VRIJE UNIVERSITEIT AMSTERDAM

MASTER THESIS

Modeling ICT4D Business cases using the *e*^{3}*value* Methodology

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I, Reshmi Sarkar
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Abstract

Information Sciences
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Modeling ICT4D Business cases using the e^3*value* Methodology

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With the rapid evolution of Information and Communication Technology for Development (ICT4D) have paved the way for providing e-services in resource poor environments. The sustainability of these services are not only challenged by the low literacy levels of people, poor infrastructure and limited purchasing power of these nations but also the limited capability of conceptual tools to asses the sustainability of these services before their deployment. The e^3*value* methodology is one such tool for understanding the sustainability and feasibility of a business idea. The aim of this research project is to explore whether the methodology is capable of modeling ICT4D business cases and how the improvements are suggested to make this methodology usable for such cases. In this paper, a new construct of "Community" has been proposed after identifying shortcomings in modeling techniques by modeling various ICT4D projects and interviewing existing users of the tool. The proposed improvements enabled the tool to capture certain socio-economic relationship which were previously not included.

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List of Abbreviations

ICT4D	**I**nformation and **C**ommunucation **T**echnology for **D**evelopment
BMC	**B**usiness **M**odel **C**anvas
REA	**R**esource **E**vents and **A**gents
NGO	**N**on- **G**overnmental **O**rganisation
m-Milk Service	**M**ali **M**ilk **S**ervice
FB	**F**oroba **B**lon

Chapter 1

Introduction

As information and communication technologies for development (ICT4D) is evolving, it promises to bring a new arena of possibilities for the poor in the developing countries. The question that lies ahead is why should we prioritize [Heeks, 2008] the needs of the poor instead of serving the needs of the world's wealthier corporations and individuals which would reap money multiple times. At first place, because we all are humans and everybody should have right to access technology and to be able to enjoy its benefits. Secondly, working for the developing countries, say in building a system, is far more challenging and satisfying as compared to working for a globalized world.

These two reasons have paved the way for providing e-services in resource poor environments such as in developing country of Mali in Sub-Saharan Africa. The sustainability of these services are challenged by the low levels of literacy of people, poor infrastructures and limited purchasing power of these nations [Bon, Akkermans, and Gordijn, 2016]. Although the challenges impose significant threats on the ICT deployed technologies, yet the needs of the locals have served as a constant motivation for further research into developing ICT services in low resource areas.

In ICT4D systems there are stakeholder or, as we all call them, actors, involved in the system. An ICT4D e-service or business case is sustainable only when the actors involved in the service are able to make profit in the long term by working together and contributing to value co-creation. The e^3value methodology is a conceptual modeling tool for understanding the feasibility and sustainability of a business idea. The aim of this research project is to explore whether this methodology is capable of modeling ICT4D business cases and if not how can the methodology be improved to make it usable for ICT4D business cases.

This chapter provides the context of the research, introduces the problem statement, the accompanying research questions and the research approach that is undertaken to find answer to the research questions. The problem statement is decomposed into six research questions. Each of the research questions is taken and the activities that will be performed to answer that question are stated in the research approach.

1.1 Context

As [Gordijn and Akkermans, 2003] explains, products or services, for instance a voice-based micro-blogging service called Foroba Blon, are offered by value webs which comprises of organizations. This service ["e-Service Innovation in Rural Africa Through Value Co-creation"] allows the locals living in the village of Mali to broadcast voice message on radio using mobile phones. The value webs consist of actors or stakeholders who have an interest in the service such as radio listeners, NGOs,

village reporters and so on. All the actors seek to gain profit in some way by exchanging objects of economic value with each other and hence for an e-business idea to succeed there must be profitable value propositions to actors. In general, for ICT4D services sound and profitable value propositions must be maintained.

The authors of [Bon, Akkermans, and Gordijn, 2016] have proposed a framework to develop ICT4D services in low resource areas such as rural Africa. The framework bridges the gap between the deployed technologies and the needs of the people. This gap, along with other reasons such as the inability of the developers to understand the context and to make implicit assumptions, the use of the traditional waterfall approach in a dynamic context, contributed to the failure of several ICT4D deployments which resulted in unsustainable solutions. With challenges such as scarce or no electricity, limited or little access to internet and computers, very low literacy rate combined with diverse local language which are far fetched by computational means, the framework covers the complete life cycle of ICT service development.

The framework consists of five components: (i) context analysis, (ii)needs assessment, (iii) use case and requirements analysis, (iv) developing, testing, deploying , (v) sustainability assessment. Context analysis is the first important component of the framework. The context must be understood both by the end user and the developer of the service. The second component is needs assessment which reflects the comprehension of the needs of the user. As users are unaware of the potential of ICT they must be given demos about ICT4D services such as voice based communication system, encouraging them to brainstorm about limitations that might be solved with technologies. The third component is use case and requirement analysis which elicits the user requirements from the stories collected and the business ideas. The fourth component is development, test and deployment. The final and most important component of the framework is sustainability analysis. This work focuses on the fifth component of the framework which is understanding sustainability of an e-service ICT4D. As with any business, being able to gain profit in the long term leads to the success of the business. Consequently a business is sustainable only when the participating enterprises are capable of making long term profit ["e-Service Innovation in Rural Africa Through Value Co-creation"]. For sustainability of such services, the ICT developers, local users and business partners must work together and eventually contribute to value co-creation. Understanding value is of crucial importance. For instance, a farmer in Mali who is using the voice based messaging service for receiving market information will only use and pay for the service is it is creating value for him. ICT4D [Gordijn and Akkermans, 2003] services consist of actors/stakeholders who form the networked value space constellation. For evaluating a networked value constellation the e^3value methodology Gordijn and Akkermans, 2003] is used. The e^3value methodology [Gordijn and Akkermans, 2014] involves a number of steps: stating ICT4D idea, representing the idea as an e^3value diagram, assigning numerical values to the e^3value diagram, assessing economic sustainability and performing sensitivity analysis. This work focuses on the first two steps stating the ICT4D idea and representing the idea as an e^3value diagram. The next phase of this work to evaluate the e^3value methodology to check whether the methodology is capable of modeling ICT4D business cases. This is followed by suggesting improvements over the methodology to make it usable for ICT4D business cases.

1.2 Problem Statement

The *e*^{3}*value* methodology [Gordijn and Akkermans, 2003] provides means to explore value webs. Value webs consist of organizations or enterprises who offer a service to the market. The *e*^{3}*value* methodology makes the exploration of a networked business idea easily comprehensible. The aim of this research project is to explore whether this methodology is capable of modeling ICT4D business cases. ICT4D systems aim to provide services in low resource areas where major need for such services have surfaced. The main question for this research therefore is:

"Can the *e*^{3}*value* methodology be used to understand ICT4D business cases?"

In ICT4D business cases, the actors participating in the value web do not always necessarily expect something in return. For instance, a NGO working for the welfare of the farmers in order to make sure their harvest is sold out, might not expect things of economic value in return. In such a case, the question is whether the *e*^{3}*value* methodology be sufficient to model this business case?

1.3 Research Question

Having identified the problem, the research questions are formulated by decomposing the problem statement.

1. What is ICT4D?
2. What is the *e*^{3}*value* methodology?
3. What specific business model requirements hold for ICT4D project?
4. How can the *e*^{3}*value* methodology be improved to make it usable for ICT4D?
5. How can the suggested improved techniques be tested to demonstrate its usefulness?

1.4 Research Approach

In order to find an answer to the introduced problem statement and the accompanying research questions, a 5-step plan set up. A pictorial representation of the research approach is presented in Figure 1.1 which illustrates the research steps that are going to be performed and which subsequent research questions will be answered.

Step 1: Perform literature review to understand the *e*^{3}*value* methodology and ICT4D. For answering the first and second research questions that is "What is ICT4D?" and "What is the *e*^{3}*value* methodology?" a thorough literature review is performed. The first step of the research approach is to understand what ICT4D is and develop an *e*^{3}*value* model to understand the *e*^{3}*value* methodology.

Step 2: Elicit requirements for ICT4D business value modeling and develop a case study. The outcome of the first step is comprehending ICT4D and the *e*^{3}*value* methodology. However the aim of this research project is to understand whether the *e*^{3}*value* methodology can be used to model ICT4D business cases. In order to achieve this goal, it is essential to answer the third research question which is finding out "what specific business model requirements hold for ICT4D project?". The activity performed for answering this research question is interviewing people who are working in the field of ICT4D projects and as well as the people who have created the *e*^{3}*value* tool.

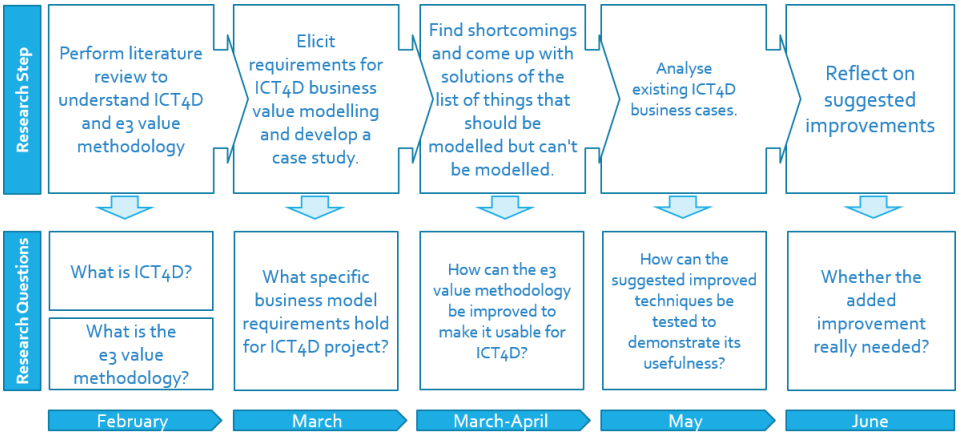

FIGURE 1.1: Pictorial representation of the research approach

Further, a case is developed and is modeled using e^3value methodology to validate the theoretical learning obtained from literature review. The case that is selected for this purpose is The Mali Milk Service 3.0 (Work in progress) which is a a voice-based milk selling and farmer networking platform for Tominian Mali. Some crucial problems such as lack of communication between milk producers and buyer, irregular milk productions have motivated the system (m-Milk) that has been developed. The principle business idea behind the proposed system is to enable farmers sell their produced milk to greater audience. From the output of the interview, the Mali Milk service case is analyzed to incorporate the findings of the interview. The aim of this step is to have clear understanding of what to look out for while finding the short comings of the tool if there are any.

Step 3: Find shortcomings and come up with solutions of the list of things that should be modeled but can not be modeled. With the requirements for ICT4D business value modeling at hand and after analyzing the Mali Milk service case, the next step in the research approach would be to find the shortcomings in the methodology and come up with solutions of the list of things that should be modeled and cannot be modeled. By finding the shortcomings in the methodology, the fourth research question is answered that is "How can the e^3value methodology be improved to make it usable for ICT4D?"

Step 4: Validate the e^3value improvements by means of already existing ICT4D business cases. Once the requirements for ICT4D business value modeling have been elicited, existing ICT4D business cases are analyzed. The aim of this step is to validate if the processed solutions work for other cases than the Mali Milk Service case. The cases to be analyzed are Foroba Blon ["e-Service Innovation in Rural Africa Through Value Co-creation"] and e-Commerce project for the Penan community in Long Lamai, Miri, Sarawak, Malaysia[Shiang et al., 2017]. This step serves as the foundation for answering the fifth research question "How can the suggested improved techniques be tested to demonstrate its usefulness?".

