Validated Model for Operational Monitoring of Telecentres' Activities in a Developing Country

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Abstract

A telecentre may be defined as a facility that provides affordable universal access to telecommunication services (such as voice calls and internet access) and office services (printing, photocopying, fax, and typing) to under-privileged communities. Under-privileged communities in South Africa are disadvantaged by lack of financial resources and ICT access, and by low literacy levels. USAASA, a government agency, sets up telecentres in these under-privileged communities and gathers information regarding universal service and access to ICTs.

Over the past decade, a number of researchers have highlighted the need for effective monitoring of telecentre activities and regular evaluation of telecentre sustainability. In support of these researchers a Malaysian study concluded that telecentre implementations often failed to provide strong systematic monitoring and evaluation systems. One of the reasons why these monitoring systems have not been implemented is the absence of a monitoring model for telecentres which our study addresses by designing and validating such a model. As our basis for this model, we used iterative semi-structured interviews with telecentres' multiple stakeholders from diverse groups to ascertain their needs, their business processes and to obtain sample data for model validation. These interviews produced a set of requirements and scenarios which were complemented by research results from literature. These requirements were validated using a checklist of scenarios based on use cases. The business processes, which are contained within the scenarios, have been displayed in an operational model using the Unified Modelling Language (UML)

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activity diagrams and use cases. A prototype has been developed based on the business rules expressed in these processes.

This operational monitoring model was validated using a triangulation of walkthroughs, expert opinion and dynamic analysis using the prototype. This model forms the basis of monitoring activities, which will provide data in order to make informed decisions on sustainability issues, at telecentres internationally.

Keywords
Telecentre, Monitoring model, UML

Introduction

Public access to Information and Communication Technologies (ICT's) by under privileged communities remains a challenge in many developing countries. Although a telecentre is a means to provide access to these technologies, the monitoring of the activities of these telecentres have been identified as a challenge by (McConnell 2001; Harris 2007;; Jacbs S. Jand Hen M. E., and by the area and telecentre managers from South Africa. This paper proposes a validated Telecentre Monitoring Model (TMM) which can be used to effectively monitor and report on activities of a telecentre operation. A model is a simplified representation of the real world and is built to provide a better understanding of a complex system being developed (Milicev 2008). The model is developed using requirements from literature and from expert opinions and is presented using the UML.

Literature review

Context and gap

According to the International Telecommunication Union (ITU) Information and Communication Technologies (ICT) 2013 Report, only 39% of the world's population use the internet. The distribution between the developing and developed worlds is 31% and 77% respectively. Further, household internet connectivity rates between the developing and developed worlds are 10% and 78% respectively. These figures highlight the existence of the digital divide and allude to the lack of access to information and connectivity to the internet by the developing world. One of the programs to bridge this digital divide is the implementation of telecentres as ICT facilities to enable access by under-developed communities.

Definitions of Telecentres

Different criteria are used by researchers to define telecentres e.g. (Jensen and Esterhuysen A.01) use ownership, (Esterhuysen A.01) use the type of equipment, (Roman 201) and (Gomez R.. al. 1999) place emphasis on the implementation and usage of telecentres, and (Hudson H.999)defines them as places which offer public access to telecommunication services. The most common definition of telecentre uses the services and the management model as recently defined by (TRA) position paper on telecentres 2012) whoused the following criteria: telecommunication services (such as voice calls and internet access);, IT services (printing, photocopying, fa, and typing); and the management

model based on the type of ownership. This ownership could be commercial, franchise, Non-Governmental Organisation (NGO), uUniversity, sSchool, mMunicipality / sStte or mMultiurpose. Te purpose of suh facilites is to allow access in a public place where people can access computers, and other digital technologies that enable them to gather information, create, learn, and communicate with others while they develop essential digital skills.

