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Papers for publication are welcome from researchers in Computer Science and Technology. Papers will be peer-reviewed by at least two reviewers who are active researchers in the respective area of each topic of the paper.

Primary Objectives:

- To serve as a forum for the advancement of computer science and technology.
- To contribute to a rapid information and knowledge exchange between researchers in computer science and technology.
- To serve as a forum for postgraduate students in computer science and technology to publish their thesis/research project results.
- To share best practices and case studies from practitioners in the industry that can be sources of new research ideas.

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Ontology for Research in Artificial Intelligence

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Abstract

An ontology is a vocabulary that describes the concepts and relationships in a particular domain serving as a knowledge representation. As there is no ontology for research in Artificial Intelligence (AI), this paper attempts to create an ontology for research in AI using OWL based Protégé 4, and then implements the ontology by building a website using HTML, CSS and JavaScript for the front end and PHP and MySQL for the backend. Input from experts is integrated into the ontology. The ontology has the research areas under AI as subclasses of the class "Research in Artificial Intelligence" and other fields that are related to AI as classes. These classes of research area have further subclasses such as "Software", "Tools," "Models," "Algorithms," "Data", "Hardware" and "Papers" relevant to the research areas. A class like "Place" where research in AI is conducted is included in the ontology. Most of these classes and subclasses are annotated with an explanation for the class. Object Properties and Data Properties are used to create relationships and axioms.

The website is designed to help those conducting research in Artificial Intelligence and is based on the ontology in that the classes and subclasses are menus and links on the website that lead to their own page. A user can register and then log in and update the website based on the ontology.

The ontology is evaluated and it well describes the domain of research in AI. The ontology can be imported for interoperability to develop and extend the ontology, for instance, to an ontology of AI, instead of just an ontology for research in AI, where education, jobs in AI and the like would be included in the ontology.

Keywords: Artificial Intelligence; Machine Learning; Computer Vision; Information Retrieval; Intelligent Interaction; Natural Language Processing

1. Introduction

Artificial Intelligence is the intelligence of machines. In Computer Science, an "intelligent" machine is an agent capable of reasoning that perceives its environment and takes actions that maximize its chances of success for some goal [2]. Artificial intelligence is a science of intelligence as it involves testable hypothesis underlying processes that are necessary for intelligent behavior. It is the study of mimicking perception, cognition, and action through using machines.

The main goal of AI research is to increase our understanding of perceptual, reasoning, learning, linguistic and creative methods. This understanding is no doubt helpful in the design and construction of

useful tools in science, industry, and culture. The major problems of AI research include reasoning, knowledge, planning, learning, natural language processing, perception and the ability to move and manipulate objects. General intelligence is among the field's long-term goals. Approaches include statistical methods, computational intelligence, soft computing (e.g., machine learning), and traditional symbolic AI. Numerous tools are used in AI, including versions of search and mathematical optimization, logic, methods based on probability and economics. The AI field is a combination of Computer Science, Mathematics, Psychology, Linguistics, Philosophy, Neuroscience and Artificial Psychology [2].

In Computer Science, an ontology is a formal naming and definition of the types, properties, and

interrelationships of the entities that exist in a particular domain. An ontology classifies the variables needed for some set of computations and creates the relationships between them. The field of artificial intelligence creates ontologies to limit complication and to categorize information. The ontology can then be used for problem solving [1].

Ontologies have been used to develop a common understanding in the field of medicine, e-tourism, construction, plans and planning information, workflow and management system endeavors, for defining and specifying products, for retrieving objects and invoking operations on objects across a network. However, to the best of our knowledge, there is no ontology developed for the field of research in Artificial Intelligence. As a result, there is no single agreed upon point of reference for research in AI, where most can agree upon as a set of concepts and relationships in the field, which can be used to develop software or websites for research in AI.

AI, as an emerging field that aims at making technological related products more intelligent and more useful to humans, would need a site of its own to aid those conducting research and to find all the information needed for those interested in the field. Particularly, a specific site for research in this area is relevant to facilitate research by providing all the tools needed in one site. The website built for this paper is constructed based on the ontology and helps those planning to conduct research in the field of AI, mainly serving as a place where they can access research materials, such as papers, books, tools, software, models, data, algorithms, and hardware in a specific research area and even guide them in choosing a topic by providing them with a list of current and future research topics or areas. Therefore, by first developing an ontology for research in the field, the ontology is implemented by building a site for the field.

This research is a combination of quantitative and design science research. As mainly a design science research, after identifying a gap on previous literature, solution design is presented. The

quantitative part of the research comes in as primarily the focus is on getting input from experts in the field in Ethiopia on the applicability of the ontology for research in AI through interviews and questionnaires and the input of experts by posting the ontology on the Web-Protégé website at Stanford University where users can edit the ontology and provide their comments.

Then an ontology for research in AI is proposed and implemented by constructing a web based system using WampSever 5, particularly HTML, CSS3, JavaScript for the front end and MySQL and PHP 5 to connect to the database and store and access data from the database. Finally, the developed ontology is evaluated by experts. The ontology can be updated by users on the website and on the Stanford University website, and hence the ontology goes through a constant wave of updating.

2. Related Work

There are quite a few papers on ontologies, although none on the domain of research in Artificial Intelligence. One of the papers, for example, is Cardoso's paper that is about developing an owl ontology for e-tourism. The paper uses OWL Full to develop the e-tourism ontology [3].

The ontology consists of concepts relations, instances, and axioms. According to the paper, "a concept represents a set or class of entities within the tourism domain". In the e-tourism ontology, "what," "where," "when," and "tourist" are the main classes. The class "Squash," "Paintball" and "Golf" are cited as examples of subclasses of the class "What." The author applies "complementOF" element to imply that tourists from European Union are not tourists from the non-European Union countries. The author describes senior tourists by taking the intersection of the class of tourism with the anonymous class of people that are senior citizens.

As far as object property is concerned, "hasActivity" relates the class "Where" with the class "What". As far as data property is concerned, the year a tourist was born is specified using a positive

integer value. Further, using cardinality restriction, the property `#visitLocal` of the class `SiteSeeingPackage` may have a maximum cardinality of 10 because it is assumed that a site seeing package ought not to have more than ten places to visit.

Machado's [4] work is the representation of domain knowledge in ontologies that can be taken advantage of to improve the current knowledge about a disease and to smooth the progress of the diagnosis and prognosis processes. The method the author used to validate is to first create a semantic model that stands for and integrates the heterogeneous sources of data necessary for the representation of a disease and its prognosis process through taking advantage of semantic web technologies and existing ontologies. Secondly, it is to develop a methodology that utilizes the knowledge represented in existing ontologies to ameliorate the results of knowledge exploration methods obtained with translational medicine datasets. The contribution of the paper is first a methodology for the creation of a semantic model in the OWL language portraying a genetic disease. This methodology is composed by numerous steps such as the identification of the data to represent, the definition of the hierarchical relations between the data elements, and the labeling of external resources to use. Secondly, a semantic model of the disease hypertrophic cardiomyopathy (used as case study) is developed. No public semantic representation existed before this paper.

The above ontologies are on e-tourism and medicine. There are other similar ontologies, but none in the domain of research in artificial intelligence. This paper bridges the gap by proposing an ontology for the domain of research in AI.

3. The Proposed Solution

In this Section, an ontology for research in Artificial Intelligence is proposed. The ontology is drawn upon literature mainly after studying an ontology of Pizzas by Matthew Horridge in his tutorial [5] and an ontology of a family in a tutorial for Protégé [6]. Protégé is an ontology development

tool, based on OWL2, and has been used to build the current ontology. The classes are drawn from reviewing the information on the websites of various Artificial Intelligence research institutions and universities such as Microsoft, Facebook, Machine Intelligence Research Institute, Massachusetts Institute of Technology, University of Washington, and University of Michigan.

The properties, the relationships, the axioms are intuitively designed, again by drawing upon the ontology of pizzas and that of a family.

3.1 The Ontology

3.1.1 Domain and Scope of the Ontology

The domain of the ontology is research in Artificial Intelligence. Artificial Intelligence is the field of computer science that deals with expert reasoning to make machines as intelligent as humans. Machines are usually fed programs according to which they operate. But with AI, programs and machines will be able to reason, make their own decisions and act intelligently to be more useful to humans.

3.1.2 Important Terms in the Ontology

Important terms in the ontology, as compiled from the websites of institutions in Artificial Intelligence are Machine Learning, Expert Systems, Robotics, Natural Language Processing, Computational Neuroscience, Computational Biology, Computer Vision, Speech and Text Recognition, Fuzzy logic, Intelligent Interaction, Brain-Computer Interfacing, Neural Networks, and Automated Planning and Control.