Step 5: Reflect on suggested improvements. The final step in the research approach would be to reflect on the suggested improvements and verify the observations with the people who are working in the field of ICT4D projects and as well as the people who have created the e^3value tool.

Chapter 2

Literature Overview

Chapter 2 introduces the e^3value methodology and other business models which are the most important competitors of the e^3value methodology.

2.1 The e^3value Methodology

The e^3value methodology [Gordijn and Akkermans, 2014] is a conceptual modeling tool for analyzing the feasibility and sustainability of a business idea. Figure 2.1 gives an example of the e^3value model showing a company MyBiscuit.com offering its customer the possibility to compose their own biscuit box and pay accordingly. MyBiscuit.com has ties with a number of biscuit sellers, box sellers and payment providers. The customer can choose from a variety of biscuits, boxes and payment provider. For a custom made biscuit box, a number of biscuits are needed and one box. Biscuits can be obtained from multiple sellers. There is also a logistics provider involved who is responsible for transporting the biscuit box from MyBiscuit.com to the customer and is directly paid by the customer.

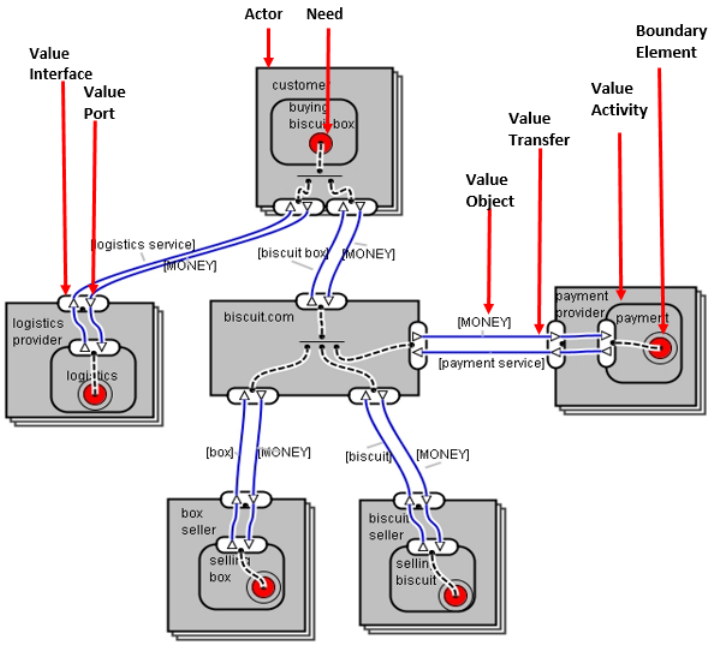

FIGURE 2.1: An e3 value model for MyBiscuit.com

For conceptualizing networked business, the e^3value methodology [Gordijn and Akkermans, 2003] presents two integrated techniques: the value hierarchy technique

and the value web technique. The value web technique consist of actors, value objects, value port, value offering, value interface, value transfer and value transaction. Figure 2.1 shows the interaction among the various actors through the value ports, exchanging value objects which have economic importance. The value objects such as (money, logistics service, box, biscuit) are exchanged through value ports which are grouped into value interfaces. “These value interfaces model the economic reciprocity, which exists in every business transaction." [Bon, Akkermans, and Gordijn, 2016]

In the above case, a customer need of buying a custom made biscuit box is satisfied if the customer is able to successfully order the biscuit box through MyBiscuit.com. Here the need of the customer is a custom made biscuit box. To satisfy this need, an exchange of value objects (biscuit box against money) via an interface is conducted. The biscuit seller, box seller, payment provider and the logistics provider form market segments implying that that many actors of similar kind may exist.The customer selects from a variety of biscuit and box sellers, logistics and payment provider. All these activities are performed in exchange of value objects, for instance in case of biscuit seller, the value object biscuit is exchanged in return of money and so on. The boundary element at the logistics provider or the biscuit seller indicates the end of value transfers.

2.2 Business Model Approaches

Besides the e^3value methodology, other business model approaches exist, include the economic resources, events and agents (REA) conceptual model and the Business Model Canvas (BMC). These two approaches are the most important competitors of e^3value methodology.

REA [Geerts and McCarthy, 1999], like the e^3value methodology, consists of actors and the notion of value object which are the agent and resource respectively. The event, in case of REA, bears similarities with the value transfer, in the e^3value methodology which implies that increase in value for one actor leads to decrease for another. For instance, in figure 2.1 a decrease in a biscuit at the seller leads to an increase of biscuits at the money. For the payment the process is other way around. Duality of events refers to economic reciprocity, that is biscuit event and payment event are related by means of duality. In REA [Geerts and McCarthy, 1999], an object constellation is an object oriented approach and is expressed in an entity relationship form. The first level of abstraction consist of process consisting of "Value added exchanges" while the second level of abstraction comprises of three second level processes such as purchase of raw materials, manufacturing goods and selling finished goods. A REA process has a give and take; or increment and decrement, in relationship with its entities. The increment event could be a cash receipt and the decrement event could be a sale occurring. The processes could be further decomposed based on the needs of the enterprise.

In the Business Model Canvas, a business model is described in terms of nine building blocks which aim to facilitate easy understanding of business idea by orchestrating its simplicity. The first block, customer segment, captures single or multiple customers; the second block, value proposition, describes the products or services that are of value to the customer; while the third block and fourth block which are channels and customer relationships explain value proposition that are delivered to customer and establishing customer relationships. The fifth block, revenue stream, emphasizes on the revenue generated; the sixth block, key resource, explains

the assets that are required to offer value propositions while the block key activities refer to the activities that must be preformed for offering key resource. The two final blocks; key partnership and cost structure refer to the resources that are out-sourced and the resulting cost structure respectively. BMC has one very distinctive difference with the *e*^{3}*value* methodology that BMC has a single actor perspective, where as, the *e*^{3}*value* methodology considers the whole network. The BMC considers an enterprise and its environment (customers, suppliers, etc.) in contrast with the *e*^{3}*value* methodology which considers the whole network; all actors are equal citizens.

Unlike in REA, in Business Model Canvas the levels of abstraction are not explicitly stated. Some building blocks out of the nine blocks are on a higher level of abstraction than the rest. The lack of defining the building blocks at the same level of abstraction render some blocks as more significant than others. As a result of which some blocks receive greater importance as compared to the other building blocks, for instance, value propositions are not decomposed further and hence lack the emphasis enjoyed by other building blocks. Although in REA, the levels of abstractions are explicitly stated but the use of abstraction in itself is complex. The use of object oriented approach further limits the implementation of REA in technologies that are enveloped with object representation only. Secondly, visualizing REA or BMC adds another layer of complexity altogether.

In case of *e*^{3}*value* methodology two integrated techniques are used to conceptualize networked business. The two techniques are value hierarchy and value webs. The value hierarchy illustrates how a customer need can be satisfied by obtaining products or service while the value web illustrates how these products or services are created, assigned and consumed in a networked business. The simplicity of illustration and conceptualization of the *e*^{3}*value* methodology makes it comprehensible by everybody facilitating both discussion and description. Unlike REA and Business Model Canvas, the *e*^{3}*value* methodology is based on value hierarchy and value webs instead of being based on the concept of abstraction. This enables the *e*^{3}*value* methodology to generate money by systematically adding value in the business environment. In addition, visualizing the *e*^{3}*value* methodology is much simpler as compared to REA and Business Model Canvas.

Chapter 3

Understanding the Problem: The Mali Milk Service

The Mali Milk service or m-Milk service [Boer et al., 2016] is a voice based milk selling and farmer networking platform for Tominian Mali. Some crucial problems such as a lack of communication between milk producers and buyers and irregular milk production have motivated the system (m-Milk) that has been developed. The principle business idea behind the proposed system is to enable farmers to sell their produced milk to a greater audience. This chapter discusses the m-Milk e-service developed and deployed in Tominian Mali in collaboration with the local milk farmers. This chapter further identifies the various actors involved who would make up the value web for e-service delivery and consumption.

The associates of the Web Alliance for Regreening in Africa have identified two key problems during describing the use case for the milk ordering and delivery system for Tomanian milk producers in Mali. The first is a lack of channels for facilitating buying and selling of milk while the second is overproduction of milk during a rainy season and underproduction during a dry season. The first problem results in buyers having to sell milk from door to door while the second problem leads to wastage of overproduced milk and expensive import of milk during scarce production. One way of solving the two problems is by having a dairy co-operative [Boer, 2016] which would collect milk from farmers by contacting them via mobile phones, pasteurize the collected milk and sell it in the market accordingly. Pasteurizing the milk delays spoiling by four days approximately. Yet loopholes in the co-operatives such as lack of prompt milk collection and unreliable communication still loom over the success of the co-operative.

The m-Milk service is a platform which facilitates communication between local milk producers and potential buyers.This e-service platform enables the farmer to call in the platform and leave a message about the milk available. The potential buyers can call in and retrieve messages from the farmers along with contact information of the farmer with milk for sale. Further, in an already existing co-operative, the platform can be used to encourage more farmers to join the co-operative and facilitating efficient collection and selling of the milk. In addition, in areas where there are no co-operatives, the farmers can communicate among themselves and organize pooling of milk and transport to a diary producer.

3.1 Technology Infrastructure

The technology at place for providing communication between the farmers and the potential buyers is a device called KasaDaka [*Kasadaka*] along with a GSM/ GPRS

FIGURE 3.1: A woman milking one of her goat in Mali *Milk production is in business.*)

dongle. It is a low-cost Raspberry Pi based system which has a low electricity consumption. Therefore, it is suitable in ICT4D context. In order to make the application able to receive calls, a dongle with a telephone SIM card is inserted. The m-Milk service is compatible with the rural landscape of Mali and requires the farmers and the buyers to have a basic mobile phone to call in to the KasaDaka. The farmers can record their messages by calling into the KasaDaka and the buyers can retrieve the messages in the same way. The KasaDaka is provided via a micro-loan scheme by the NGO to a group of farmers allowing them to pay back the money in installments with gradual increase of profits. The KasaDaka could also be hosted at co-operatives having a computer and where in the local browser could be used to view messages received and amount of available milk. The co-operative could also use the service to encourage more farmers to join the co-operative and collect and sell milk as efficiently as possible.

3.2 *e^{3}value* Models for m-Milk service

Two alternative *e^{3}value* models are constructed to represent the actors involved in the m-Milk service and to show the value objects exchanged between them. The first alternative involves the co-operative which hosts the device while in the second alternative hosts the device at a hosting party which might constitute of one or more farmers.

