses any capabilities of in-house maintenance of the service. Further more the supporting partner (the mobile network operator) is not evident in the value network. This provides a probable explanation for a lack of the negotiations in the Organizational Arrangement CSF that could have contributed to the excessive tariffs earlier discussed. Participation of the mobile operator while formulating this CSF may have assisted in negotiation of affordable rates.

4.4 Finance Investments, Costs, Revenues and Risks sources

The financial model is a direct result of the three previous domains as demonstrated by the Organizational, Technological and Service CSFs influencing the Financial domain CSFs in figure 5 (Value activities, Technical Architecture, Delivered Value and Market segment). Starting with service design that focused on two basic processes rather than opportunity and benefit creation, a technology selection and architecture dominated by a single participant, and an unbalanced value network with the core participant and key stakeholder(s) playing a passive role, the financial model demonstrates an unfair investment situation and risky view of the service. MoH and healthcare facilities were asked to continue investment into a service innovation that performs basic functionalities that could have alternatively been done using cheaper and equally efficient technologies (Mecheal et al, 2010). The "push" CSFs (Sources of Investments, Costs, Revenue and Risks) are controlled by the contributing partners, while the "resulting" CSFs (Investments, Costs, Risks) are the responsibility of the structural partners whose resources and capabilities cannot support them. (Lucas, 2008) indicates that it was expected of government to take on the responsibility of scaling-up and running the service at annual cost up to US$5m from an overall US$150m health budget. This together with the registered technology / device failures and ineffectiveness (Lucas, 2008; Rashid and Elder, 2009; Mecheal et al, 2010) raised investment, costs and risks. In the end, the service value was undermined by its cost (Price CSF).