Traditional data collection methods of telecentres

Telecentres have been researched in the areas of sustainability, service usage and models of implementation. Research has shown that interviews and questionnaires are the most commonly used methods to collect information regarding telecentres and their usage. Furthermore, the most common attributes used from this collected information are age category, occupation, gender, number of users, number of visits, services offered and services used, and equipment at the telecentres (Cheang and Lee 2010; Alasow et. al. 2010; Rajapakse 2012; Gomez et. al. 2012; Lashgarara et. al. 2012; Abdulwahab and Dahalin 2012; Cheuk et. al. 2012). These common attributes are also attributes identified as being necessary, through interviews with telecentre managers in South Africa, for collection for monitoring purposes. In his work Gomez (2012) examined the user profiles and services rendered in 25 developing countries around the world, in particular 799 user surveys were completed and analysed in in South Africa alone. This indicates the large amount of work needed to collect, analyse and manage the data. Furthermore these manual based research techniques require minimal training of staff in the data collection process in order to assist the researcher, (Gomez, t. al. 1999). This is only one of many such manual surveys carried out by many researchers over the decades to gather information on users and usage of telecentres. These manual surveys are conducted at ad-hoc intervals which produce snapshot data; our TMM will provide continuous data of user and usage profiles. Harris R.200) observed and interviewed 800 users at seven sites users in Malaysia. These methods of data collection are not only costly and time consuming, but their implementation has been done sporadically.

1.1 The need for real time electronic monitoring

Harris (2007) concluded that even programs that were meant to demonstrate the potential of ICTs through pilot projects have often failed to implement strong monitoring and evaluation systems to systematically capture what has been learned. Because of the lack of monitoring systems, researchers have been unable to effectively and timeously identify the success factors that could be implemented at telecentres operating in similar conditions. The availability of ICT's allows real time monitoring of telecentre activities. Throughlows data to be collected from device sensors and process monitoring agents in real time; this data ired in a database for future reporting. The avs and Hersleman (2006) proposed that such systems can support community centre staff and enable management to provide and improve service to users. These shortcomings in data collection can be addressed using an appropriate TMM with ICT that can be implemented at telecentres. Such a model will need to be general so that it can be adopted internationally and used throughout the lifetime of the telecentres.

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Gomez and Reilly's (2002) research, on the needs and expectations of telecentre operators in Latin America and Caribbean revealed that monitoring and evaluation is not strong in the region and in particular:

- Monitoring often did not begin immediately after implementation, but rather at the very end of a long term project; consequently the data detailing the continuous impact of the project was not captured;
- Monitoring during projects was mostly used as a means to correct errors and introduce efficiencies;
- Evaluations have been either part of needs identification exercises, or carried out by external parties;

Razak's (2009) paper discusses the factors that contribute to the sustainability of telecentres in Malaysia. One of the key areas he highlighted is "to institutionalize evidence and inform policy and practice via adopting improved methodologies for monitoring, evaluating of e-inclusion programmes and continuous monitoring", (Razak 2009)

Although telecentre research has been conducted in terms of roll out of telecentres, services offered, and its impact, the results of such research are made available after a long period of time, in some cases well over a year or two later. This lack timely information makes it difficult to make management decisions which results in decisions on sustainability of telecentres being delayed. Services and internet usage trends are not currently monitored in real time at the telecentres. Consequently, stakeholders do not have sufficient and relevant information to support their decision making processes resulting in incorrect decisions in the areas of further investment in infrastructure, designing of customised services, staffing, support etc.

Record Keeping and reporting

Telecentres must be continuously and automatically monitored throughout its lifetime as highlighted by (McConnell 2001). As a solution to this monitoring problem, it is necessary to develop an electronic monitoring and reporting system as required by Gomez et al. (1999). Such a system would assist to collect, analyse and report on telecentre activity data as suggested by (Young et. al. 2001; Kyabwe and Kibombo 1999); and Cocchiglia 2004).

According to Bailey (2009) researchers have suggested that telecentre staff be included in the monitoring and evaluation processes in order to allow the opportunity of feedback from the community. However, even the inclusion of the community will require an effective monitoring model to ensure that the data is collected regularly and saved so that it can be referenced and analysed at a later stage. Such a model can provide ongoing feedback to the community on a regular basis.

South African context of telecentres

An initial study of telecentres in South Africa by Benjamin (2001) identified several challenges that inhibit sustainability such as financial support, equipment failure and technical support. Further there is no sustainable model for telecentres or cost effective monitoring model as yet that can be rolled out on a large scale for South Africa.

Consequently, the direct impact of these telecentres on the rural communities is yet to be studied and analysed on a continuous basis.