3.2.1 Service offered by a Co-operative

As outlined in the report of Boer et al., 2016 there are places in Mali where dairy co-operatives exist. This section presents the *e^{3}value* models of the m-Milk service where such co-operatives exist. Figure 3.2 presents the *e^{3}value* model for the m-Milk service hosted at the co-operative with a loan from the NGO. The primary actors of this service are:

1. Platform Suppliers

2. NGO
3. Co-operative
4. Farmers
5. Potential buyers
6. Mobile phone providers

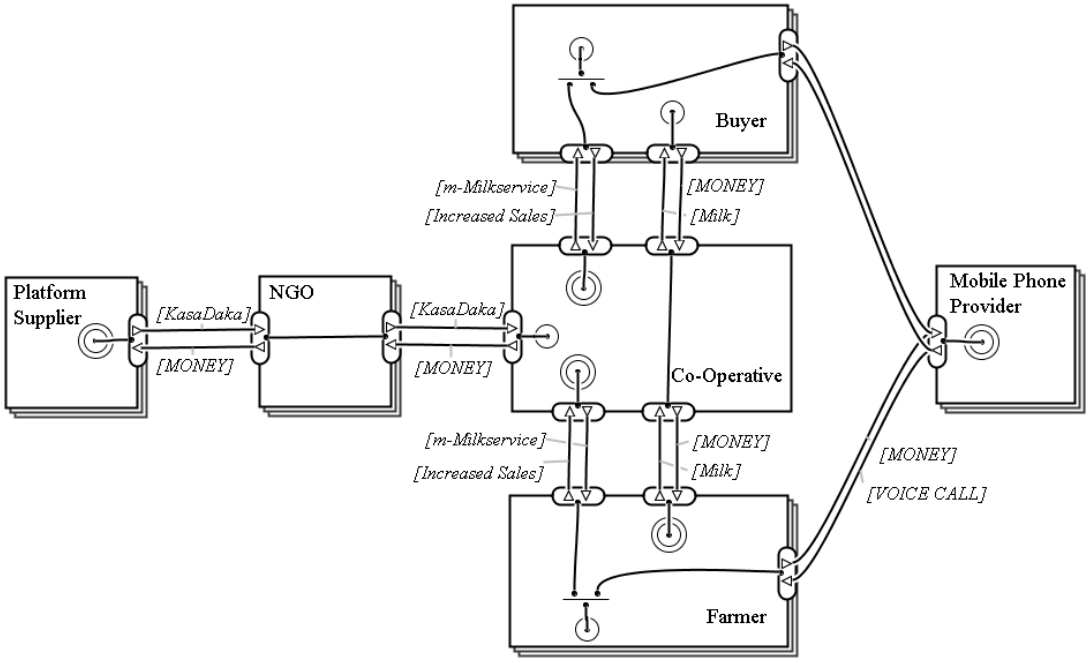

FIGURE 3.2: m-Milk platform with KasaDaka hosted at the co-operative with a loan from from NGO

The platform supplier refers to the actors offering the KasaDaka hardware to the NGO in exchange of money. The NGO in turn offers the KasaDaka devices to dairy co-operatives in terms of micro loans which could be paid off eventually. The dairy co-operative hosts the KasaDaka system and offers the m-Milk service to the farmers and the potential buyers in return of increased sales. The farmers are encouraged to call in to the KasaDaka device to share their information regarding the availability of milk. By providing the service for free to the farmers as well as the buyers the Co-operative aims to involve more farmers to sell their milk and more buyers to buy the milk from the co-operative which would result in increased sales for the Co-operative. Since the KasaDaka is hosted at the Co-operative, the maintenance cost such as electricity is covered by the Co-operative. The farmers and the buyers pay the mobile phone provider for making calls to the application (KasaDaka). The farmers record their calls with date and availability of milk. The buyers call the KasaDaka to listen to the calls dropped by the farmers and reach them accordingly. The platform supplier, NGO, farmer, buyer and the mobile phone provider form market segments implying that that many actors of the similar kind exist. The co-operative acts as a single actor hosting the m-Milk service.

Figure 3.3 illustrates the m-Milk service with the KasaDaka hosted at the co-operative but without any loan from the NGO. The actors involved in this e^3value model are as follows:

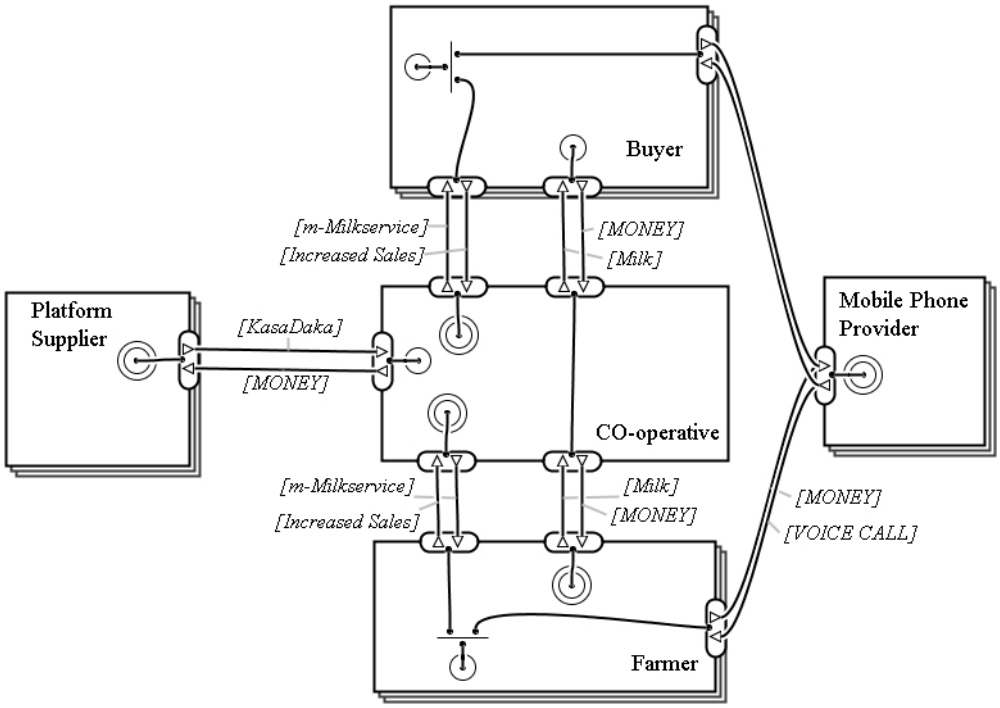

FIGURE 3.3: m-Milk platform with KasaDaka hosted at the co-operative without a loan from NGO

1. Platform Suppliers
2. Co-operative
3. Farmers
4. Potential buyers
5. Mobile phone providers

The *e^{3}value* model is similar to figure 3.2 with the only difference being, the complete ownership of the KasaDaka devices is with the co-operative. The co-operative buys the device directly from the platform suppliers without the financial help of any NGO and hosts it. The value object exchange is similar to that of figure 3.2

3.2.2 Service hosted by a Farmer

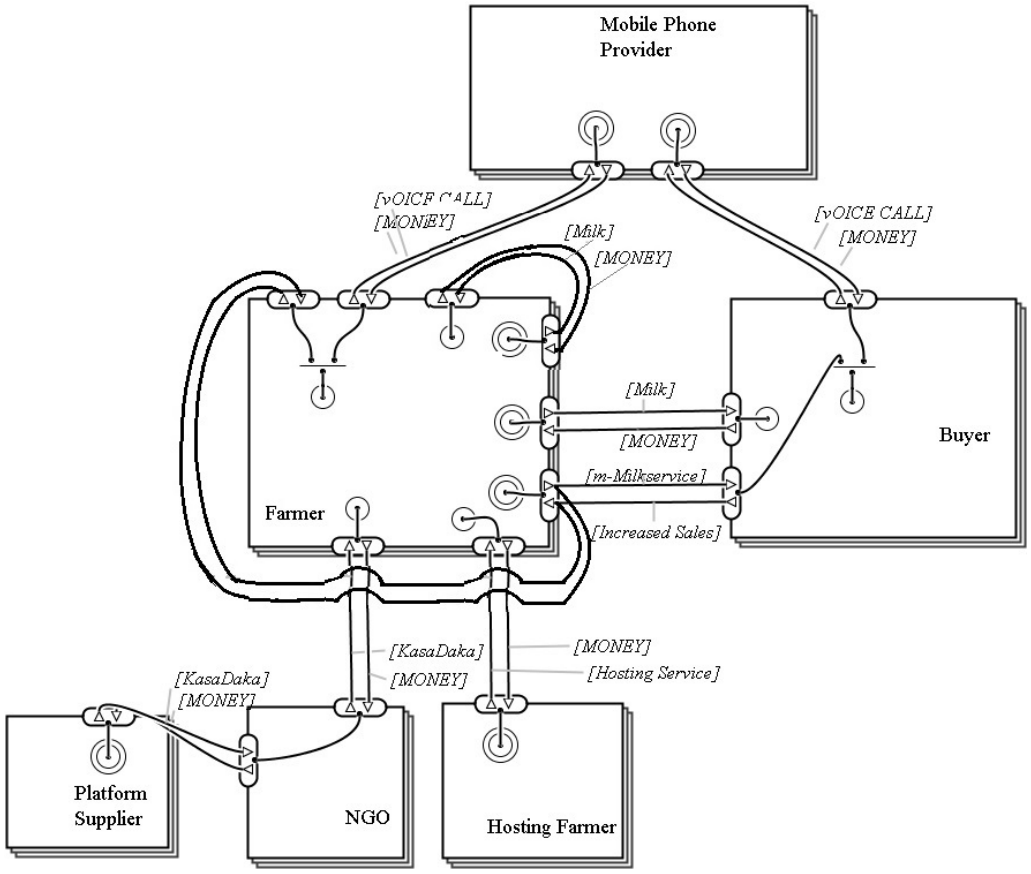

FIGURE 3.4: m-Milk platform with KasaDaka hosted at a hosting party with NGO loan

Figure 3.4 presents the e^3value model for m-Milk service offered by a group of farmers with the KasaDaka hosted at a hosting party (for example, at one of the farmer's place) with a micro-loan from the NGO.The primary actors for this model are:

1. Platform Suppliers
2. NGO
3. Farmers
4. Potential buyers
5. Mobile phone providers

In this model, it is illustrated that a group of farmers buy the KasaDaka a micro-loan from the NGO. The group offers the service to other farmers both inside and outside the group. One or more farmers hosts the device at their place in exchange of money. The hosting party (one or more farmers within the group) pays the maintenance cost such as electricity. The group of farmers pay off the loan to the NGO and the maintenance cost to the hosting party eventually as profit would rise by using the m-Milk service.

Figure 3.5 illustrates the *e^{3}value* model for the m-Milk service with the KasaDaka hosted at a hosting party but without a loan from the NGO. The complete ownership of the device lies with the group of farmers who have purchased the device.

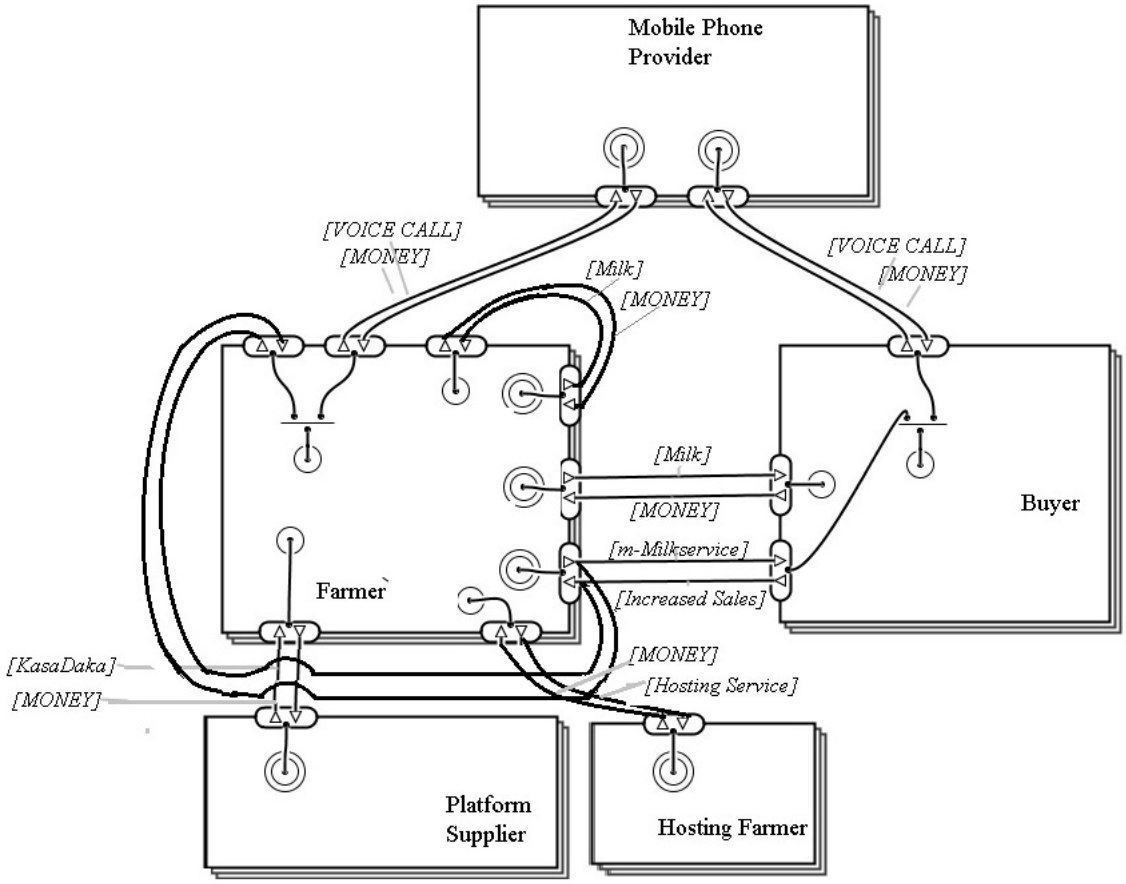

FIGURE 3.5: m-Milk platform with KasaDaka hosted at a hosting party without NGO loan

During modelling the m-Milk service a few limitations appeared with regards to the modeling technique. The first limitation appeared while modelling the case study where the service is hosted by a hosting party. In this case, a group of farmers is given a micro-loan from the NGO allowing them to pay back the money in installments and use the service simultaneously.