3.1.3 Defining the Classes and Class Hierarchy

At this level, the top-down approach is used where the most general concepts and classes are defined first and the subclasses are defined afterwards.

Main classes:

- Places (places where research in AI is being conducted)
- Research in Artificial Intelligence

Subclasses:

- Current Advances in Research
- Areas of Future Research
- Automated Planning and Control [7]
 - Robotic control
 - papers
 - Use of planning and control models in computational neuroscience
 - papers
 - Automated planning under uncertainty
 - papers
- Brain-Computer Interfacing [7]
 - Computational Neuroscience
 - papers
 - Computational Biology
 - papers
- Computer Vision [7, 8]
 - Object Recognition
 - papers
 - Scene Understanding
 - papers
 - Human Activity Recognition
 - papers
 - Active Vision
 - papers
 - Grouping and Figure-Ground
 - papers
 - Visual Data Mining
 - papers
- Ethics
 - papers
- Information Retrieval [15]
 - Collaborative filtering
 - papers
 - Information extraction
 - papers
 - Image and video search
 - papers
 - Intelligent information systems
 - papers
- Intelligent Interaction [7]
 - Activity recognition
 - papers
 - Applications of machine learning and preference elicitation in UIs
 - papers
 - Crowd-sourcing, community sourcing and mixed AI/human computation
 - papers
 - Decision-theoretic interfaces and agent interaction
 - papers
 - Interactive machine learning and active learning
 - papers
 - Programming by demonstration
 - papers
 - Smart sensing and embedded devices
 - papers
- Machine Learning [7, 8]
 - Knowledge representation and reasoning
 - First order probabilistic logics
 - papers
 - Symbolic algebra
 - papers
 - Expert Systems
 - papers
 - Fuzzy logic
 - papers
 - Learning and Probabilistic Inference
 - Graphical models
 - papers
 - Kernel methods
 - papers
 - Nonparametric Bayesian methods
 - papers
 - Reinforcement learning
 - papers
 - Problem solving, decisions, and games
 - papers
- Natural Language Processing [15]
 - Speech and Text Recognition

- o papers
- Parsing
 - o papers
- Information Extraction
 - o papers
- Machine Translation
 - o papers
- Context Modeling
 - o papers
- Dialog Systems
 - o papers
- Robotics: subclasses [7, 8]
 - Mechanism design, sensors
 - o papers
 - Computer vision,
 - o papers
 - Robot learning
 - o papers
 - Bayesian state estimation
 - o papers
 - Control theory
 - o papers
 - Numerical optimization
 - o papers
 - Biomechanics
 - o papers
 - Neural control of movement
 - o papers
 - Computational neuroscience
 - o papers
 - Brain-machine interfaces
 - o papers
 - Natural language instruction
 - o papers
 - Physics-based animation
 - o papers

All the above classes are annotated with descriptions and have individual members.

3.1.4 Defining the Properties of the Classes

Based on the Horridge's pizza ontology, besides to classes, an ontology needs to have object and data properties and these properties are used to form restrictions and axioms that apply to the classes [5].

a. Object Properties

Object properties are used to link classes and as a result the individuals of the classes [5]. The following are the revised object properties in the ontology:

- Conducts_A_Research: This property would link a place to the type of artificial intelligence research conducted. Its domain is Place and Range Research in Artificial Intelligence.
- Has Papers: This would link a place like MIT - Massachusetts Institute of Technology - to the papers in AI it has. This property is a subclass of Conduct_A_Research. If a place conducts a research in some AI topic/s then it should have papers in the field. Its domain is Place and Range Research in Artificial Intelligence.
- Is_Paper_In: This would link a paper to a research area. Its domain is All Papers and Range Research in Artificial Intelligence.
- Research_Conducted_At: This would link a research area to the place it is conducted at and is the inverse of the object Property Conducts_A_Research. Its domain is Research in Artificial Intelligence and range is Place.

b. Data Property

Data properties are used to link individuals to certain data values [5]. One data property is Level_Of_Advance_in_Research. This is to indicate whether the members of the class "Current Advances in Research," are "High Level Research" (if an integer number above or equal to 5 is assigned to the research) or "Low Level Research" (if an integer number below 5 is assigned to the research).

"High_Level_Research" and "Low_Level_Research" are defined classes serving as axioms, a current advanced research being categorized as one of these depending on the integer value it is assigned.

The goal of this data property is to classify the current advances as being really advanced, or a benchmark research that has a big impact in the field of AI or an advance that is not quite as revolutionary based on the opinions of the experts.

3.1.5 Defining the Facets of the Properties

As a subclass of the class Research in Artificial Intelligence is an existential restriction "Conducts_A_Research some Research in Artificial Intelligence" meaning all the research conducted at the Place, like Google, Microsoft, Facebook, MIT fall under one of the subclasses of Research in Artificial Intelligence. As a subclass of Place, there are two existential restrictions:

- "Has_Papers some Place" meaning A place where research in AI is done should have some papers in the field of artificial intelligence.
- "Research Conducted At min 1 Place": A research is conducted at a minimum of one place.

3.1.6 Data Collection and Analysis

In order to review the ontology developed and to get input from others, especially from scientists, a questionnaire consisting of nine questions was distributed to five experts in the field from Addis Ababa University and from HiLCoE School of Computer Science and Technology. The questionnaires consisted of whether the scientists agree with the proposed classes for research in artificial intelligence ontology, with the object, and data properties and if they have any additional suggestions and comments.

The answers to the questions from the five experts were not all the same but they have some aspects in common. They all commented that the class "Ethics" should be redefined. Some suggested additional classes and some mentioned that related fields to research areas to artificial intelligence should be included with their relationship to research in AI. Some proposed additional object property, "Is_Related_To," to show the relationships of other

fields to AI, and commented a data property that helps classify researches as theoretical or advanced should be included. All their suggestions have been used to modify and extend the previously designed ontology.

The related fields to research in AI, drawn from literature, are Business Intelligence, Neurology, Cognitive Science, Data Mining, Linguistics, and Mathematics. The class "Ethics" has been redefined as "Ethics of Artificial Intelligence." Additional subclasses to the class "Research in Artificial Intelligence" and additional members have been added. The subclasses "Software," "Tools," "Models," "Algorithms," "Hardware", and "Data" have been added under each subclass of each research area in AI to include relevant software, tools, models, etc. Further, the class Places has been modified with additional subclasses such as "Address", "People," "Projects," "Publications," "Research Areas." Additional classes such as "Big Data Analytics," "Decision Support Systems," "Cognitive Architectures and Computational Cognitive Science", "Assistive Technology," "Multi-Agent Economic Systems", "Books," "Papers" subclasses under each major field to categorize the papers written in that field, "All_papers_in_Research_Artificial_Intelligence" which has as its subclasses the papers category of each field.

In addition, there is an additional object property "Is-Related-To" that relates the additional fields such as Business Intelligence, Neurology, Cognitive Science, Data Mining, Linguistics and Mathematics to the research areas in AI. For example, brain computer interface is labeled as "Is_Related_To some Neurology" while "Information Retrieval" is labeled as "Is_Related_To some Data Mining."

The object property "Has Papers" is no more a subclass of Conduct_A_Research. It stands on its own and it would link a place to the papers in AI as before. If a place conducts a research in some AI topic/s then it should have papers in the field.

One of the existential restrictions for the class "Place" has been changed to Conducts A Research in some research in artificial intelligence, meaning a place, like Massachusetts Institute of Technology, Google, or Microsoft, has to conduct some research in artificial intelligence to be included in the ontology under the class "Place." The existential restriction on "Research in Artificial Intelligence" is changed to "Research Conducted at some place" meaning the subclasses or the research areas are conducted at some place.

An additional data property "Level of Theory" is also added based on which the defined classes "Theoretical" and "Applied" are created. These classes gain members based on the integer value assigned to "Level of Theory" for the individual of the class "Current Advances in Research", an integer value above five labeling the individual as a member of the defined class "Theoretical", and an integer value below four labeling the individual as a member of the defined class "Applied".

3.2 Proof of Concept

A website is developed using HTML, CSS3, JavaScript for the front end and PHP and MySQL for the backend with a title "Research in Artificial Intelligence". It is aimed for those planning to conduct a research in the field. It has seven navigating links at the top right, below the title of the web page: Home, Places where Research in AI is Conducted, Future Research Areas, Current Advances in Research, Papers, Books, and Contact Us. The above, excluding Contact Us, are the classes of the ontology. In the left corner are links for the research areas of artificial intelligence, as per the subclasses of the class Research in Artificial Intelligence and links for other areas of fields. There are also links for other related areas of research in AI. These links both at the top and bottom lead to their own pages with full description and Java script based moving related pictures. Users can search for any entity of the web site. They can also register and log in to update the website.