As a partial solution to this monitoring issue the development of a monitoring model, along with the data it gathers, could be a valuable resource for future research on measuring the impact on rural communities. One of USAASA's (Universal Service Access Agency of South Africa) strategic objectives is to monitor and evaluate the extent to which universal access and services have been achieved in these communities. In particular one of the key performance indicators is to develop a monitoring and evaluation tool, (USAASA Business Plan, 2011).

According to Gomez (2012), attempts by the South African government to improve access to ICTs have been slow to develop and consequently have not had a major impact in the public. Many of telecentres that were setup did not function well, and many of them no longer operate. He further notes that the USAASA has not met its announced goal to establish additional telecentres, especially in rural areas. New strategies have been established in the USAASA in which its future role will focus more on policy than on implementation. They have now refocused to form partnerships with organizations that are tasked to implement telecentres.

Methodology

Introduction

Our literature review identified a need for electronic monitoring of telecentres. In order to implement this model, we needed to design a model that will incorporate all the business processes that are related to monitoring of telecentres. This model will ensure that all incoming data with respect to the user and service usage profiles are correctly captured within their processes. This data will form the basis of reporting for management, sponsors and researchers. A series of semi-structured interviews were used to obtain the requirements as the business processes were not well defined. Walkthroughs ensured that all paths of the draft model were covered. Expert opinion was used as the area manager and telecentre managers were experts in this field. Dynamic analysis of the prototype and the TMM demonstrated that in real world conditions the prototype functioned and the actual outputs matched the expected outputs as anticipated by the business logic. Triangulation of these methods indicated by Figure 1 guaranteed that the requirements and the TMM was validated accurately as the deficiencies of any one method can be overcome by combining methods and thus capitalizing on their individual strengths, (Yeasmin and Rahman 2012).

The requirements were formulated into specific scenarios that encompassed the activities of the telecentre. Scenarios have been advocated as an effective means of acquiring and validating requirements as they capture examples and real world experiences that users can understand (Potts et. al. 1994). The validation of the requirements and the TMM was carried out through a triangulation of methods which included walkthroughs, expert opinion and dynamic analysis.

Figure 1: Triangulation of methodologies

Requirements gathering

The first step in designing the TMM was requirements gathering from telecentre managers. The TMM is a model designed from the requirements which represents the activities, and their interactions with external entities, that are performed at a telecentre. The data generated from these activities and interactions are captured for monitoring purposes. This includes the actions that are performed prior and after the service being used. UML is a standardized, object-oriented, visual language for modelling software intensive systems (Milicev 2008) which offers multiple perspectives of the TMM. The scenarios are easily understood by the end users (telecentre managers) whilst the developers will use the activity diagrams and use cases to develop the system. UML activity diagrams are used to model the telecentre activities with specific emphasis on monitoring. Scenarios described by the telecentre managers are grouped into use cases that can be easily modelled. The use cases are documented using the template described in table 1. Each use case is allocated a unique identification number which is later used to associate it with the scenarios. The use case is also related to a specific requirement obtained from the semi-structured interviews and each use case achieves a specified goal. The use cases are illustrated using the symbols in figure 2 where the actors include persons and / or subsystems interacting with the system.

Category	Description
1. Use Case No	Use Case Identification
2. Related Requirements	Indicate the requirements this use case partially or completely fulfils.
3. Goal In Context	The use case's place within the system and why this use case is important

Table 1: Use Case Definition

To begin our requirements gathering process, a series of semi structured interviews of key stakeholders comprising of the area manager and telecentre managers were used to obtain preliminary requirements. These requirements and scenarios of the activities performed at the telecentres were used to draw a draft TMM as illustrated in the first half of figure 3. The processes modelled in the TMM, and detailed scenarios defined using criteria in table 2, were used to create the use cases. The drafting of the use cases was an iterative process and each iteration further refined the use cases, scenarios and the TMM.

Category	Description
1. No	Scenario Identification
2. Name	Scenario Name
3. Preconditions	What needs to happen before the use case can be executed?
4. Successful End Condition	What should the system's condition be if the use case executes successfully?
5. Failed End Condition	What should the system's condition be if the use case fails to execute successfully?
6. Primary Actors	The main actors that participate in the use case. Often includes the actor that triggers or directly receives information from a use case's execution.
7. Secondary Actors	Actors that participates but are not the main players in a use case's execution.
8. Trigger	The event triggered by an actor that causes the use case to execute.
9. Main Flow Action Steps	The place to describe each of the important steps in a scenario's normal execution.
10. Extension Branching Steps	A description of any alternative steps from the ones described in the main flow.