The model in figure 3.4 does not precisely model the case. The *e^{3}value* methodology can only model an one to one scenario and it fails to depict a "group" of farmers taking the loan together and paying it off accordingly. Instead it models "one farmer" taking one loan. It fails to model "multiple" farmers buying one KasaDaka as "a group" and paying for it. Similarly while paying to the hosting party for the maintenance cost, the model fails to show the transaction of value objects between the hosting party and the farmers as "a group". Conclusively, one of the limitations of the *e^{3}value* methodology that appeared during modeling the Mali Milk service was representing a community or group.

Chapter 4

Treatment Design: Modeling Communities in the *e*^{3}*value* methodology

4.1 Proposed Modeling Improvement

The *e*^{3}*value* methodology has the notion of market segment implying that many actors of similar kinds may exist. In the case of m-Milk service the notion of market segment partially holds true. In other words, although many actors (for example farmers) of similar kind exist, they exist as a group. Further market segments are used to show that a number of actors assign economic value to objects in the same way. But in this case, instead of one farmer buying one KasaDaka and paying one time for it, we have a group of farmers (or community) buying one KasaDaka and paying one time for it.

The main argument is that a clear, unambiguous meaning of the concepts of *market segment* and *community* is required. In case of market segment all actors share the same value activities where as in case of community all actors together offer something of value.

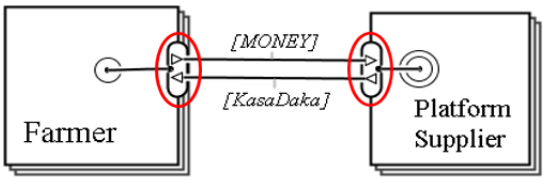

FIGURE 4.1: Model representing distinction between market segment and community or group

4.1.1 Alternative 1

An alternative proposal of modeling a group of farmers is illustrated in figure 4.1. By placing the value interface on the multiple line surface of the market segment, the notion of a group can be created. Here the consumer need refers to the need of the group of farmers. In this case, the need of the group of farmers is owning the KasaDaka device.

Further the concept of modeling market segment for capturing actors of similar kinds can be refined by placing the value interface on the single line of the market

segment. This can be an extension to the market segment concept, of the already existing e^3value methodology, implying an one to one relationship as illustrated in figure 4.1. In this case, the need of the group of farmers which is owning KasaDaka device is satisfied by a single platform supplier.

When both the group of farmers and individual farmers co-exist in a market segment, the scenario could be modeled by combining both the cases stated above. This scenario is illustrated in figure 4.2 where needs of both individual farmer and group of farmer has been stated.

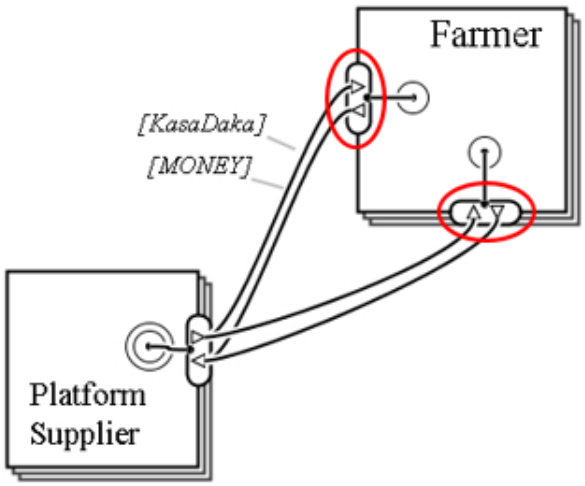

FIGURE 4.2: Model representing both the group of farmers and individual farmers within a market segment

Figure 3.5 showing the m-Milk platform with KasaDaka hosted at a hosting party without NGO loan, has been recreated incorporating the above changes to the model. The primary actors of this model are the following:

1. Platform Supplier
2. Farmer
3. Buyer
4. Mobile phone provider

Here the platform suppliers satisfy the need of the group of farmers by providing the KasaDaka device in exchange of money. On one hand the m-Milk service is the need of the group of farmers and individual farmers while the service is also the need of individual buyers who form the market segment. Thus individual farmers as well as buyers use the m-Milk service provided by the group of farmers. By providing the m-Milk service to the individual farmers, the group of farmers can get more milk for selling. On the other hand by providing the service to the buyers, the group of farmers can get an increase in sales in return as more buyers can contact them and the available milk (both the produce from the individual farmers and group of farmers) can be sold efficiently. The individual farmer can either be part of the group or can belong outside the group and can sell their milk to the group of farmers for money. The group then sells this milk to the buyers upon being contacted through

the m-Milk service by the buyers. Selling the milk as a group is the need of the group of farmers because by selling milk as group, the maintenance cost of the device can be achieved. In contrast it is the need of the individual farmer because selling milk is his livelihood. The mobile phone provider provides voice call service to individual farmers and buyers who are part of the market segment.

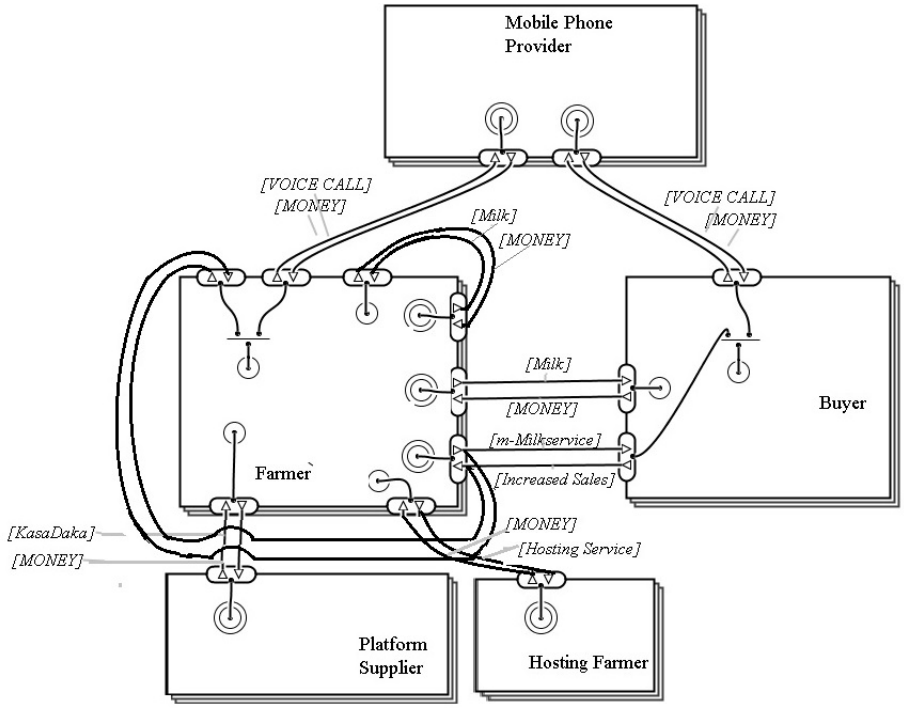

FIGURE 4.3: Re-modeling of the m-Milk platform with KasaDaka hosted at a hosting party without NGO loan

In figure 4.3 the concept of market segment is used to capture the notion of community by placing the value interface at certain places of the market segment symbol. The symbol of market segment named "Farmer Group" represents the group of farmers, the value interfaces placed at the multiple lines of the symbol indicate the exchange of value objects as a group. While the market segments of "Farmer", "Mobile Phone Provider", "Buyer", "Platform Supplier" and "Hosting Farmer" capture the essence of market segment implying actors of similar kinds co-existing. In this case the value interfaces are placed at single line of the market segment symbol indicating all actors share the same value activities, individually.

The *advantages* of using the market segment to capture the notion of both community and individuals:

1. In modelling construct, it is desired to have minimal symbol representation of concepts. Hence, the first alternative fruitfully serves the purpose of keeping to minimal symbol representation.

2. Two different concepts can be parallely illustrated that is the community notion and the notion of the group by using a single symbol.

The *disadvantages* of using the market segment to capture the notion of both community and individuals:

1. The main challenge of using the market segment to show both community and individual lies in placing the value interface at the correct position. Thus, it would require readers to have precise knowledge of concepts to understand the models.

2. Using the market segment for both purpose not only makes it difficult to draw the model but also takes away the precision of the diagram as several value transfers can intersect each other as illustrated in figure 4.3.

4.1.2 Changes in the e^3value Metamodel

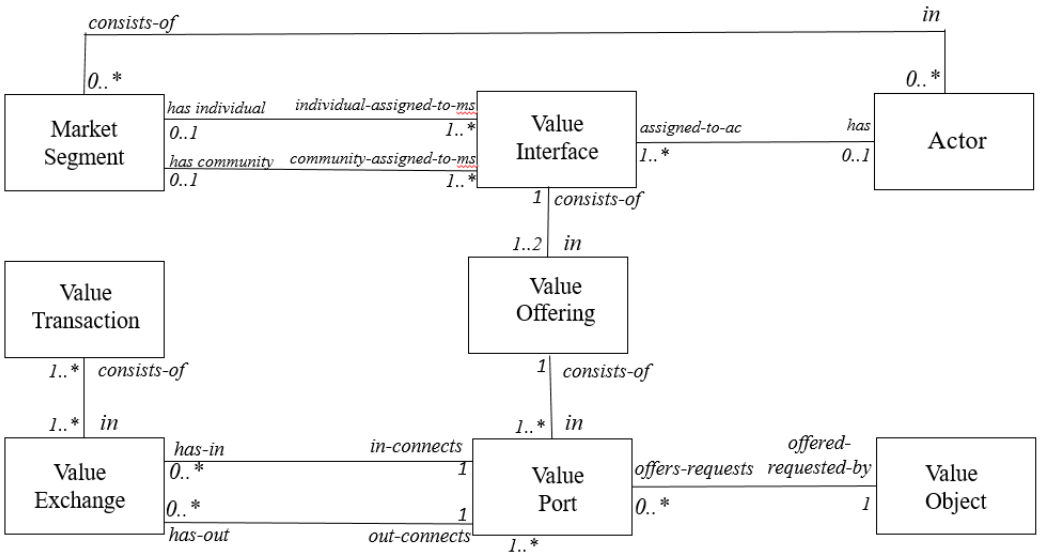

FIGURE 4.4: Modified e3 value ontology for Alternative 1

Figure 4.4 represents the e^3value ontology based on UML class diagram. The rectangles represent the concepts while the lines represents associations which relates the concepts. Here, associations are expressed between value interface and actor, value interface and value offering, value offering and value port and so on. Further cardinality constraints are used to express the degree of a relationship. For example, the association between value interface and value offering reads as, value interface consists of one or two value offering, and , a value offering in one value interface.