4. Discussion

There are various evaluation techniques of ontologies as there is no agreed standard form of evaluation [9]. For the evaluation of the current ontology, seven questions were formulated drawn from the evaluation techniques of Brank and Hartman [10, 11] to be reviewed by five experts in the field from Addis Ababa University and from HiLCoE School of Computer Science and Technology. The evaluation questions are based on two formal quantitative evaluation techniques - evaluation of the result, the implementation as to its relation to the ontology, and evaluating the ontology on how well it has covered the domain through assessing the different levels of the ontology. According to the evaluation, the majority of the research areas in artificial intelligence have been included and the other classes are found to be quite relevant. As to the object and data properties, they apply to the majority of their instances and hence are relevant.

5. Conclusion and Future Work

Ontology is a proper naming and explanation of the types, properties, and interrelationships of the entities that exist in a particular domain. In review of previous literature, ontology for e-tourism and for the field of medicine have been developed. However, there is no ontology developed for research in AI. In this paper, ontology for research in AI is developed. In the ontology, research in AI was divided into subclasses of the major research areas with each subclass having further subclasses. To create relationship between the classes and between the classes and the domain, object properties and data properties were created to ensure that a class is within the scope of the domain, to establish relationship with other classes, and to create defined classes.

A knowledge base is an ontology and a set of individual instances of classes. The ontology developed is a knowledge base adding to the knowledge base of research in AI through proper

naming and explanation of the types, properties, and interrelationships of the entities that exist in the field of research in AI.

The ontology is a back-end means to support the use of the ontology for specific group of users. In this paper, the specific group of users are those interested in pursuing a research in AI. A website that is based on the modeled ontology is built by integrating the distributed information about research in AI from various sites. Users can register and update the website besides to being able to update the ontology on the Web-Protégé site of Stanford University. The basic idea of an ontology based website is to provide all the links associated with an entity. For instance, when a user clicks on "Place where research in AI is conducted," s/he will find publications, projects, people, research areas and when s/he clicks on a research area, s/he will find most of the links associated with a research area. Overall, the ontology can be used to build software for a reference point for research in AI.

A further research area would be to develop an ontology for AI, instead of just for research in the field, which would include jobs in AI, education in AI, integrating AI at the work-place for companies for increasing productivity, and other areas of AI.

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Viewpoint Based Nonfunctional Requirements Elicitation Framework for Service Oriented Enterprise Systems

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Abstract

The changes from traditional software development process to a more sophisticated Service Oriented Software Development (SOSD) process initiated a new way of thinking on requirements elicitation process. Over the years, the existence of several unstandardized requirement elicitation practices was observed to lead into inefficient SOSD practices resulting in unsatisfactory software products and increased overall costs. This paper attempts to investigate the critical challenges in the methods that are widely practiced in the local industry for Service Oriented Enterprise Systems Requirements elicitation (SORE) process. In addition, the paper aims to define a Viewpoint based framework for Service Oriented Non-Functional Requirements Elicitation (SONFRE) process of Service Oriented Enterprise System (SOES) by integrating a Viewpoint based Requirement elicitation approach with some of the currently used requirements elicitation techniques into a well-specified process method. The proposed Viewpoint based framework was evaluated with case studies conducted on e-government system and by industry experts. Based on the evaluation, the proposed framework is usable and can be applied by anyone with little business analysis experience on SORE. In addition, it allows establishing stakeholders agreed SONFR and also helps in identifying SONFR conflicts very clearly.

Keywords: Service Oriented Enterprise System; Service Oriented Non-Functional Requirement; Service Oriented Non-Functional Requirement Elicitation; Viewpoint Oriented Requirement Elicitation; Requirement Elicitation Techniques

1. Introduction

Software systems are evolving through the years and through these changes the traditional way of software provision has been replaced with a more sophisticated Service Oriented Software systems provisions. Service Oriented Paradigm emerged as a response to bridge the gap between business process models and software architectures in order to give on demand solutions to business needs [1]. Service oriented engineering originated from Object Oriented Software engineering, component based software engineering, and distributed computing concepts that resulted in Service Oriented Architecture development approach and requirements engineering process. The use of this Service Orientation concept in an enterprise brought up another more confined

concept called Service Oriented Enterprise System (SOES). SOES is a Service Oriented system that emerged because of the integration of Service Oriented paradigm and existing enterprise system [2].

This change of paradigm required a new way of eliciting customer requirements to fulfill customers' needs. Service Oriented Requirements Elicitation (SORE) involves elicitation of enterprise requirements in Service Oriented context. This includes analysis and incorporation of different stakeholders in the process, identifying the viewpoint these stakeholders have and identifying different focuses of SOES. Over the years, techniques have been introduced to deal with these problems with the aim of reducing the time and cost of software

development. However, these techniques are of little use if well defined frameworks are not provided to assist software engineers in software requirements capturing.

The difficulty of Service Oriented Non-Functional Requirements Elicitation (SONFRE) comes from its vague and intangible nature of Service Oriented Non-Functional Requirements (SONFR) [3] and the existence of different views and viewpoints of different stakeholders in SOES. Based on these core problems, two research questions were raised at the beginning of this research. The first question is how challenging is SONFRE than Service Oriented Functional Requirements Elicitation (SOFRE) in practice and what methods are being widely practiced in SOES? The second question is how the viewpoint based requirements elicitation approach and other requirements elicitation techniques that are widely practiced in traditional requirements engineering can be applied in SOES Viewpoints and Views context in order to elicit SONFR from SOES stakeholders?

The motivation for this research is the existing SONFRE challenges that include poor and unstandardized SONFRE practice in SOSD process, less attention given to SONFRE process, expensive iterative requirement discovery process and maintenance cost in the process of service provision [4]. Because of these challenges, there is a need for generic SOES framework that can be applied effectively and easily implemented locally.

The general objective of this research is to analyze the current SONFRE trends and design a framework which improves upon the existing requirement elicitation methodologies. The key objectives of this research include understanding the challenges of the SONFRE process, exploring the existing SONFRE techniques and their challenges, developing a framework for SONFRE process and evaluating the newly proposed framework.

2. Related Work

The work in [5] contributed a view reconciliation methodology for SOES having concrete terms of Viewpoint, Perspective and View. The Viewpoint includes Metaphysical, Cost-based, Value-based, Pragmatic, and Provider's and Designer's Viewpoint. The Perspectives include Presentation, Transportation, Infrastructure, and Web service, Application, Data and Domain. Presentation perspective describes Enterprise Business Systems (EBS) quality from the point of view of the presentation of information produced by an EBS for service requestors. Transportation perspectives describe EBS quality from the network point of view. Infrastructure perspective describes EBS quality from the implementation platform point of view. Web service perspective describes EBS quality from the service point of view. Application perspective describes the nonfunctional properties of a component as a software product or EBS technical quality. Data perspective describes the nonfunctional properties of data stored in the enterprise's databases, XML documents and other content. Domain perspective describes the domain-dependent EBS qualities which are specific to a particular business domain.

The fact that quality is a broader concept that consists of Non-Functional Requirement as a sub category makes the perspectives of this framework reference perspective for View point based SONFRE process.

The work in [1] emphasizes Quality Requirements negotiation as part of SOES Requirements Engineering to resolve conflicts among stakeholders' quality requirements. It utilizes the concept of Viewpoint and View that is constructed from the integration of SOES Perspectives suggested in [5] and SONFR in a view reconciliation methodology. The idea of View construction from the identified SOES perspectives and SONFR is considered to be vital in Viewpoint based requirements elicitation process as specifying

Views guides and narrows the focus of the elicitation process.

The work in [3] undergoes six main steps including identifying enterprise based Service Oriented Architectures (SOA) stakeholders, SONFR and viewpoint framing them, identifying SONFR conflicts and overlaps, modeling SONFR conflicts and overlaps using Goal Requirements Modelling (GRL) and Use Case Map (UCM) Notations, developing alternative solutions (alternative SONFR and elaborating proposed solutions) SONFR and perform proposed SONFR judgment and trade-offs.

In this work, only the requirements capturing process that focuses on Service Oriented Enterprise Architecture (SOEA) Stakeholders and Roles identification, Viewpoints extraction based on Enterprise Architecture (EA) frameworks and standards, identifying SONFR Conflicts and Overlaps and performing proposed SONFR judgment and trade-off were reviewed and discussed.