Table 2: Scenario definition

Figure 2: Use Case Diagram Key

Figure 3. Methodology to build and validate the TMM

Requirements Validation

The methodology to validate the requirements and build the TMM used is illustrated in Figure 3. Based on related research, we derived a set of commonly used attributes required for of monitoring activities at most telecentres throughout the world. This group of attributes were reviewed and validated by domain experts from USAASA. The expert opinions from the area manager and telecentre managers form an integral part of the modelling, requirements definition and validation processes.

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The requirements consisting of scenarios, use cases and the draft TMM were validated using a walkthrough and expert opinion to produce a checklist, validated requirements and a validated draft TMM as illustrated in Figure 4. Using a checklist of scenarios and business rules in conjunction with a walkthrough, it was ensured that all scenarios and all possible paths of the draft TMM were covered. In addition to the walkthrough, expert opinion was used to validate the requirements and the draft TMM as indicated in figure 4.

Figure 4. Requirements Validation Process

TMM Validation

After the requirements were finalised and validated, a prototype was designed. A normalised relational database consisting of attributes relevant to the TMM was constructed using Microsoft SQL Server. The prototype of the TMM together with its business rules was created using Microsoft .Net. The prototype included a dashboard consisting of sample proposed views of information to demonstrate the potential results of the TMM.

In order to simulate the operations of a telecentre, a set of sample data was carefully captured to cater for all possible scenarios. Test data for the user profiles and scenario usage data was generated to cover all possible combination of users and service usage. A total of one thousand combinations of usages of the different services were created to provide a wide range of data including exceptional circumstances.

Figure 5 illustrates the validation process of the TMM where scenarios, prototype and the TMM formed the inputs. The prototype, scenarios and TMM inputs were fed into the walkthrough, expert opinion and dynamic analysis processes to produce a validated prototype, comments from stakeholders and a validated TMM. Expert opinion was used because the key stakeholders had firm knowledge of the telecentres domain and of business processes including exceptional circumstances. This expert opinion was also a very accurate method of ensuring coverage of all possible activities and all contingencies. A walk through was conducted with sample data to ensure proper outputs were produced and all paths were followed. Dynamic analysis of the prototype was used to ensure that proper outputs were produced by the prototype matched the expected outputs as defined by the sample data inputs and the business rules.

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Figure 5. TMM Validation Process

Results

Requirements

After a series of interviews with telecentre stakeholders we obtained the requirements and scenarios. Using these scenarios which covered all possible activities of the telecentre, we derived a draft TMM and use cases. Several iterations of walkthroughs and expert opinion sessions affirmed that the use cases and scenarios were accurate and a complete representation of the requirements. The checklist that was produced ensured coverage of all scenarios during the walkthroughs. A total of 15 use cases listed in table 1 covering all possible scenarios were created. Five of the most important use cases that are related to user profile and service usage and that will deliver the information required by the telecentre mangers and researchers are explained. For the purposes of this paper these five main use cases together with one scenario for each of the use cases is discussed. Each of the use cases were documented in Tables 4 to 8 using the template and were complemented by use case diagrams in Figures 6 to 10. These use cases together with their respective scenarios are documented in Table 3. Besides use cases related to the service offering, additional use cases were identified to monitor power and internet connectivity.

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No	Name	Description
UC01	Acquire Equipment	Maintain an inventory of equipment that will be used at the telecentre.
UC02	Dispose Equipment	Removal of unusable equipment from inventory
UC03	Request Service	The users request for a service from the administrator is logged.
UC04	Allocate Service	A User is allocated a service by the Administrator
UC05	Start Application	Log the start of application
UC06	Terminate Application	Log the close of an application
UC07	Complete usage of service	Log the completion of usage of a service and completion of a survey.
UC08	Bill Service	Bill for all services rendered
UC09	Make payment	Record all payments received
UC10	Identify Internet connection fault	Record all internet connection failures
UC11	Restore Internet connection	Record all internet connection restorations
UC12	Power failure	Record all power failures
UC13	Power restored	Power is restored
UC14	PC is switched on	Record all instances when the PC is switched on
UC15	Equipment is switched off	Record all instances when the PC is switched off

Table 3: TMM Use cases

Figure 6 illustrates the “Request a service” use case “UC03” that is described in Table 4, of a user who requests a service from the administrator who will log the request in the service request log. The administrator logs the user profile comprising of the age and the occupation category together with the services requested. In this scenario the process can follow three possible paths viz. firstly the service is usable and the user can perform the task, secondly the task is handed over to the administrator to perform and lastly, service is not available.