The modification that has been made to the existing e^3value ontology [Gordijn, 2002] is with regards to the concept of Market Segment as suggested in Alternative 1. In the modified ontology the market segment has *individual* and *community*.In the first place, the market segment has zero or more individual assigned to value interface, and, a value interface has one or multiple individual assigned to the market segment. In the second place, the market segment has zero or more community assigned to value interface, and, a value interface has one or multiple community assigned to the market segment.

4.2 Alternative 2

In order to capture the notion of a group existing within the market segment it is essential to place the value interface in a particular fashion on the market segment

as illustrated in 4.2. This creates difficulty to draw or position the interface and becomes an obstacle in creating a neat, easily comprehensible diagram.

The concept of market segment implies that many actors of similar kind exist and assign economic value equally. But in ICT4D cases, the concept of market segment partially holds true as in these cases the notion of community or group appears to be the actors. Every actor then becomes the part of the group. In this scenario it would be more convenient to have a separate symbol representing a group. Such a symbol is illustrated in figure 4.5.

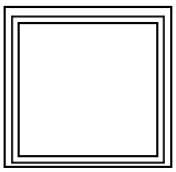

FIGURE 4.5: Symbol representing group

Figure 3.5 showing the m-Milk platform with KasaDaka hosted at a hosting party without NGO loan, has been recreated in figure 4.6 incorporating the new symbol which represents the group of farmers.

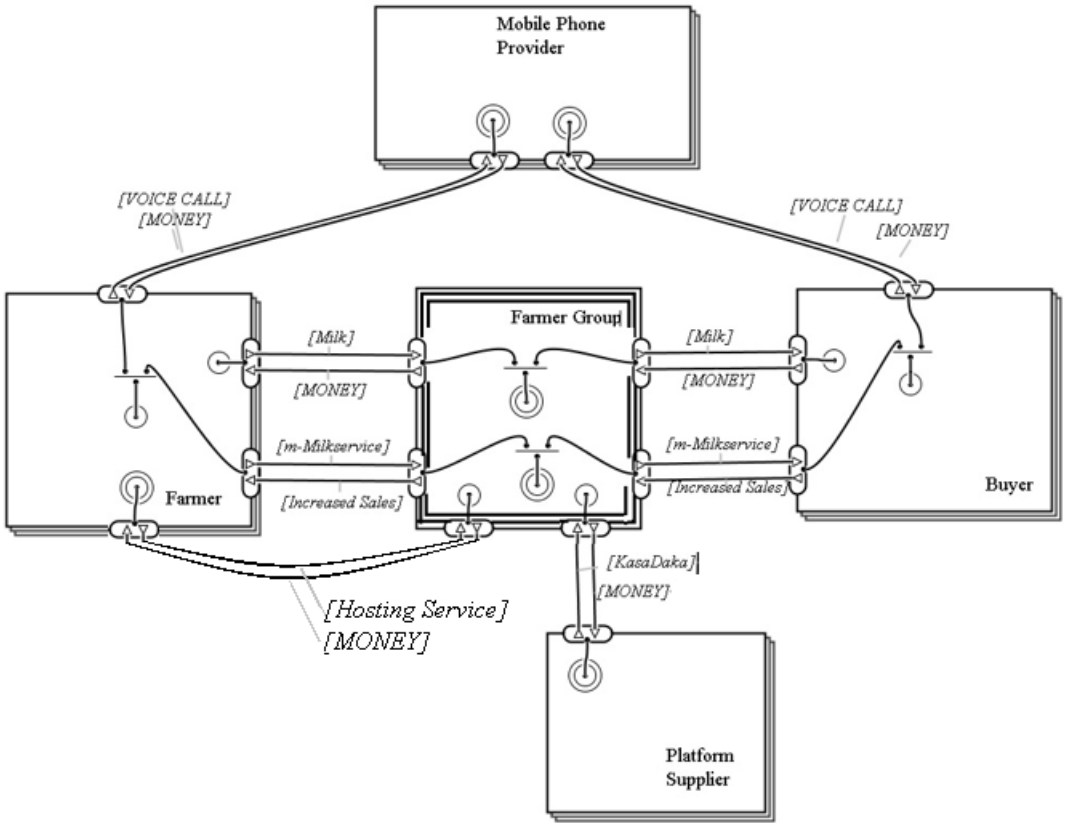

FIGURE 4.6: m-Milk platform with KasaDaka hosted at a hosting party without NGO loan incorporating group notion

The *advantages* associated with the introduction of this new symbol to the e^3value methodology are listed below:

1. The new symbol is able to capture the essence of community which is an integral part of ICT4D business cases.
2. With the introduction of the new symbol placing the value interfaces on certain areas(to illustrate group or individuals) of the market segment is no longer essential.
3. Both the concept of market segment and the concept of community can exist parallely with this new addition.
4. It becomes easier to draw as well as understand the model. It supports the neat diagrammatic representation of the model and reduces the complexity of representation by removing the constraint of positioning of the value interfaces.

The *disadvantages* associated with the new symbol are:

1. In modeling construct it is desired to have minimal symbol representation of concepts. Thus, introduction of a new symbol increases representational complexity.

4.2.1 Changes in the e^3value Metamodel

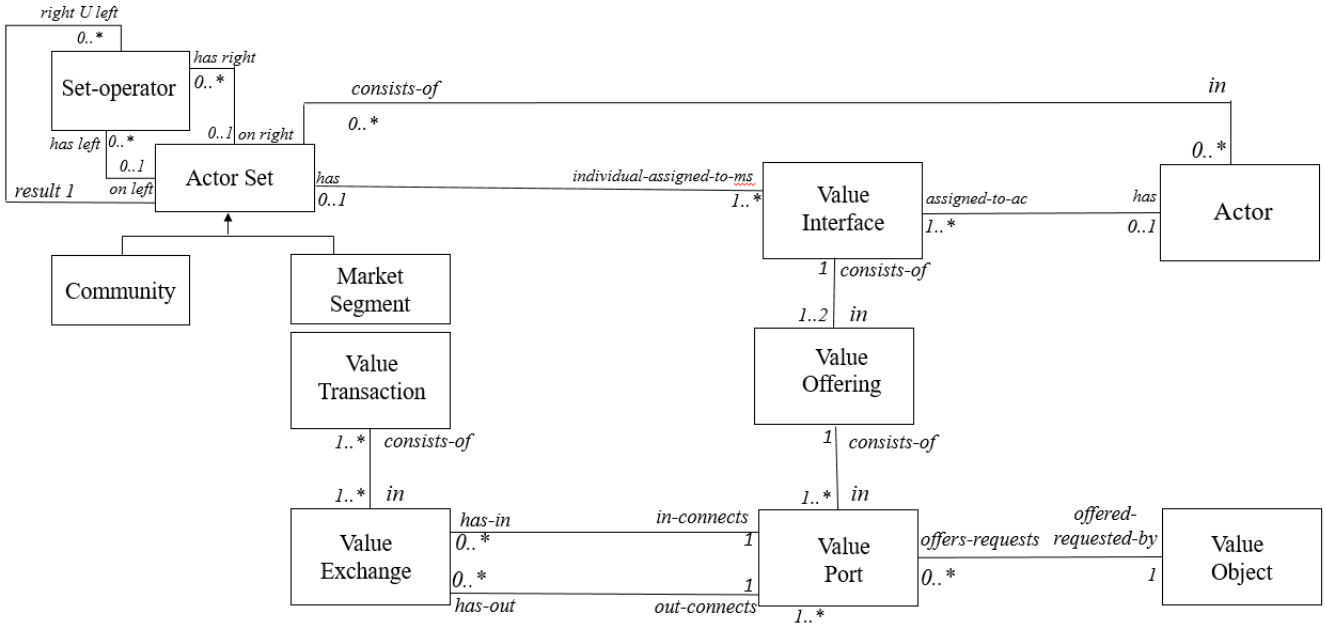

FIGURE 4.7: Modified e3 value ontology for Alternative 2

Figure 4.7 reflects the modification that has been made to the existing e^3value ontology [Gordijn, 2002] with regards to the concept of Market Segment as suggested in Alternative 2. A new concept has been introduced named "Actor Set". "Actor Set" consists of "Community" and "Market Segment". The actor set, for instance, comprising of milk farmers consists of "community" of milk farmers as well as "market segment" of milk farmers.The community which is part of the actor set has zero or one value interface. The market segment, which is part of the actor set also, has zero

or one value interface. On the other hand, the value interface has one or multiple market segment as well as community assigned to the actor set.

One of the questions that needs to be addressed is "*How do we represent that the farmers in a community are also in a market segment?*"

A new concept called "Set Operator" has been introduced into the *e^{3}value* ontology. The purpose of this new concept is to capture the dependencies of the two actor sets "Community" and "Market Segment" on each other. The set operators such as subset, superset, union and intersection are used to show the relationship between the "Community" and the "Market Segment" or between two communities and two market segments. For instance, the community of milk farmers might be a subset of the market segment. Further, two or more different farmer communities might unite to work together, hence an union operator is required to represent the union of the two different communities. Therefore, the concept of subset, superset, union and intersection has been introduced. The symbols corresponding to the set operators are represented in figure 4.9 which can be used while modeling ICT4D cases using the *e^{3}value* methodology. In case of subset or superset, the set operator has a right actor set and a left actor set. While in case of union, the set operator has a right actor set and a left actor set which results in the formation of a new actor set.

A way of representing that the farmers in a community are also in a market segment in illustrated in figure 4.8. The dashed arrow shows dependency specifying the direction of a relationship. In other words, the Farmer Group is a "subset" of the Farmer. The "Farmer Group" is a part of the market segment. Figure 4.9 shows the symbols that can be used to represent that farmer in a community are also part of the market segment.