Accordingly, Stakeholders and Roles including Business/IT Steering Group, SOEA Steering Board, EA Governance Board, SOEA Centre of Excellence, Business Domain Representatives, SOEA Governance Board, Solution Development Team, Service Development Team, IT Operations and SOEA Consumers were identified from SOA Governance Reference Model (SGRM) and TOGAF 9.1, 2011 governance models. Viewpoints of Enterprise Strategy, Enterprise Business Processes, Consumer, Business Process and Service were extracted. Enterprise strategy Viewpoint focuses on overall enterprise mission of SOES. Enterprise business process Viewpoint focuses on displaying business process of the enterprise without aligning to software systems. Business Process Viewpoint focuses on business processes and supporting service organization for SOES. Consumer Viewpoint focuses on application or human-oriented access of business services in SOES. Service Viewpoint focuses on realization of services for the business and IT capabilities of SOES.

The idea of stakeholder identification and extracting Viewpoints to frame stakeholder requirements is considered to be vital in Viewpoint based Requirements Elicitation.

Taking the above works as a basis and integrating the idea of use of perspectives for View construction and identification of stakeholder and Viewpoint process, a Viewpoint based process framework that customizes the Spiral Process Model for Capturing of Non-Functional Requirements of SOES is suggested in this paper.

3. Research Methodology and Findings

3.1 Research Methodology

This research was conducted in three phases, namely: conceptual analysis, empirical research and constructive design. In the conceptual study phase, previous research works were thoroughly reviewed to get good understanding of SOES, Viewpoint based requirements elicitation process and to identify the gap in recent researches on Viewpoint based SONFRE process for SOES. In the empirical study phase, a quantitative based questionnaire and qualitative based interview were designed and applied to study the challenges and practices of SORE in the Ethiopian software industry. In the study, 29 participants were involved in questionnaire based study and 5 participants in the interview.

3.2 Findings from the Questionnaire

a. On challenges of SORE Process

Based on the results, challenges of selecting a proper service requirements elicitation technique and inability to meet customer expectations were the top challenges taking 52.2% of the responses each. 21.7% of the responses indicated inability to achieve the benchmark quality requirements set for the service system and 19.6% of the responses indicated inability to properly identify service consumers. Based on the figures, it was concluded that all SORE challenges exist in the industry with similar and considerable amount.

b. On Experts' Level of Experience on Predefined Techniques of SOFRE and SONFRE

Based on the results, most of the experts have experience on predefined techniques of SOFRE than SONFRE. The result indicates that there is a need of research on SONFRE techniques than SOFRE techniques.

c. On Frequency of SONFRE Predefined Techniques Usage by Experts

Less than half of the participants often use predefined SONFRE techniques and more than half of the respondents rarely use or don't use predefined SONFRE techniques.

d. On Experts' Satisfaction Level on Existing Techniques of SOFRE and SONFRE

These questions contain four scale choices; Excellent, Above satisfactory, Satisfactory and Not good. Accordingly, the satisfaction on SOFRE techniques got the highest response rate of above satisfactory and satisfaction on SONFRE techniques got the highest response rate of satisfactory.

3.3 Findings from Interviewees

Based on the content analysis method used for interview data analysis, the non-existence of initial SONFRE process in SORE, non-existence of

standardized methods or framework for SONFRE, use of traditional methods for SONFRE and the less attention given for environmental constraints in SONFRE process were observed.

3.4 Conclusions on the Empirical Research Findings

Generally, the above empirical results concluded that most written challenges of SORE do exist in the real world. In the industry experience, SONFRE is more challenging than SOFRE, SONFRE often gets far lesser attention than SOFRE, and constraints which affect SONFR do not get much attention in SONFRE process. As noted in the literature, there is lack of standard framework for practicing SONFRE in the industry and traditional requirements elicitation methods are still widely used in the industry for SOES Requirements Elicitation Process.

4. The Proposed Framework

The Viewpoint based SONFR elicitation framework for SOES, as shown in Figure 1, is a four-stage process framework which includes stakeholder identification, SONFR and their constraint identification, Viewpoint and Perspectives identification and Stakeholder Specific SONFR Capture and arrangement stages.

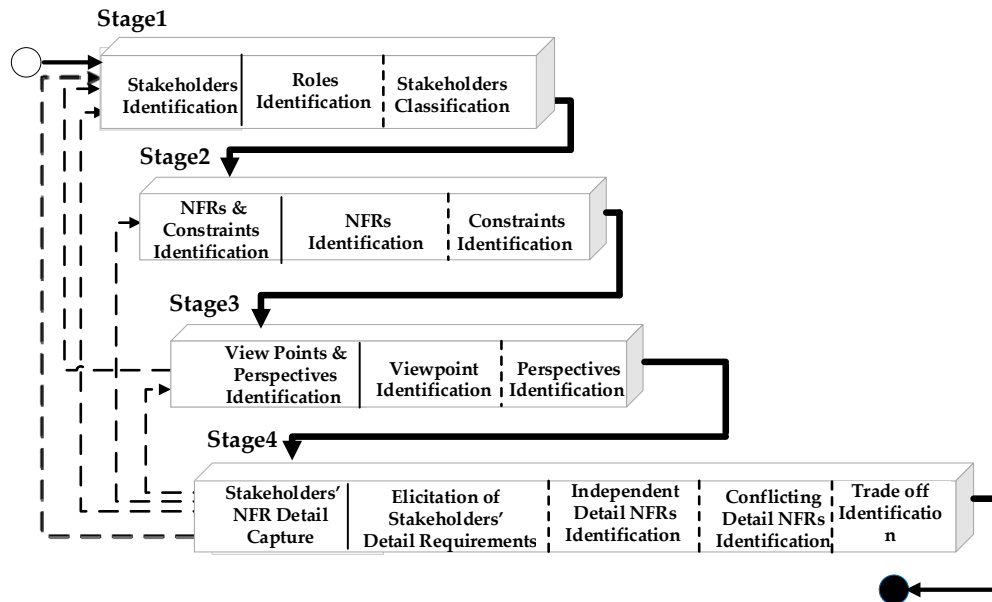


Figure 1: Viewpoint Based Nonfunctional Requirements Elicitation Framework for Service Oriented Enterprise Systems

4.1 SOES Stakeholder Identification Stage

At this stage, Stakeholder groups in SOES are

identified with their corresponding Roles as shown in Figure 2.

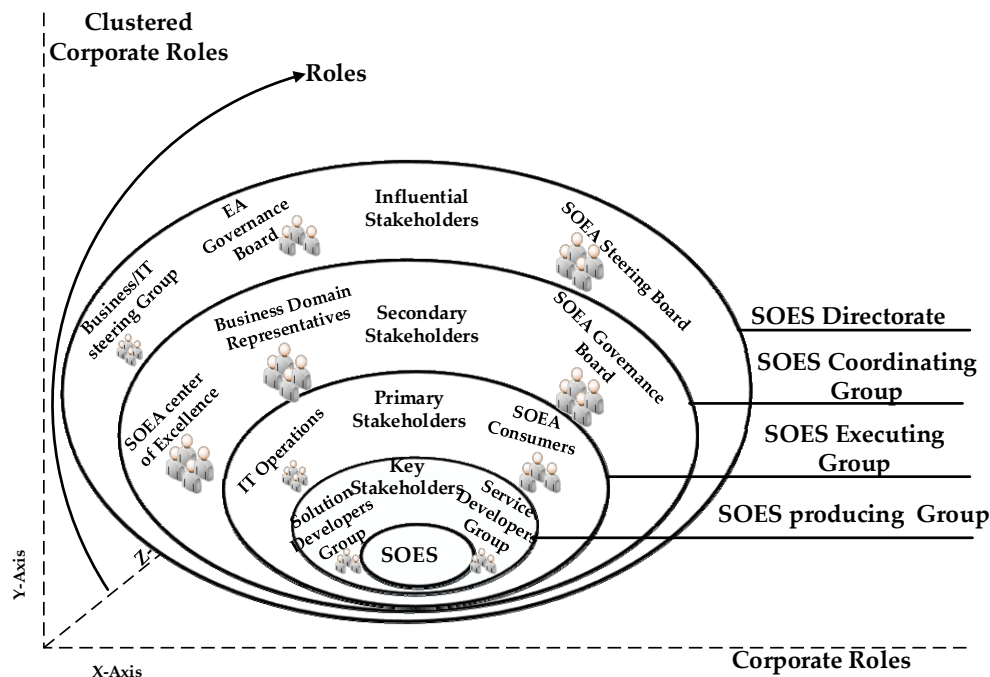


Figure 2: Three-Dimensional Identification of Roles and Stakeholder Types in Clustered Corporate Roles

The first sub-stage of this stage of the framework is SOES Role identification which involves identification of Clustered Corporate, Corporate and individual Roles. Examples of these Roles which were observed on e-government system of Ethiopia are shown in Figure 2. Clustered Corporate Role identification is an observation of skeletal Role arrangement of SOES which is formed from assembly of Corporate Roles. Corporate Role identification is an observation of intermediate Role arrangement of SOES which forms Clustered Corporate Roles. Role identification is an observation of internal Role arrangement of SOES which forms individual Roles of Corporate Roles.