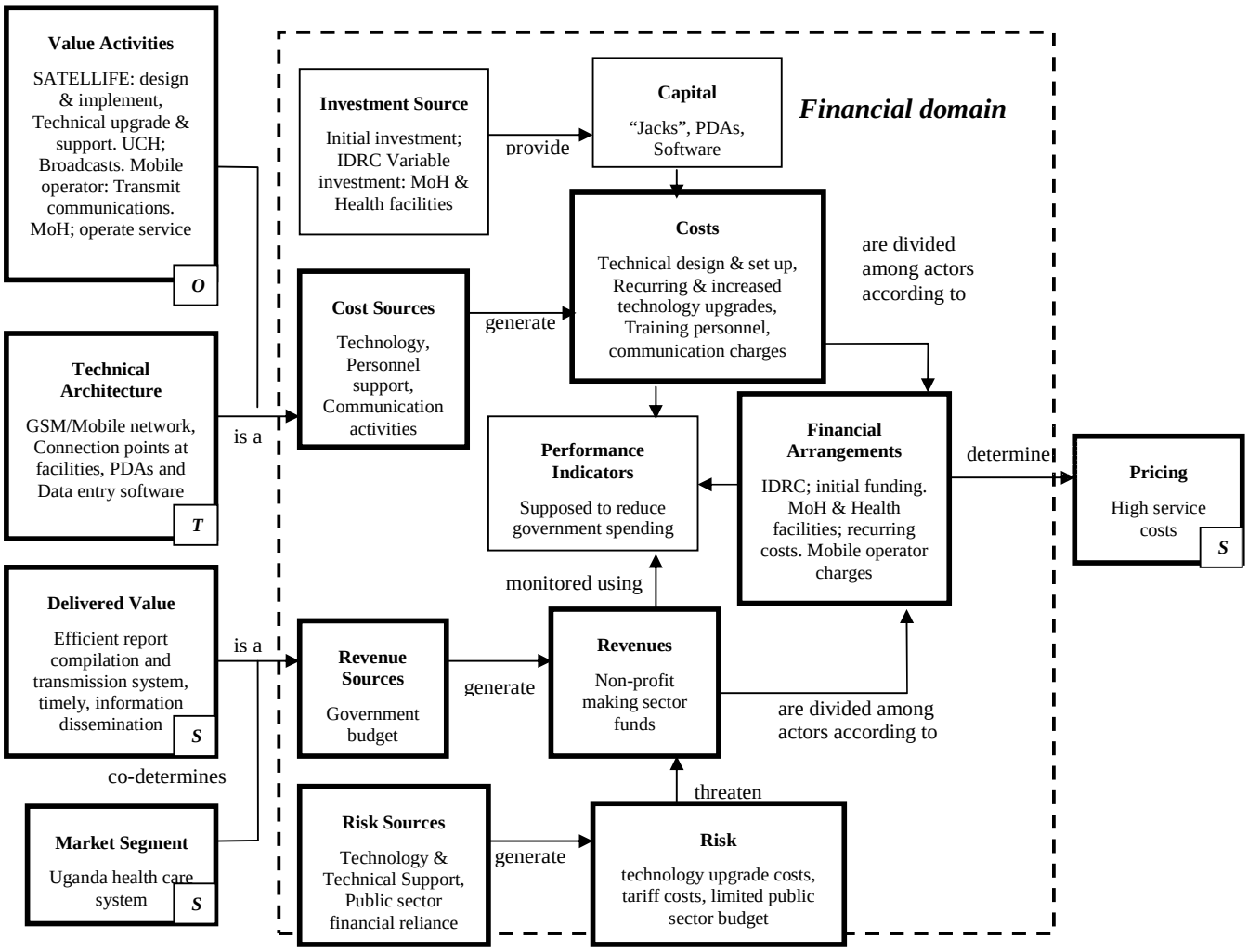

Figure 5: Finance model (Bouwman, Vos, Haaker, 2008)

Drawing on the four domains, the combined lack of sufficient Delivered Value in the Service domain in figure 2, and unaffordable pricing in figure 5 above, the overall business model failed to provide a balanced customer and economic value chain for MoH and the healthcare facilities.

5 Conclusion

Starting with the service domain, although benefits were registered, the value proposition was not achieved because the implementation process did not make a through analysis when designing the service. (Haines, Kuruvilla & Borchert, 2004; Lucas, 2008; Rashid & Elder, 2009; Mechael et al, 2010) unanimously state that there is need for more evaluation of this innovation and others to justify their value to the public sector. Context, end-users, customer(s), needs and processes, and technology were not adequately identified and defined. This was the primary reason the innovators (SATELLIFE) neglected to take into consideration the ability for MoH and the healthcare facilities as the customers to meet the service costs. As a direct consequence, the technology domain suffered poor technology selection and architectural designs. The additional technical infrastructure costs aggravated the value proposition. Appreciation of the complexity of this particular service was not evident. Partner selection in the organization domain was imbalanced with the core organization structures (MoH and healthcare facilities) playing a passive role in the value network. Potential stakeholders (GSM/mobile network operators) did not feature in the

collaboration and this affected communication costs. These areas caused a failure in value generation and therefore affected the revenue model of the service innovation.

In the chain of value generation, the three domains of Service design, Technology and the Organizational value network presented gaps and poor design decisions made by the implementers of the project. Complexities of modern service innovation and open innovation in the mobile and wireless industry need a dynamic model framework to guide design and evaluation. The relational CSF, their cause/effect results can make or break a service. The STOF model offers such a framework, offering a holistic view of the service and its social, organizational, political and economic context. Evaluation is key in service innovation. Without this view, objective evaluation is impossible to attained.

However, the area this paper focuses on (ICT4D and development) should not be compared to or mistaken to be the competitive, market driven private sector. Strategic design and evaluation must approach it as such (Norris, Stockdale and Sharma, 2009). In many ways, the gaps identified in the UHIN are (Heeks, 2002)'s "design reality" gaps. The call for development and technology theory application in ICT4D design and analysis finds a knowledge gap in this project design. Could a stakeholder analysis framework have offered a better foundation for organizational value network? Could the livelihood approach have provided a more information centred innovation design, offering more opportunities and benefits for MoH and the healthcare facilities? These questions can only be answered if ICT4D research begins to apply development theory. While we struggle to attain financial sustainability, it is important to remember that value in the social and public sector is development, not profit.

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