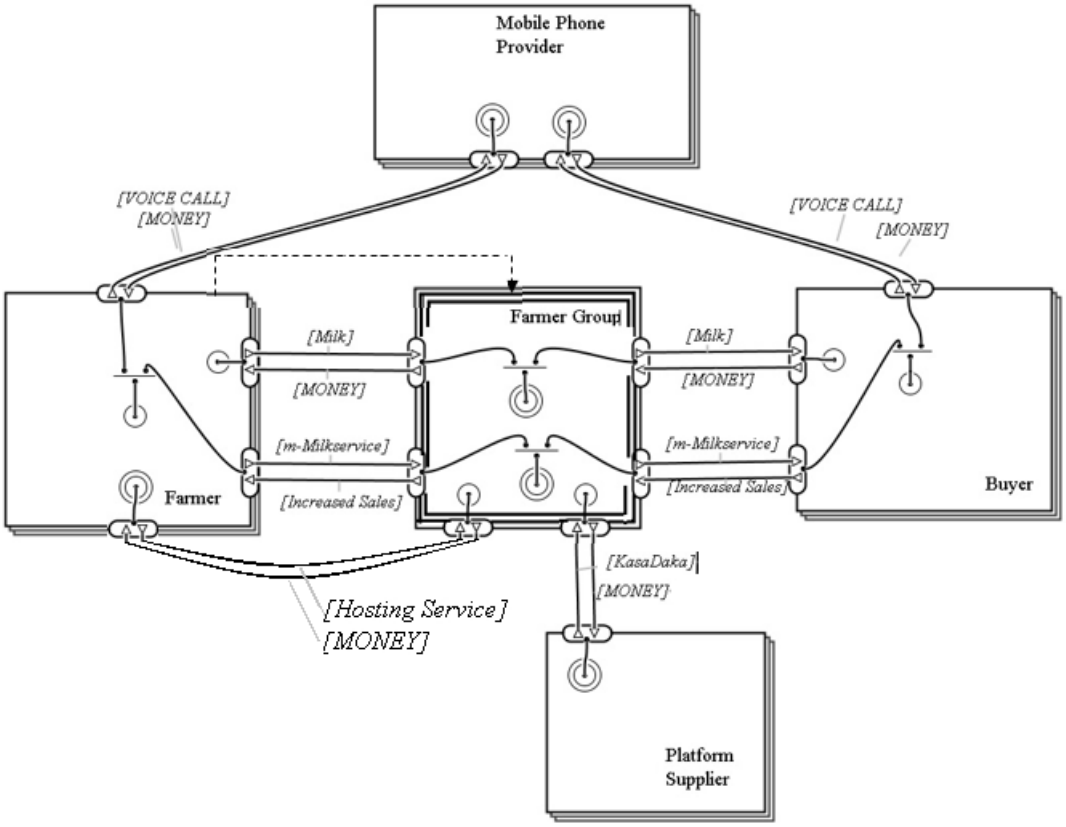

FIGURE 4.8: m-Milk platform showing relationship between farmers in a community and in a market segment

Set Operator	Symbol
Is a Sub-set of Is a Superset of	← - →
Equal set of	- - - - - - - - - - - - -
Union of	← - - - - - - - - - - - - →
Intersection of	◄ = = = = = = = = = = = = = = = = = ►

FIGURE 4.9: Symbols corresponding to the set relationship

Chapter 5

Treatment: Case Study of Community commerce for Penan community and Community Radio Journalism of rural area Mali

5.1 Community Commerce for Penan Community

FIGURE 5.1: The community and products of Long Lamai (Shiang et al., 2017)

Long Lamai, one of the biggest and ancient settlements of the Eastern Penan in Sarawak is the home to the Penan Community (Davis and Henley, 1990). Once known for living a nomadic life, the Penan Community has evolved since settling down in 1930s. Now the community thrives on farming, collecting fruits and hunting.Furhter due to geographical constraints the community is only reachable by water ways or by boats. Figure 5.1 illustrates the people of the community, the products they offer and also their neighborhood.

The Penan Community is known for its fine handicrafts. In order to enable the community to sell their crafts outside, an E-Commerce website was created and run. This site was also used by the inhabitants to offer their houses to tourists for stay in the village. This project was funded by the Telecentre. The aim of the telecentre project was to diminish the gap between the urban and Long Lamai Community.

Since the project was heavily dependent on the Telecentre the sustainability and feasibility of the community commerce was dependent on the sustainability of the telecentre.

5.1.1 The Current *e*^{3}*value* Model for the Penan Community Commerce

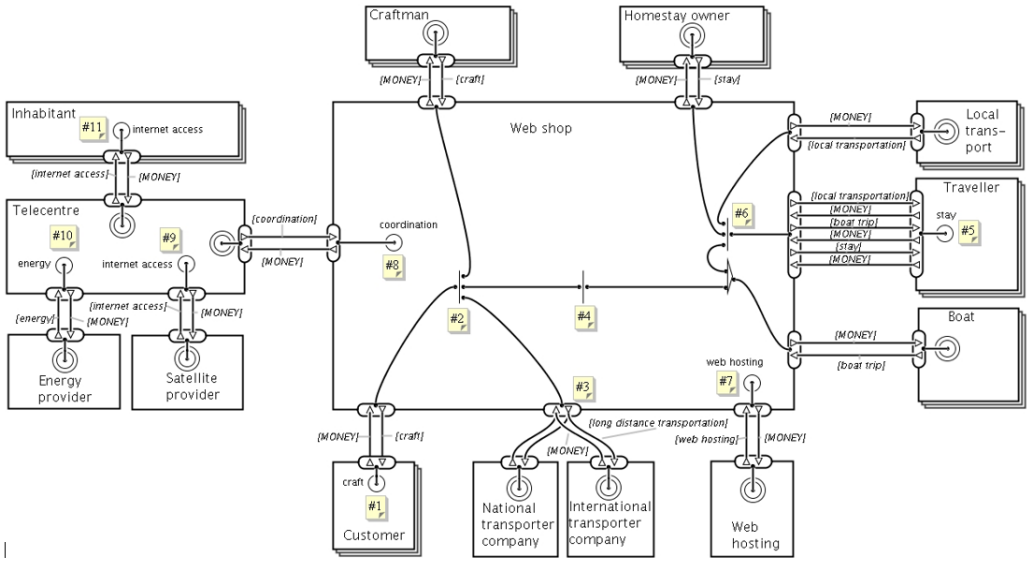

FIGURE 5.2: The current e3 value model of Community Commerce

In the current *e*^{3}*value* model for the Penan Community Commerce, there are fourteen actors that are involved in the community. The actors are customer, traveller, web shop, craftman, homestay owner, local transporter, boat owner, national transporter, international transporter company, web hosting, inhabitant, telecenter manager, energy provider and satellite provider (Shiang et al., 2017). The Penan Community offers their crafts for sale and their homes for stay to travelers through the webshop. The webshop is owned and run by the university, ISITI, Unimas. This project was funded by the local Telecentre project in 2006(Shiang et al., 2017).

The buyers are the customers and travelers, who buy crafts and stay at the village.The craft that is bought can be delivered either withing Malaysia through the national transporter and outside Malaysia through the international transporter. Hence, the selling price of the craft includes the transportation cost as well as transportation cost of the boat service for obtaining the craft from the craftsman. Further a traveler who pays for a stay in the community pays through the webshop. He pays for three things. First of all he pays for a boat ride to reach the community, secondly he pays for the home to stay and thirdly he pays for local transportation for transporting his luggage.

The telecentre is responsible for facilitating co-ordination between the craftsman and the homestay owner and is paid by the webshop for this service. This implies that the sustainability of the webshop is heavily dependent on the sustainability of the telecentre and vice versa. Further, since the webshop is funded by the university, the feasibility of the community commerce is not certain as the funding, however, might end. The question that arises is how can the community commerce be made sustainable and feasible in the long run?

" Can the webshop be replaced by a community run service?"

5.1.2 The modified e^3value Model for the Penan Community Commerce

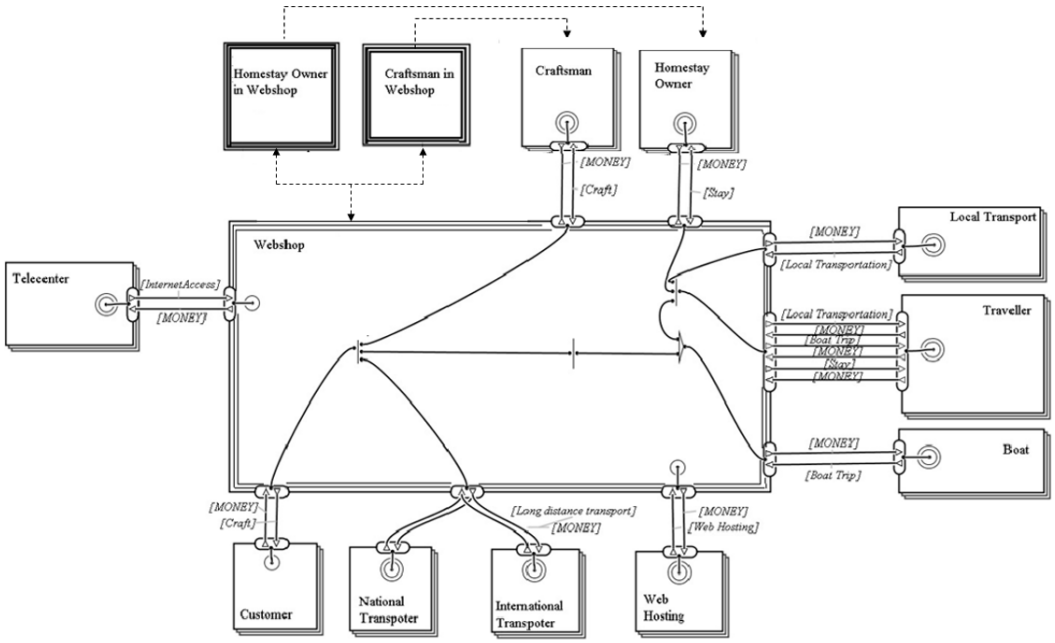

FIGURE 5.3: The modified e3 value model of Community Commerce

Figure 5.3 represents the modified e^3value model for the community commerce of the Penan Community. There are eleven actors that are involved in the community commerce. The actors are customer, traveler, web shop, craftman, homestay owner, local transporter, boat owner, national transporter, international transporter company, web hosting and telecentre. The webshop is a community run service. It is assumed that a subset of the Penan community consisting of craftsman and homestay owner run the webshop after receiving formal training from the university. The craftsman and the homestay owner form market segment and offer their crafts to the customer, and their house for stay to the traveler,respectively through the webshop. The customer and the traveler are the buyers of the web shop. A subset of the community of craftsman and the homestay owner are responsible for running the webshop. Since the webshop is a community run service offered by the union of the homestay owner and the craftsman, the union between the two communities is illustrated in the model by a double headed dotted arrow.

A customer visits the E-Commerce webshop, buys a craft and pays for it. The webshop is run by a subset of the craftsman and the homestay owner. The selling price of the craft includes the transportation cost be it through local transportation (by boat) or through national or international transportation for long distance transportation. Similarly, a traveler can book his stay in the village through the webshop. For this, he pays for his stay to a homeowner, buys a boat trip to reach the destination and hires a local transporter for the luggage.

In this modified e^3value model, it is assumed that the webshop is run by the Penan Community as a community service. It is not funded or dependent on the Telecentre. The telecentre serves only an actor who provides internet access to the webshop and in return is paid for the service. Thus sustainability of the webshop is not dependent on the sustainability of the telecentre. The telecentre is just seen as a service provider, thus eleminating the risk of dependency. If one telecenter fails to provide internet access, another could be contacted for the same.

If there is a profit incurred by the webshop, it gets distributed among, three types of actors who are considered as sellers in the webshop.

1. The craftsman who offer service for running the webshop.
2. The homestay owner who offer service for running the webshop
3. The craftsman and the homestay owner in the webshop who form a subset of the market segment of "Craftsman" and "Homestay Owner".

Suppose there are 10 craftsman in the market segment "Craftsman" and 10 homestay owner in the market segment "Homestay Owner". A subset (say 5) of the market segment "Craftsman" have formed the community "Craftsman in Webshop". Similarly, a subset (say 5) of the market segment "Homestay Owner" have formed the community "Homestay owner in Webshop". So the profit incurred by the webshop is distributed between the 5 "Craftsman in Webshop" and the 5 "Homestay owner in Webshop" who are also part of the market segment "Craftsman" and "Homestay Owner" respectively. It must be made sure that the "Craftsman" and "Homestay Owner" in the market segment are not repaid.

5.2 Community Radio Journalism of rural area, Mali

In the rural area of Mali several community radio stations exist. Citizen journalist or village reporter delivers their messages to the radio station which in turn forecasts the messages to the wider audience. An instance of such a voice based village reporting or citizen journalism service is called the Foroba Blon (Gyan et al., 2013). The term Foroba Blon is derived from the Bambara Language, spoken in Mali which refers to "Big Field" or "Collective Field" or in other words "for everyone"(*IPI/FurobaBlon*).