The second sub-stage of this stage of the framework is stakeholder classification which is based on TOGAF 9.1, 2011 stakeholder classification power grid, Keep Satisfied, Keep Informed, Key Player and Give Minimal Effort, being interpreted into stakeholder types. Accordingly, the suggested Stakeholders Classification Schema consists of Influential Stakeholders (Keep Satisfied) that influence the

SOES development, Secondary Stakeholders (Minimal Effort) that are affected positively or negatively by the SOES development, Primary Stakeholders (Keep Informed) that can contribute knowledge to the SOES development and Key Stakeholders (Key players) that are key players in the SOES development. Examples of stakeholder types in Clustered Corporate Role are shown in Figure 2.

While applying this stage in the process of elicitation, Corporate Role and Role structure can be referenced from reference models of ISO/IEC/IEEE 42010:2011, SOA Governance Reference Model (SGRM) and TOGAF 9.1, 2011.

4.2 SOES NFRs and Available Constraints

Identification stage

At this stage, SONFRs which are significant to that specific Enterprise system and the constraining conditions are identified based on the Enterprise mission.

4.3 SOES Viewpoints and Perspectives Identification Stage

At this stage, Viewpoints and Perspectives of SOES are identified with the corresponding stakeholders and SONFR concerns for requirements elicitation process.

In this paper, Viewpoints are defined with three criteria. These are Identified SOES Roles alignment approach for that SOES, Business IT alignment principles of SOA and Standards and Frameworks of EA followed by that SOES. An initiation of the Viewpoints suggestion in this sub-stage included Viewpoints suggested by Svanidzaitè [3]. These include Enterprise strategy Viewpoint which focuses on overall enterprise mission of the SOES, Enterprise business process Viewpoint which focuses on displaying business process of the enterprise without aligning to software systems, Business Process Viewpoint which focuses on business processes and supporting service organization for the SOES, Consumer Viewpoint which focuses on application or human-oriented access of the business services in the SOES, Service Viewpoint which focuses on realization of services for the business and IT capabilities of the SOES, and Operation Viewpoint which focuses on the overall facilitation of the SOES from the implementation or operation point-of-view.

In this paper, Perspectives represents a particular aspect or focus of SOEA. The initiative for the Perspectives identification in this paper were taken from the available literatures on SOES perspectives [5] and interviews conducted in this study. The suggested perspectives include Presentation, Application, Domain, Information, Integration, Technology and Composite Perspectives. Presentation Perspective is a point of view of presenting and acquiring of every information (data) that forms the overall service system. Application Perspective is a point of view of a component as a new or legacy software product. Domain perspective is a point of view of business area or domain of the enterprise. Information perspective is the point of view of SOES information and data that will be

available and processed in the SOES. Integration perspective is a point of view of orchestration of different services in SOES. Technology is a point of view of available or requested implementation technology including the tangible and intangible infrastructures systems, e.g., network and implementation platform that will be applicable in SOES. Composite Perspective is a point of view of internal factors like policy, mission, business target of the SOES system and external factors like political, cultural and ethical norms that could affect the system.

4.4 SOES Stakeholder Specific NFR Capturing Stage

This final stage focuses on capturing specific requirements from the identified stakeholders and arranging these requirements for the next requirements engineering stage of SOES.

The first sub-stage of this stage involves elicitation of SOES stakeholder specific detail requirements. Detailed requirements of stakeholders within each Viewpoints are elicited from different Views using appropriate requirements elicitation techniques.

The second sub-stage of this stage is SOES Stakeholder Specific Detail Requirements arrangements within the same Viewpoint which involves identification of Independent, Overlapping and Conflicting SONFR details and registration.

The third sub-stage of this stage is SOES Stakeholder Specific Detail Requirements arrangements among different Viewpoints which involves identification of Independent, Overlapping and Conflicting SONFR details and registration.

The fourth sub-stage of this stage is SONFRs Trade-off identification from captured stakeholders' Requirements. This involves identification and registration of stakeholders' SONFRs Trade-off among stakeholders of the same and different viewpoints.

5. Discussion and Evaluation

The proposed framework was evaluated with two case studies on e-government systems which were

chosen based on contextual difference and evaluations from three practicing experts in the area.

The first case study was done on Email management system of government-to-employee based e-government system. In this case, only two Roles, Clustered Corporate and Corporate Roles, were identified since the system is based on standards and conflicts and diverging requirements within internal Roles is unlikely. For testing purpose, only three Viewpoints, namely: Enterprise Strategy, Service, and Consumer Viewpoint were identified. Group discussion based Elicitation technique was chosen for capturing SONFR from stakeholders.

The second case study was done on e-transport system which is government-to-citizen based e-government system. In this case, Clustered Corporate, Corporate and individual Roles were identified since conflicts and diverging requirements within internal Roles is likely. Six Viewpoints including Enterprise Strategy, organizational business process, Service, business process, consumer and IT operation were identified. Group discussion, Observation and Interview requirements elicitation techniques were chosen for capturing requirements from stakeholders.

Based on these two cases, the necessity of the Role identification stage in the process of Role incorporation in a Viewpoint and how Viewpoints are defined and prioritized based on the criteria set are illustrated and tested.

For evaluating this framework, three industry experts were chosen from local and international experienced groups and a questionnaire was given. The questionnaire was prepared with six questions containing three 5-level Likert scale based multiple choices and three open-ended type. Based on the multiple-choice answers, the experts agree on the practical usability, benefit, customizability and adaptability of the framework in the industry.

This framework has some contributions which helps to improve the existing practice and previously suggested methodologies.

1. It is a more standardized and guiding framework for experts which can be applied with preferred elicitation techniques.
2. It is much easier to be applied by anyone with little business analysis experience on SORE.
3. It allows establishing stakeholders agreed SONFR and also helps in identifying SONFR conflicts very clearly.
4. It is much more convenient to be applied in an indistinct SOES that is immaturity SOEA based system.

6. Conclusion and Future Work

Over the years, several techniques have been introduced to deal with SORE in an enterprise. However, these techniques are of little use if well defined frameworks are not provided to assist software engineers in software requirements capturing. Based on the findings of the conceptual analysis and empirical researches, this paper presented a SONFRE framework for maturely and immaturity SOEA based SOES which involves guiding Role identification strategy for SONFRE process, Utilization of Identified SOES stakeholders' Roles for viewpoints definition and Consideration of SOES perspectives as part of view construction process. The proposed framework was evaluated with case studies conducted on e-government systems which were chosen based on contextual difference and by experts practicing in the industry. Based on the evaluation, the proposed framework is usable and can be applied by anyone with little business analysis experience on SORE. In addition, it allows establishing stakeholders agreed SONFR and also helps in identifying SONFR conflicts very clearly.

The construction of methodologies for Stakeholders' fuzzy Views, Stakeholders' fuzzy detailed SONFRs analysis and management, captured detailed requirements analysis and extending Viewpoint based framework for Functional Requirements Elicitation process could be investigated in future studies. In addition, Role vs

Responsibilities matching Semantic tool and methodology for Conflict resolution and Trade-off analysis of detailed SONFRs could be studied further.

Acknowledgments

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Order-To-Delivery Process Architecture in Cement Factories: The Case of Derba Midroc Cement Factory

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Abstract

Order-To-Delivery (OTD) in most general sense is a point of making request to the delivery of a product to customers. It has been a part of doing business for ages and has developed alongside technology to provide powerful means of accepting orders, shipping and delivering them. This paper focuses on developing a framework which can facilitate the order collection and the delivery of the product to customers in cement factory (F-OTD). The ability to take orders and deliver the right product, to the right place, at the right time is critical to any organization. Processing orders rapidly and accurately and on-time delivery has a direct impact on customer satisfaction. Transforming the order-to delivery process can determine an organization's survival, competitiveness and entire success in the market.

Keywords: Order-to-Delivery; Purchase Order; Order Delivery

1. Introduction

In the general sense Order-to-Delivery (OTD) is defined as sequence of steps involved in processing an order to the satisfaction of the customer and making the necessary changes in inventory records. It may also include processing of returns and re-adjustment of the records, also called order processing [1].

Customer satisfaction plays a significant role in the success of a company. Processing orders rapidly and on-time delivery has a direct impact on customer satisfaction. Currently in Derba Midroc Cement (DMC) factory, orders are taken through phone calls or in-person. While taking orders there is no centralized way of cross checking the level of production of cement in the factory with the amount of order that the sale office receives resulting in the customer not knowing the exact delivery date; also don't provide promise dates for the entire orders. This causes a time gap and customers not receiving what they need when they need it.