Category	Description
1. Use Case No	UC03
2. Related Requirements	Request a service
3. Goal In Context	The users request for a service from the administrator is logged.
Scenario	
1. No	UC03SC03
2. Name	Request a PC to use an application
3. Trigger	User arrives at the telecentre to use an application on a PC.
4. Main flow action steps	1. A user requests to use a PC for an application. 2. The administrator enters the user profile where the following detail is captured: Services requested, Occupation, Age category 3. The administrator saves the profile in the service request log. 4. The user joins the queue.
5. Extension branching Steps	3.1 The user requests the administrator to perform the task. 3.2 The use exits. 4.1 The service is not available / unusable. 4.2 The administrator captures a reason for non-usage of service. 4.3 The user is removed from the queue. 4.4 The user exits.

Table 4: Use case and scenario – Request a service

Figure 6. User case – Request Service

Figure 7 illustrates the “Allocate Service” use case “UC04” described in Table 5, of a user who is allocated a service by the administrator. This allocation of service to the user is logged by the administrator together with the user profile in the service request log. The use case diagram Figure 7 illustrates that one of the actors is the “service request log” as this unit delivers part of the input whilst the remaining actors are the administrator and the user. The scenario “UC04SC02” allows the date and time of allocation together with the equipment and services to be logged together with the user profile. This data is used for operational and reporting purposes.

Category	**Description**
1. Use Case No	UC04
2. Related Requirements	Allocate Service
3. Goal In Context	A User is allocated a service by the Administrator
Scenarios	
1. No	UC04SC02
2. Name	Allocate PC for application usage
3. Trigger	Availability of service and a user is in the queue for the service
4. Main flow action steps	1. The User / Administrator is allocated a PC for Application usage. 2. The administrator captures the service allocated and Equipment ID against the user profile.

Table 5: Use case and scenario – Allocate a service

Figure 7. User case – Allocate Service

Figure 8 illustrates the “Complete usage of service” use case “UC07” that is described in Table 6, of a user who informs the administrator the he has completed usage of a service. In the case of the user utilising a service on a PC, he will close all applications and report to the administrator. The user has the option of completing a survey. If the administrator has performed the activities on behalf of the user, the administrator will notify the user that

the work has been completed. The administrator will optionally complete a survey and then hand the work to the user.

Category	Description
1. Use Case No	UC07
2. Related Requirements	1. Complete usage of service
3. Goal In Context	2. Log the completion of usage of a service and completion of a survey.
Scenarios	
1. No	UC07SC01
2. Name	Complete usage of the service
3. Trigger	Administrator / User has completed usage of the service.
4. Main flow action steps	1. The Administrator / user closes all applications. 2. The user reports to the Administrator. 3. The Administrator / user completes a survey. 4. The user exits
5. Extension Branching steps	3.1 The Administrator notifies the user for the completed task. 3.2 The user collects the competed work. 3.3 The user exits.

Table 6: Use case and scenario – Complete usage of service

Figure 8. User case – Complete usage of service

Figure 9 illustrates the “Bill usage” use case “UC08” that is described in Table 7, of an administrator who checks the availability of the requested service and bills the user for the service. The cost is calculated, recorded and the receipt is printed. If the user is an account customer then the account is debited else the user is billed for the service usage. The University of South Africa (UNISA), an example of an account customer, has an agreement with some of the telecentres in South Africa for students to utilise the telecentres for which they will settle the account.

Category	Description
1. Use Case No	UC08
2. Related Requirements	Bill Service
3. Goal In Context	Bill for all services rendered
Scenarios	
1. No	UC08SC01
2. Name	Bill usage
3. Trigger	User is in the queue and service is available.
4. Main flow action steps	1. The user requests the administrator for a service. 2. The administrator checks to see if the service is usable. 3. The administrator calculates the cost and records it. 4. The receipt is printed. 5. The user pays for the service requested.
5. Extension branching Steps	3.1 The user positively identifies himself. 3.2 The cost is billed to the institution responsible for the payment e.g. UNISA.