Some of the community radios are either state funded or privately funded and connected to the the national broadcasting service ORTM (Office Radio Television du Mali)(Shiang et al., 2017). Some radio stations have computers and internet connections, while some have only computers without internet connections while the rest are devoid of both. The Foroba Blon is a voice messaging (Bon et al., 2012) which enables radio stations to receive, store and manage incoming voice messages for broadcasting.

Messages obtained from inhabitants, like a missing cow or excess production of a commodity good (such as honey) are collected by village reporters and reported to the radio stations. Radio stations uses the service provided by Foroba Blon to store and retrieve the message and finally broadcasts the message to the wider audience. The context of the message can either be personal (like a missing cow) or can be commercial (for announcing excess production of honey).

5.2.1 The e^3*value* model for Foroba Blon

In the existing e^3*value* model for the Foroba Blon as shown in figure 5.5, six actors are involved. The actors are customer, village reporter, radio station, telco, FB service provider and listener. The customer is an inhabitant of one of the remote villages (for example, Konobogou) in Mali. The need of the customer is to announce a message for instance if one of his cows is missing, to the other villagers. As the customer does not own a mobile phone, he reports his message to the village reporter who owns a mobile phone. The customer pays the village reporter money for reporting

FIGURE 5.4: Radio Journalist at work at community radio, ORTM

his message. The village reporter collects many such messages and reports to the radio station by making a phone call.

The Village reporter pays the radio station for forecasting each message of the customer and also pays the Telco for the mobile connection. The radio station pays to the Foroba Blon service provider for the service. The primary objective of the radio station is to serve a wider audience. A listener only receives announcements that are broad-casted. By broadcasting one announcement, the radio station reaches out to 80,000 listeners(Shiang et al., 2017) potentially. Getting more audience is of immense value to the radio station as it could be a medium to attract other sources of revenue such as advertisements (not shown in the model).

5.2.2 The revised e^3value model for Foroba Blon

In this section, two revised e^3value models have been proposed for Foroba Blon. The number of actors involved are similar to the existing model.

In the first model, the area of difference is that the actor, Village Reporter has been replaced by a "Community" of Village Reporter over a "Market Segment" of Village Reporter as shown in figure 5.6.

The Village Reporter has been introduced as a "Community" due to a number of reasons:

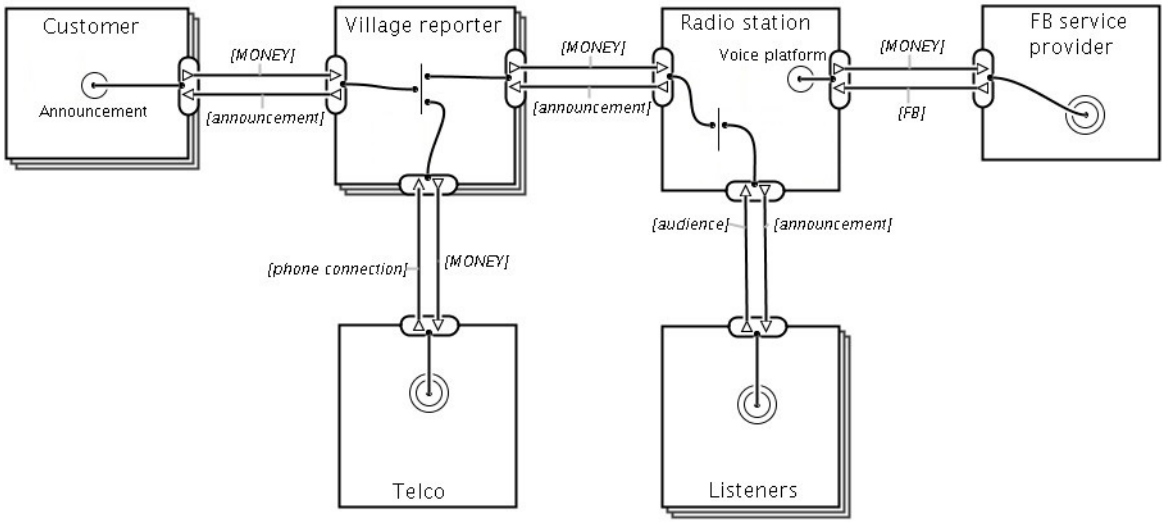

FIGURE 5.5: The e3 value model for Foroba Blon

1. By providing their service as a community, the village reporters can decide on a nominal amount of fees to charge the customers. By reducing the price charged to the customer, they can attract more customers to report their messages.

2. Secondly, working as a community eliminates competition among the village reporters. As a result, as a community they can negotiate the money charged by the radio stations. Previously, with the existence of the market segment of village reporters, the village reporters had to pay the exact money that was asked by radio stations without having any room for negotiation. With the revised modeling technique by the introduction of the "Community" construct they can negotiate rates as a "Community".

3. Thirdly, the village reporters can together own one or more mobile connections as a "Community" that eliminates the need of possessing one mobile phone each any paying individually. By owing mobile phone the cost of maintaining the phone can be shared and the cost of possession reduces significantly.

4. Fourthly, with the introduction of the "Community" the village reporters could have a far reaching impact with respect to reaching out to customers from various villages and collecting messages from them. It is assumed that each village would have a village reporter representing the village. These reporters from several villages could form a community of village reporters.

It is observed that, adding the "Community" construct to the existing e^3value model increases the profitability of the case and make it more sustainable from a theoretical point of view in a long run. Moreover, it is able to capture the very idea which is central to ICT4D cases that value objects are exchanged mostly in a group or community. Therefore, the "Community" construct lays the very foundation of such cases.

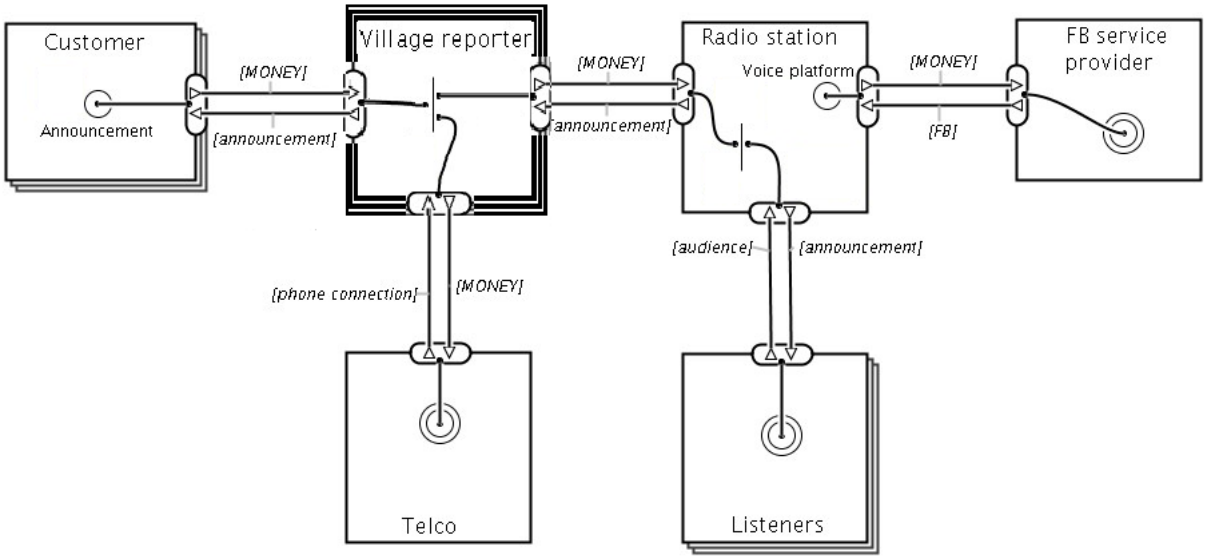

FIGURE 5.6: The revised e3 value model for Foroba Blon

Chapter 6

Treatment Reflection: Evaluation and Improvement

In this chapter, the treatment that is proposed in the previous chapter is evaluated and improvements are suggested based on this evaluation.

6.1 Treatment Evaluation

For modeling ICT4D cases using the *e*^{3}*value* methodology, it was important to understand the needs of such business cases and then model those using the tool. While studying about the ICT4D cases, it was observed the idea that was central to these cases was the sense of a "Community". This observation was further strengthened by modeling the m-Milk service, Penan Community Commerce service and the Foroba Blon service where the need of a new "Community" construct was strongly observed.

In all the above cases, value objects were exchanged in small groups. Hence, it was essential to introduce the "Community" construct into the existing *e*^{3}*value* methodology. Although all these cases were modeled using the existing *e*^{3}*value* methodology, it failed to illustrate the core concept of the ICT4D cases, that is, the exchange of value objects as a community or a group. Though, the concept of market segment partially explained the community scenario, the holistic view of the case was still not achieved. *The main argument was that, a clear, unambiguous meaning of the concepts of market segment and community was required.*

While modeling the m-Milk service it was further observed that some more modeling constructs were required in some cases. For instance, when both market segment of farmers and community of farmers existed paralley in the same model, it was essential to highlight the relationship between the two constructs. To capture that farmers in a community were also in a market segment and vice versa, the need of a construct to show the dependency relationship appeared. In order to achieve this the *"Set Operator"* concept was introduced in the *e*^{3}*value* ontology. The purpose of the new concept was to capture the dependencies of the two actor sets "Community" and "Market Segment" on each other.

Thus, together with the new "Community" construct and the "Set Operator" construct, two more cases, namely, the Penan Community Commerce and the Foroba Blon were re-modeled. It was observed that the new constructs had significant influence on the sustainability and the profit ratio of the business cases. By introducing these new constructs into the *e*^{3}*value* methodology could possibly improve the success rate in terms of sustainability and profitability of the projects. For example, in the Penan Community commerce, by modeling the webshop as a community run

service, eliminates the dependency of the webshop on the telecentre. Further, by being a community run service, the webshop need not be dependent on the university for long term funding. The funding could be used to train the inhabitants to run the webshop and eventually the training will lead them to run their shop on their own.

In the Foroba Blon case, the use of the community construct is seen to have influence on the profit margin of the actors involved. By modeling the village reporters as a community, it is observed that they could negotiate rates with the big players, namely, the radio stations who is seen to make the most profit. Working as a community eliminates competition among the village reporters, fetches them more customers, reduces maintenance cost in terms of phone connection and enables them to negotiate rates with the radio stations.

It is observed that it is crucial to include the community construct in the existing *e*^{3}*value* methodology. It not only simplifies the representation of actors in the case but also presents a holistic view of the ICT4D cases. It also has far reaching consequences with regards to sustainability and profitability of the projects.

During the research, several insightful questions were raised with regards to the absolute necessity of introducing a new construct in the *e*^{3}*value* methodology. Some of the questions are:

1. Is it essential to introduce the "Community" construct? In other words, can the concept of community not be captured using the additional informal natural language description?

2. Is the additional "Community" construct really needed or the same result can be achieved otherwise?

In order to answer these questions, the practitioners, as well as, the creators of the tool were interviewed for their validation. With the aid of the provided feedback, the new construct was further consolidated. It was highlighted during the interview that the construct of "Community" was necessary with regards to the ICT4D cases. The existing construct which is the market segment is itself a class or in other words, are set of instances that are copies of each other. In contrast, a "Community" is a differentiated network having network of actors who are not copies of each other but are individuals who contribute to the value constellation differently. These individuals have agreements amongst each other and also they have their own economic nature.