Once customers place orders, no confirmation about their order details is given including product and scheduled delivery date. Customers are not

aware of either their orders go into production or not. In this case, poor customer services are experienced.

Considering the delivery stage, there is no proof of delivery that the product is being received by the delegated person due to the non-existence of a system which can verify the identity of a person receiving the products. Hence, it is difficult to track goods arrive at the designated address on time. So creating a framework to fill these gaps and improve the order to delivery process is what this paper is all about.

2. Related Work

Different researches are conducted regarding order to delivery process.

Order and delivery strategies was addressed by Wortmann [2] and continued by Mather [3] in a discussion of the P:D ration, where P is defined as the production lead-time (lead time is the latency between the initiation and execution of a process, i.e., how long it takes to manufacture a product) and D is the demand as lead-time. D can be viewed as:

- i. The lead time quoted by the firm to the customer,
- ii. The lead time the customer wishes, or

iii. The competitive lead time.

According to La Rosa [4], the process starts with the ordering task, where purchase orders can be created, modified, approved or rejected. If an order is rejected or not confirmed in time, the process terminates; otherwise the logistical arrangements can start in the task Carrier Appointment. This task deals with the preparation of the shipment quote, with delivery and pick-up arrangements and culminates in the actual pickup of the freight from the Carrier Department. If the quote is not prepared in time, the whole process terminates and the order is cancelled. If the freight was picked up, tasks Payment and Freight in Transit are started in parallel. The former deals with the processing of the payment for the freight and for the shipment. The latter allows the Order department to issue inquiries after the status of the freight in transit, and handles notifications of the shipment's progress from the Carrier Department. This task terminates with the actual delivery of the freight to the customer.

After completion of payment and delivery, Freight Delivered task handles loss or damage claims and requests for return of merchandise. If no claim or request is lodged within a certain time frame, the process terminates. A Return of Merchandise document contains the reasons for return and the line items to be returned, while a Loss or Damage Claim indicates the reason for claim. Both these documents are lodged into the system by a Client Liaison upon client's request. If no client communications are received within a certain period after the delivery – the length of which is specified in the Shipment Notice – the Order fulfillment process is considered to be successfully completed.

As a part of the supply chain, the order process plays an important role in connecting customer with supplier. A customer order serves as one of the information sources that makes logistics activities in operation. The key element included in the order process is information flow, which has a great impact on operation efficiency, total cost, and the level of customer service. Inefficient information flow may

lead to loss of customers, high inventory level, and inaccurate production forecast.

As stated by Grant [5], information system and order processes are the foundations for logistics and corporate management information system, an area which has potential to improve logistics performance. Nowadays, organizations are equipped with information systems to support logistics activities. Several studies have shown that information systems have been the key to improve enterprises' competitiveness. Nowadays, there are many third-party forwarders which are not carriers but agents that provide logistics services.

According to Ballou [6], Order process in sale includes five steps: order preparation, order transmittal, order entry, order filling, and order status reporting. The time needed for each step depends on the type of order. Overall, we can see that a good Order to delivery management system must fulfill and follow some steps in order to be successful.

Besides information systems, a number of other factors may affect order process, including processing priorities, order-filling accuracy and parallel or sequential processing [6]. Some companies process customers' orders according to the receiving time while some others may prioritize their customers in order to satisfy the more profitable orders and customers.

The accuracy of order filling is another important factor. The fewer the errors the more order processing time can be saved. Order accuracy can be a key and a focused indicator to assess and improve order processing performance. In some cases, processing orders one by one or in parallel may greatly affect order processing efficiency, time, and customer service. So sometimes it is necessary to handle different orders or different steps of the processing order in parallel in order to reduce order processing time.

There are a number of ways for customers to place an order. Historically, customers book orders by hand and then sent, faxed, or mailed to suppliers

or a sales person. Nowadays, the orders are commonly booked through calling the suppliers' operations persons who are equipped with an Internet access directly connected to their own data warehouse and order booking system. The advantage of this booking method is obvious: the suppliers' operations person can check the availability of the order products automatically and reduce the order preparation time. By using this method, the company is almost able to improve its customer service by reducing the order cycle time [5].

The basic function of the order processing system is to provide a communication network between customer and supplier. Another key function is to link the sales information to marketing forecast, to production planning and to logistics operations.

Generally, manual methods are associated with a long waiting time and more communication errors while electronic ways mean a more efficient and a more accurate order process.

Businesses face several challenges throughout the order fulfillment process. These include challenges related to demand planning, inventory management, supply chain optimization, logistics planning, and several other complex concerns. However, at the risk of over-simplifying matters, what it really boils down to is knowing and being able to make effective decisions about what you have to sell, whether a customer is likely to buy it, and how are you going to get it to them if they do.

Businesses across the manufacturing, high-tech, and retail industry sectors face many of the same challenges in managing their supply chains [7]. All this is happening as order processing windows narrow and customer demands intensify. Complying with the heightened demands likely increases internal costs to meet these order fulfillment requirements.

When it comes to speeding up order to delivery process, there are many steps one can take to make a big impact. Start by looking at some of the "quick wins" that don't require a massive investment, but will make a quick difference, such as classifying

inventory and ensuring that it is stored as logically as possible.

The next step is to make sure that you are making the most of the systems you already have in place. Many companies have the pieces in place that are needed to improve their order and delivery processes, but are unable to get the most from these systems. Finally, one can also look at making new investments in automation to speed up order handling times.

Reclassifying inventory from fastest moving to slowest will not only help save time in the order to delivery process, it will also save money in terms of labor costs in the warehouse. Systems integration will help to improve the order to delivery process but also provides better reporting and analytics that can aid decision making and profitability. Automating processes speeds order fulfillment but also provides more accurate data for future orders.

3. Research Methodology and Findings

3.1 Methodology

Methodology is the systematic and theoretical analysis of the methods applied to a field of study. This paper focuses on order to delivery process framework of a cement factory. Design science is the main research method employed due to the nature of the order process.

3.2 Data Collection

Typically, the prime method of data collection is interviews. Other sources of data used are internal reports, through direct observation and documentation. Primary data was gathered from management and operational level employees from the same company located at different sites where secondary data was acquired from the document provided inside and outside of the organization so as to arrive at a conclusion for the study. In this section the data collection methods used are described.

- i. *Interview*: Interview includes personal (face-to-face) and telephone interviews. In order to probe the ideas of the interviewees about the phenomenon of interest oral questioning of respondents is used. Interview has been made

with the staff and the person in charge of the current system environment. Interviewees that are relevant to the topics based on their position and oral questionnaires are selected to have a deeper understanding about the subject.

- ii. *Documentation*: involves studying existing documents, either to understand their essential content or to lighten deeper meaning which may be revealed. Documents can be provided on paper or online resources.
- iii. *Observation*: includes naturalistic (Field Note) observation by simply observing the subjects in the environment and arrive at a conclusion. It is simply observing people, activities, or physical aspects as they naturally exist and record the observation in narrative, expressive style as one notices or hear something of importance. The observations are recorded by taking field notes that are relevant to the research problem.

4. Empirical Findings

From the data that has been gathered and from the documents provided inside and outside the organization, Order-To-Delivery Process (ODP) is schematically described with a series of major processes. The ODP starts with the Sales Process in the branches, continuing with the Cement Order Process. The company handles the Material Supply Process, Production Process, Stock Process, Importation process and Delivery Process. The Head Office takes care of further transportation [8].

a. Order to Delivery Process at DMC

Customers' orders are registered into the database system through phone or in-person at sales office. After registration customers get payment slip print out that can be sent through fax, email or receive at the sales office in person and then the customers receive Purchase Order (PO) number. The payment is done either in cash or credit. After a bank payment is done, the customers get VAT receipt at the sales office and finally the delivery scheduling begins. All

the customer orders that are being carried out are exported in Excel file and emailed to the factory.

Delivery of the products is carried out in two ways: Pickup sale (Non-transport) and delivery sale. Pickup sale is sale that is carried out by customers' truck and delivery sale is the one that is carried out by the organization's truck which is called Derba Transport (DT).

All the orders that the sales office received are sent to the manufacturing company via email to the concerned departments (Production department, and Technical manager). All the concerned departments receive the orders and then the dispatch supervisor prepares the materials. After preparing the materials, the orders are processed and assembled. Then the dispatchers prepare Delivery Note for the products. Based on the Delivery Note the carrier department prepares Freight Order (FO) for the trucks. Then the products are sent to the customers (delegated person). Finally the delegated person (customer) receives and makes a confirmation about the product received through signature or seal (for organization) in the delivery note and freight order form.

b. Analysis and Discussion

The first study concerns about the information flow between the sales office and the factory. Interviews and personal observation show that there is no link or a centralized information system between the sales office and the factory.