Table 7: Use case and scenario – Bill Usage

Figure 9. User case – Bill usage

Figure 10 illustrates the “Make Payment” use case “UC09” that is described in Table 8, of user who make payment to the administrator for the service usage.

Category	Description
1. Use Case No	UC09
2. Related Requirements	Make payment
3. Goal In Context	Record all payments received
Scenarios	
1. No	UC09SC01
2. Name	Payment for service
3. Trigger	A user requests for a service that is usable.
4. Main flow action steps	1. The bill is presented to the user 2. The user pays the administrator for the service.

Table 8: Use case and scenario – Make Payment

Figure 10. User case – Make Payment

TMM

As the requirement were refined, the draft TMM was altered to reflect these changes. After the requirements were validated, a final TMM was produced. Using the three methods outlined in the methodology, we validated the TMM. The telecentre experts affirmed that the TMM met their requirements and that there was a correlation between the business processes of the telecentres and the TMM. This model included all telecentre activities both pre and after service usage as indicated in Figure 11. One aspect of this figure illustrates the process of a user's request for a service and the administrator consequently logging the user profile together with the requested services. The user is billed and if the service is available, they are allocated the equipment to be used. The TMM caters for both cash and account users. If the service is not available, the user is requested to wait until the service is available. Should there be an interruption in service the user is reallocated the service or offered a refund where applicable. The user is requested to optionally complete a survey once usage is completed.

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Figure 11: TMM

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Self / Full Service usage

Some telecentres offer services on a self-service and / or full service model. In the case of a full service option, the user elects to hand over their work to the telecentre administrator to be completed by the telecentre staff and the user will be billed for the service. Once the task is completed, the administrator informs the user. Alternatively the user selects a self-service where they will request a service and perform the service personally. In both cases the model will capture the user profile and service usage together with the provision of payment. An example of this is shown in Figure 12. The start and end of applications and all domains visited are logged by the TMM.

Prototype

A prototype was developed from the TMM and use cases. Using the test data that was setup as in Table 9, 1000 scenarios were generated for a six month period covering all scenarios. This test data was comprised of the combinations of the different age categories, possible equipment and occupation categories as listed in Table 9. The prototype with its test data together with the TMM formed the basis of the dynamic analysis. Using dynamic analysis, we determined that the actual outputs of the prototype met the expected outputs as determined by the sample input data and the business rules incorporated within the telecentre business processes. Due to the matching of the actual and expected outputs produced from the selected input data, the dynamic analysis of the prototype validated the TMM.

Age Category	Application Name	Occupation Category	Services
Age 11 to 20	Word	Learner	Internet access
Age 21 to 30	Excel	Student	Word Processing
Age 31 to 40	Power Point	Entrepreneur	Print
Age 41 to 50	Publisher	Unemployed	Fax
Age 51 to 60	Outlook	Employed	Copy
Age 61 +	One Note	Retired	Scan

Table 8: Categories of data

Telecentre manager comments

Although the area manager and telecentre managers were impressed that the model met their monitoring requirements, they were further impressed with the potential reporting of the model after having captured the necessary data at an individual user and service usage level. In particular, they appreciated value of the TMM having the capability of aggregating data and producing graphs of service usage and total usage. Figure 13 shows the usage of different services over a six month period. The TMM's ability to change the

granularity of the reporting data enables it to be used to produce reporting for the different management levels as well as different perspectives of the information. The TMM reporting capabilities have the potential to inform government on continued subsidisation, sustainability and exceptional circumstances e.g. power and internet outage.