Thus, the first question whether it was essential to introduce the "Community" as a new construct was answered on the basis that the existing construct "Market Segment" and the new construct "Community" are two different concepts. As a result, the practitioners of the tools advocated that it is important to separate the two concepts and introduce the notion of "Community" into the modeling construct.

Secondly, while answering the second question, the interviewees were presented with alternative models (as shown in the Appendix) of the Penan Community Commerce and the Foroba Blon service where the market segment was used to express the notion of community by placing the value interface at certain positions of the market segment icon (as previously discussed in Chapter 3). This review session led to the further validation of this research. Although, it was desired to have minimalistic representation of concepts, but also the need to differentiate the concepts of "Market Segment" and "Community" was strongly advocated. The models having "Community" construct was preferred over the models using the "Market Segment" to capture both the concepts. Thus, thorough the interviews, it was validated that this research was able to provide a clear picture of ICT4D cases, by capturing the unambiguous meaning of the concepts of market segment and community,

6.2 Treatment Improvement

Improvements regarding the introduced "Community" construct is discussed in this section. During the research while modeling the various ICT4D business cases, several observations were made.

1. *Cannot model the value divisions among the actors within the community.* The aim of this research was to find the shortcomings of the e^3*value* methodology in modeling ICT4D cases. The entire research was conducted from a modeling perspective. After identifying the inability of the e^3*value* tool in modeling the notion of a group or co-operative a new construct named "Community" was introduced. A modeling icon was selected which pictorially represented the notion of a group and cases were modeled using the new "Community" construct. Since the aim of the research was to evaluate the e^3*value* methodology from a modeling perspective, the financial calculation has not been studied. The new construct just introduces the notion of community but does not model the value divisions within the community.In the current research it is assumed that everyone in the community gets an equal share which is unlikely in real world scenarios. A significant improvement over the current research would be to perform an in-depth study on how the value is divided between the different actors within the community.

2. *Observation 2: Modeling the internal structure within the "Community" is limited*. In this research, the concept of community in a broader context has been presented. A notion of subset is provided to capture the internal structure of the community to some extent. For instance, in the Penan Community commerce, a craftsman is a seller at the webshop as well as an operator of the webshop. He belongs to a subset of the market segment of craftsman who perform both the tasks. In a real world scenario, there are several actors within the community who perform a variety of tasks. For instance, a person in a community may be responsible two or more tasks, for managing the cash as well as acting as a transporter. A major improvement over this research would be modeling the internal of the community. A detailed study from a modeling perspective, on understanding the various layers of actors within the community and how each of these layers interact with each other would be a major improvement over the current research.

Chapter 7

Conclusion and Future Work

7.1 Key Points

In this paper, a new modeling construct, "Community" has been proposed as an extension to the existing *e*^{3}*value* methodology. The aim of the construct is to present a more holistic view of the ICT4D cases. Using the new "Community" construct several ICT4D cases have been modeled to demonstrate the importance of inclusion of the community concept in these cases and the consequences it has on sustainability and profitability of such projects.

At first a thorough research was performed to understand the needs of ICT4D cases by studying several ICT4D business cases. Then, the *e*^{3}*value* methodology was used to model three cases namely the m-Milk service, Penan Community commerce and the Foroba Blon service. The shortcomings of the *e*^{3}*value* tool with regards to modeling a group of farmers, was illustrated while modeling the m-Milk service. Further, improvements were suggested in modeling techniques to capture certain socio-economic relationships like community or group which were previously not included in the tool.

In addition, the efficiency of the improved technique, that is, by including the "Community" construct, was demonstrated by modeling two other ICT4D business cases, namely, the Penan Community commerce and the Foroba Blon service. In the above cases it was illustrated how efficient the "Community" construct was in capturing community bases e-service. The entire research was conducted in close collaboration with the creators of the *e*^{3}*value* tool. Hence, this new addition is validated by the practitioners of the methodology. Additional work with regards to financial calculation must be integrated with this research in order to present a more profound and constructive ICT4D business case model.

7.2 Reviewing the Research Questions

The research question (section 1.3) that were formulated at the beginning of the research has been reviewed in this section. Each of all the six research questions have been answered and the reference to these questions has been provided.

1. *"What is ICT4D?"*. ICT4D refers to providing e-services in resource poor environments with low infrastructure by applying information and communication technologies. The answer to this question can be reviewed in Chapter 1.1: *Context*. Further in Chapter 3 (*Understanding the Problem: The Mali Milk Service*), an ICT4D case, named, the Mali Milk Service has been studied to understand the concept of ICT4D in depth.

2. *"What is the* e^{3}value *methodology?"*. The *e*^{3}*value* methodology is a conceptual modeling tool for assessing the sustainability of a business idea. The review of

this research question can be found in Chapter 2: *Literature Overview*. In addition, the application of the *e*^{3}*value* methodology in modeling such ICT4D cases can be found in Chapter 3 (*Understanding the Problem: The Mali Milk Service*) which further helped in understanding the *e*^{3}*value* methodology applied in a real world scenario.

3. *"What specific business model requirements hold for ICT4D project?"* The idea that is central to ICT4D project is that, in these business cases trade is conducted in group or co-operatives. Thus, the specific business model requirement for ICT4D project is having a "Community" construct in order to model these cases involving "Community" or co-operative. Further, it is very likely there are more improvements that could be made over the existing *e*^{3}*value* methodology, but, due to time constraint the focus was mainly in introducing the "Community" construct and validating the new addition. The answer to the fourth research question can be reviewed in Chapter 3: *Understanding the Problem: The Mali Milk Service*

4. *How can the* e^{3}value *methodology be improved to make it usable for ICT4D?* For improving the *e*^{3}*value* methodology it is essential to incorporate the "Community" construct to make it usable for ICT4D projects. A detailed review of this research question can be found in Chapter 4: *Treatment Design: Modeling communities in the* e^{3}value *methodology.*

5. *How can the suggested improved techniques be tested to demonstrate its usefulness?* The introduction of the "Community" construct that was suggested in Chapter 4 is further tested by modeling two other cases namely the Penan Community Commerce and the Community Radio Journalism of rural area Mali. The answer to this question can be reviewed in Chapter 5: *Treatment: Case Study of Community commerce for Penan community and Community Radio Journalism of rural area Mali.*

7.3 Future Work

One of the things that is central to the *e*^{3}*value* modeling technique is financial calculation. The aim of this research was to evaluate the *e*^{3}*value* methodology from a modeling perspective. As a result the financial calculation has not been studied. In the scope of this research, it has been assumed that everyone in the "Community" gets an equal share which is unlikely in real world scenarios. It would be interesting to observe how the money is distributed within the "Community". In addition, it must be studied whether it is necessary to include some more new constructs (e.g. new value interface) to capture those value transfers within the "Community" or is it sufficient to use the existing value interfaces to capture the same. Thus, more detailed research is essential to model the value transactions between the community and the actors within the community.

In addition, further research can be conducted to model the internal structure within the community. For instance, in the Milk service case, broad overview of the farmer community has been provided. The internal structure of the community, that is, where there are further sub-divisions, such as a transporter within the community, who manages the transport of milk to the buyers has not been studied. The various layers within the community construct could be studied to have a more concrete grasp into the cases.

A possible area of further work is having a concrete definition of the "Community" construct that has been introduced. In this research only discussion of concept has been made without introducing a formal definition of the "Community" in the context of ICT4D cases. Hence it is essential to have a formal definition to introduce the concept to readers. In addition to this, the need for defining the characteristics of the "Community" is also observed. This along with the definition will provide the readers a holistic view of the concept of "Community".

Appendix A

Alternative Models

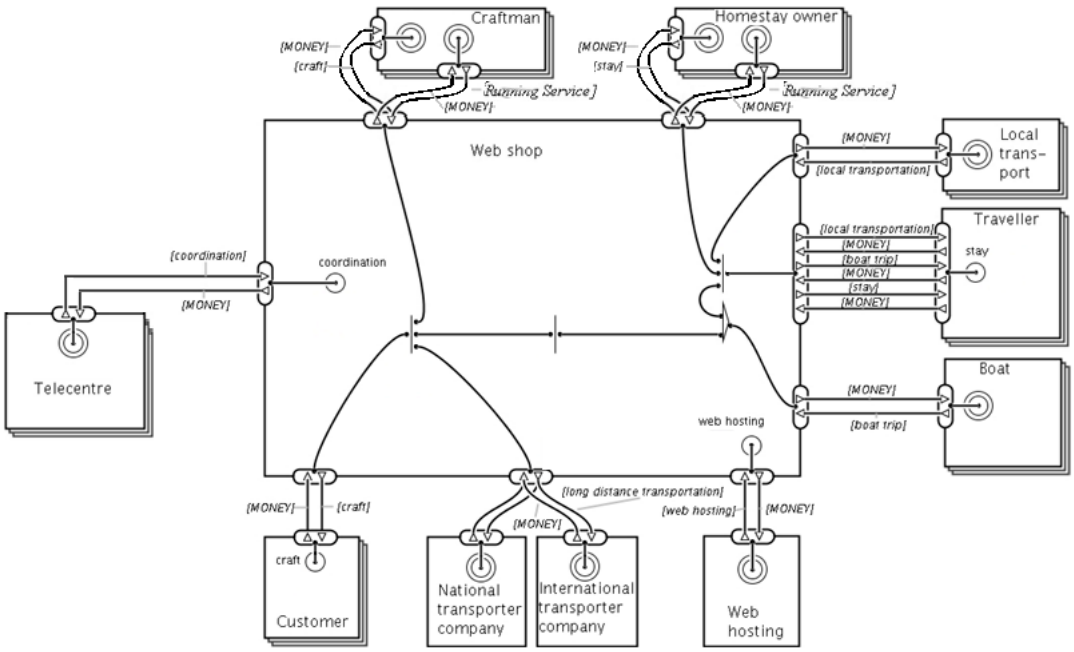

FIGURE A.1: The alternative e3 value model for Penan Community commerce

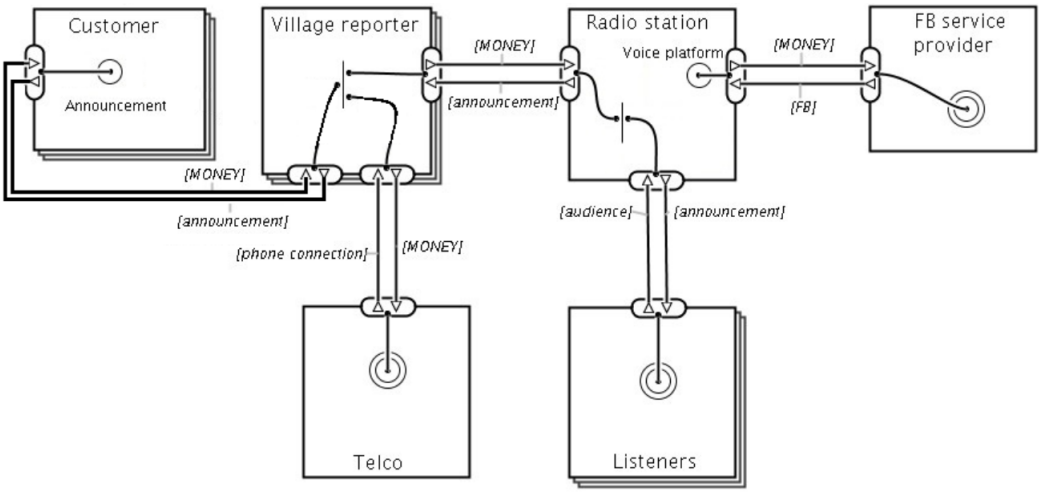

FIGURE A.2: The alternative e3 value model for Foroba Blon

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