The second study concerns with the customer perspective towards the order to delivery process. Through observation, most of the customers had a complaint about the delivery of the product at the right time due to the fact that there is no centralized way of cross checking the level of the production with the amount of orders received.

The next study concerns about the delivery stage. In this stage there is no proof of delivery that the product is received by the delegated person. There is no tracking of every step of distribution to ensure that goods arrive at the designated address on time.

Further analysis is made about customer satisfaction and point of view in the process of order to delivery.

- Most customers are aware of the delivery date while they order but not the exact delivery date.
- Most customers are aware of the procedure of making an order when they need but not aware of the order status (Order Confirmation) via email, through phone or SMS.
- Dispatch supervisor and managers are not aware if the product is being received by the customer/their delegate on hand (proof of delivery).

Following a case study conducted by Derba Midroc Cement (DMC) Factory and from the data that have been gathered, the following are the new findings and the suggested practice for managing the order to delivery Process.

- *Make it simple by having a centralized information system:* Having a centralized information system helps to make a decision. Knowing what is in stock and being able to provide visibility on stock levels as the order is placed prevent customers from being disappointed with backorders and delays. Using this method, the company will improve its customer service by reducing the order cycle time. The company can also minimize the order processing time, reduce inventory and improve order accuracy.
- *Having a confirmation message:* Once customers place an order, they need to be aware of their orders and products through SMS or email. Customers must be confirmed about their order details which include the exact delivery date of the products and when their order goes into production. After it goes into production, customers must also be confirmed that the products are ready to be delivered. Using this method, the company can improve customer satisfaction.

5. The Proposed Solution

5.1 Overview of the System

From the literature review and empirical findings some important points have been discovered so as to come up with the process framework which facilitates activities starting from order collection to the delivery of the product. Our focus is to have an Online Order-To-Delivery (O-OTD) system for cement factories which can determine a company's endurance, attractiveness and entire success in the market, improve its performance, and brings customer satisfaction.

The developed system (O-OTD) has different features to manage the order to delivery process. These features have been identified based on the literature review and from empirical findings.

Feature 1: The first feature is to have a centralized order entry that can crosscheck the level of production with the amount of orders received. Using this feature the system provides a communication network between sales office and the factory so as to link the sales information to production planning and provides visibility on stock levels as the order is placed. O-OTD is designed to schedule orders based on the production so as to monitor orders through production and provide the promised dates for the entire orders to the customers. It helps to meet customers' expectations, prevent delay, optimize service fulfillment through accurate scheduling, and track inventory.

Feature 2: Once a customer places an order, the second feature is receiving order and delivery confirmation messages through SMS. Using this feature the system confirms customers about their order details, when their order goes into production and when the product is ready to be delivered (delivery confirmation) so that customers can easily track their order status and their products which in turns makes customers satisfied. The SMS messages are sent to both the customers and their delegates.

Feature 3: The last feature is to confirm that the product is being received by customers or their

delegates on hand (proof of delivery). Using this feature of the system, while confirming customers that their product is ready to be delivered, it automatically generates a secret code on the Delivery Note form that can be sent through the driver who delivers the product. As soon as customers receive the product, it claims about the product received

through inputting the secret code into the SMS message that is sent through his/her phone. Then users are able to see if it is received through delivery status report form on the system.

Table 1 explains the SMS message formats that will be sent to customers or their delegates about their orders and delivery.

Table 1: SMS Message Formats

No.	Message	Possible plain SMS with Rules
1.	Report order confirmation and Scheduled delivery date	The orders are being sent to the factory The scheduled delivery date of the product is dd/mm/yy. For more information contact us: +251-xxxxxxx
2.	Report delivery confirmation	The product is ready to be delivered by Driver name: Plate No: Please receive the secret code from the driver and insert the code and send it through the received message.

5.2 O-OTD Framework

The O-OTD involves five main elements that are important for managing the Order-To-Delivery process. Figure 1 shows the O-OTD framework.

5.3 System Architecture

Client server architecture with three-tier implementation is selected for O-OTD. Figure 2 shows the system architecture.

6. Conclusion

The purpose of this paper is to develop a process framework that can effectively and efficiently facilitate order collection in the delivery of products to customers. Only one case company is selected for the study. In the case analysis it is found that the company doesn't have a centralized order entry that can crosscheck the amount of orders with the level of production which doesn't allow to fulfill its commitments to customers or not providing the promised date for the entire customers' orders. This implies that sales information is not linked to production planning which doesn't allow it to

schedule orders based on the production and not being visible on the stock level at the time of the order placed. It is also found that once customers place an order, they are not confirmed about their orders and products. Considering the delivery stage, there is no proof that the product is being delivered to the delegated person and being received properly.

In order to solve this problem, an Online Order-To-Delivery (O-OTD) system is proposed. In implementing the system, the core features of the system have a centralized order entry in which all the incoming orders are sent automatically to the factory and also product information is sent automatically to the sales office. The stock levels per day are visible at the time of the order. With this they can schedule and monitor their orders through production easily. Once customers place an order, they receive an order and delivery confirmation message through SMS so as to track their orders and products easily. In the delivery stage, there is a proof of delivery by the customers that respond through SMS as delivery confirmation message.