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Figure 12: Service usage

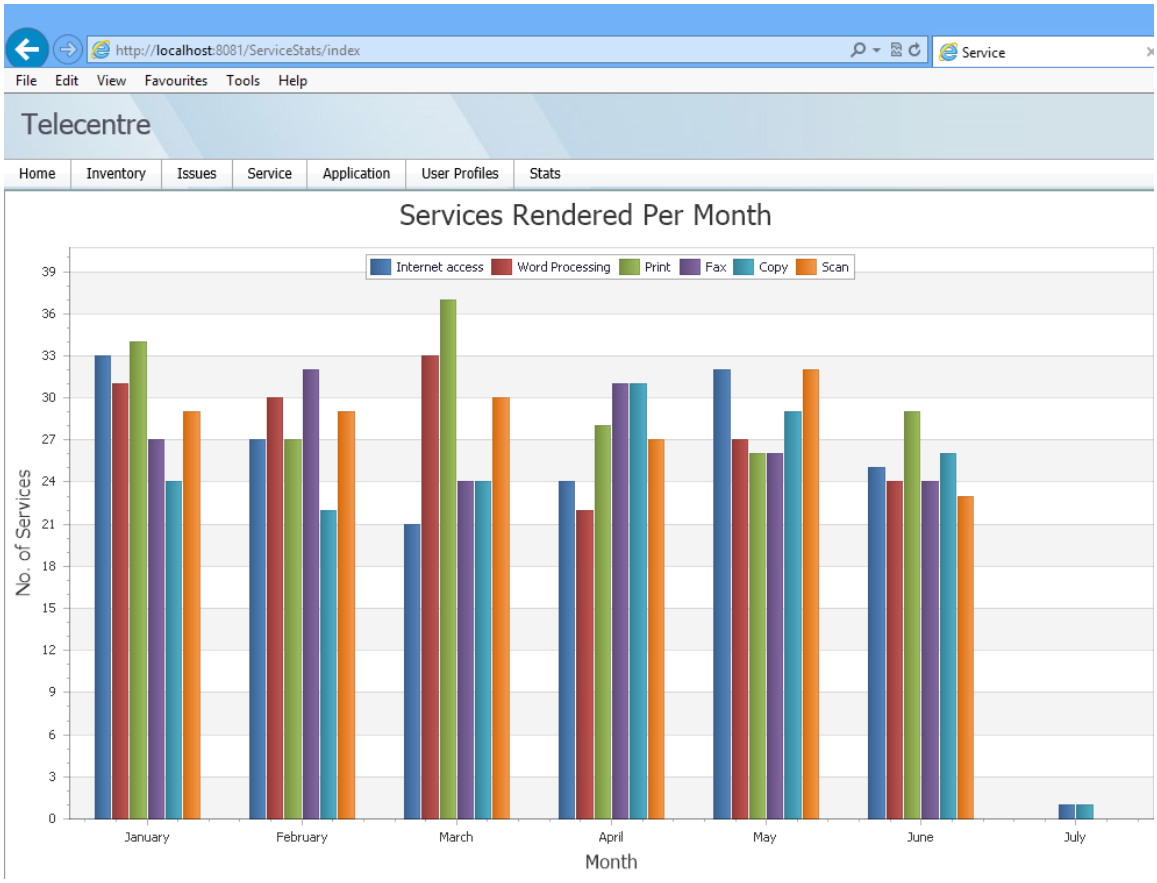

Figure 13: Graph of service usage over a 6 month period.

The managers noted that there were variations in the mode of operation across telecentres for the same activity. It was identified that there are different modes of charges e.g. one telecentre will charge for a pc usage which will include printing, word processing and internet usage whilst another telecentre will classify and charge for these services separately. Our TMM is adaptable to these different modes of operation. It will log the service usage whether it is charged separately or charged as a combined service. In the case of a combined service the service usages will be logged using monitoring software on the PC. In the case of separate charges the individual service usages will be logged by the administrator.

The area manager and telecentre manager recognised the potential to monitor the telecentre activities live from a remote site. Activities such as number of people in the queue, service usage and user profiles can be monitored live from the data captured by the TMM. They were further advised that this data can be summarised for each of the different provinces and for the country.

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Conclusion

Using a combination of methodologies we validated the requirements and the TMM. The requirements use cases and scenarios formed the basis for a prototype which can be developed further to a full working system that will satisfy USAASA's immediate reporting needs. We demonstrated the potential of the TMM to represent necessary attributes graphically to support decisions on sustainability, staff and equipment scheduling, funding etc. Further the correlation between the user profile together with service usage and financial data can be used to detect fraudulent activities and to support decisions made in this regard.
Future work can include implementing the TMM with the flexibility to support telecentres, sponsors and researchers. The TMM is a building block for the implementation and reporting of funding of users to use telecentres. Such a model will present information to all stakeholders timeously and cost effectively via a dashboard feature. Our TMM has generalised the attributes, scenarios and use cases of a typical telecentre that can be used locally and internationally.

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