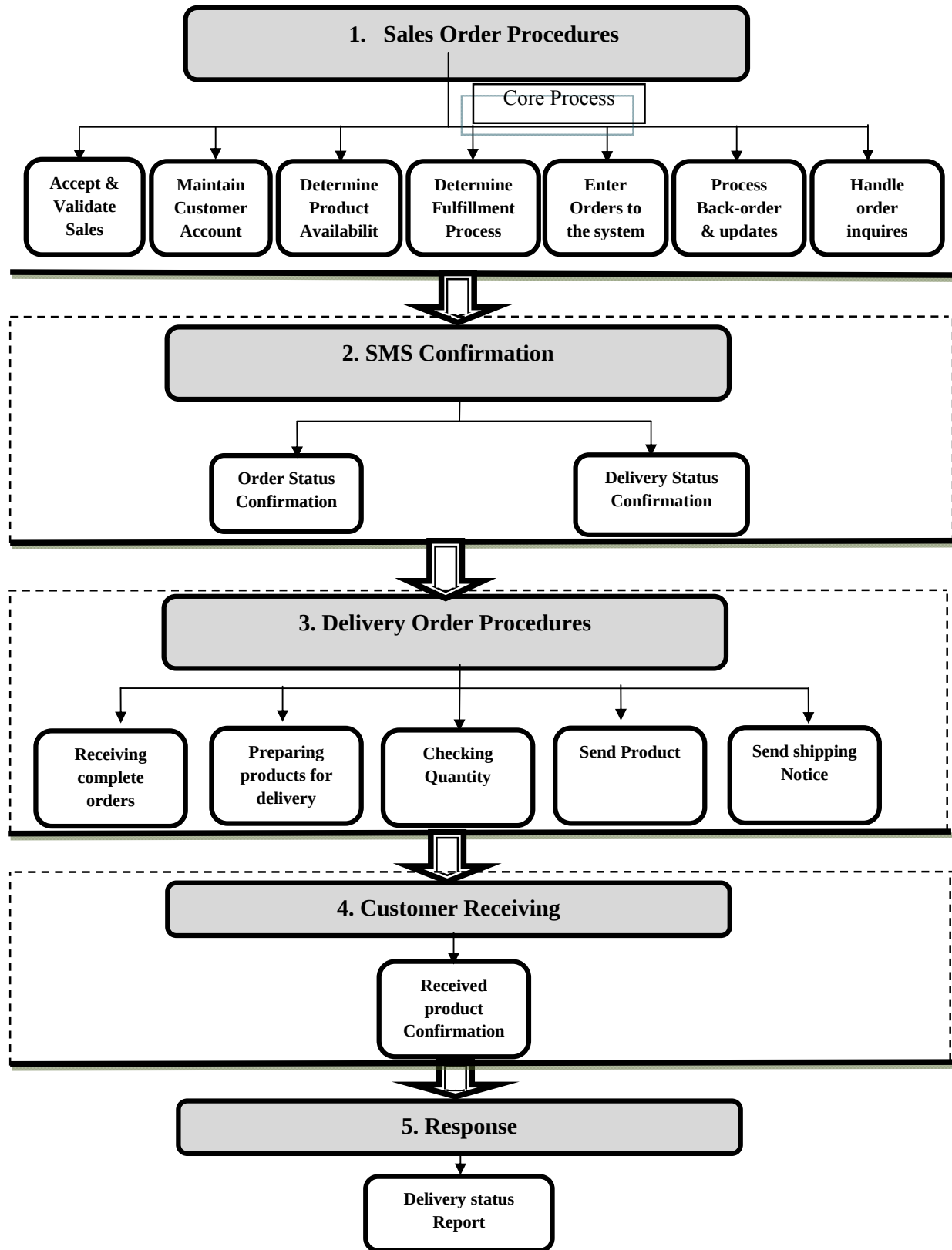


Figure 1: O-OTD Framework

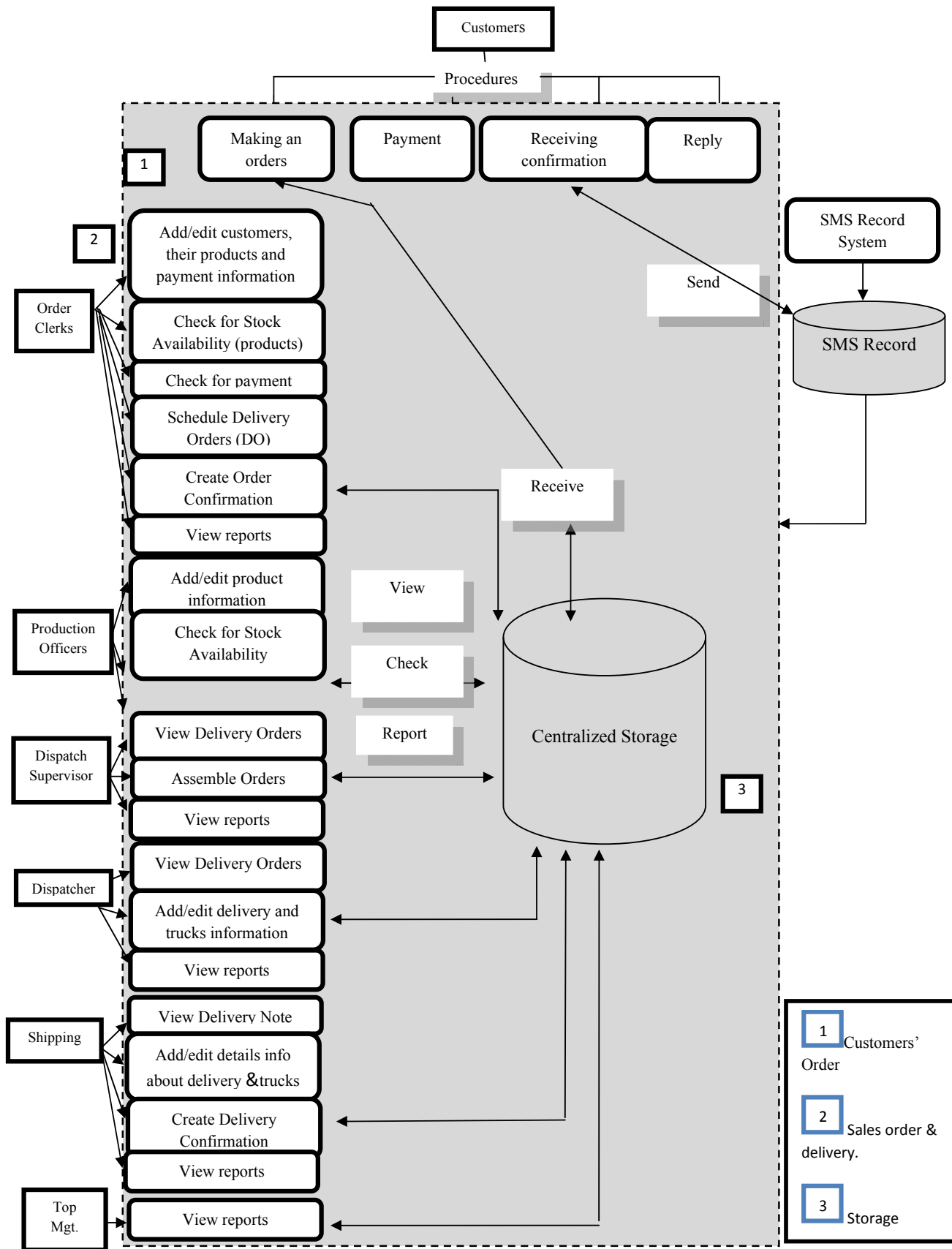


Figure 2: System Architecture

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Card Based Fare Collection System: The Case of Addis Ababa Public Transit System

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Abstract

Our life is based on travel and nowadays it is highly unlikely that a day goes by without any of us using some kind of transit system. This paper explores the current public transit system of Addis Ababa and experiences of other cities around the world to come up with a card based fare collection system that is open to any standard payment card solution. Different people were selected through subjective sampling for interviews in addition to observation and case studies through literature reviews.

The existing transit system causes inconvenience for commuters by creating long queues to buy tickets hence wasting valuable time. It also has logistics issues for the transport service providers because it involves ongoing ticket printing and making the system easily susceptible to fraudsters. The proposed solution will remove the problem by allowing customers to pre-pay for their travel using their existing banking cards which is then authenticated when trying to board a bus or a train through a POS machine that will communicate with a fare gate to allow or deny entry based on the customer's balance.

The system will be deployed at stations through POS devices while all the transactions will be monitored and customers' information is handled through a back office system. In addition, the system will allow easy fare adjustments and the customer will be charged only for his/her travel distance discarding any pre-determined fare charge allowing flexibility for payments.

Keywords: Transit; Commuters; Card; Fare; Transaction; Payment; POS

1. Introduction

Smart card fare collection systems are being used more and more by public transit agencies. While their main purpose is to collect revenue, they also produce large quantities of very detailed data onboard transactions. These data can be very useful to transit planners, from the day-to-day operation of the transit system to the strategic long-term planning of the network [1].

Smart card fare collection systems are now widely implemented all over the world. The concept is well advanced in Europe, especially in France, the UK and Italy. In the United States, there are implementations in New York, Washington, Chicago, San Francisco and in more than ten other metropolitan areas. The smart card is also popular in

Asia and is increasingly used in South America, for example, in Santiago, Chile [1].

A smart card is a device that includes an embedded secure integrated circuit, like an NFC (Near Field Connection) chip. The card connects to a reader with direct physical contact or with a remote contactless radio frequency interface. Some smart cards have the ability to securely store large amounts of data, carry out their own on-card functions (e.g., encryption and mutual authentication) and interact intelligently with a smart card reader [2].

In public transit, the use of smart cards for payment requires the existence of a corporate information system, which makes it possible to validate the use of the card through the network while storing transaction data for its financial accounting process [1].

In recent years, the technology and processes for open standard bankcard payment systems have reached the point where they can meet the needs of transit systems. Such systems enable transit authorities to focus on their core competency – transportation - and get out of the costly business of processing payments [2].

The biggest enticement of open bankcard payments is the notion that a transit authority can vastly reduce the infrastructure it has in place to support issuing and managing its own expensive closed loop card and paper ticketing systems. The goal is to allow consumers to use debit, credit and prepaid cards that are already in their wallets to directly pay for rides on a transit system, rather than using cash or those cards to buy another card sold by the transit authority [2].

As of today there is no smart way of payment for public transportation in Ethiopia which is starving the country of all the benefits mentioned above. This paper attempts to come up with a System Requirement Specification (SRS) document and System Architecture Document (SAD) as well as a prototype of a card based fare collection system which is open for “Open bankcard standards” for payments which are set by the world’s most common financial networks, including Visa and MasterCard [2].

2. Related Work

Even though electronic smart cards for payments have been in use throughout the world for decades, it is still challenging and a work in progress for many. But this is not to say there haven’t been success stories. Among these successful implementation are NOI Card Dubai, MTA New York City Transit and Los Angeles County Metropolitan Transit Authority (LA Metro) [3]. The NOI card is an electronic smart card that enables commuters to pay for the use of various RTA transport models in Dubai (UAE) with a single card. There are 4 types of NOI Cards available to meet travel requirements. In addition to paying for transport, the card can also be used to pay

for parking fees. As other card based systems, NOI has benefits such as commuters no longer need to carry cash or worry about the correct change while enjoying low cost fares and flexible transfers across different modes of transport. Commuters also have the ability to add credit to account and the card will automatically deduct the correct fare based on usage.

The MTA New York City Transit (NYCT) began Phase 1 of a pilot program in partnership with MasterCard and Citibank in 2006. The trial was intended to test the viability of accepting standard contactless bank-issued smart cards to pay transit fares directly at the point of entry without the need to purchase the fare media. The participants’ PayPass device functions as a credit or debit card, depending on the individual customer’s relationship with Citibank. When a participant passes through a fare gate, s/he would tap the card or fob against a reader. However, his/her account is not charged at this point. Instead, a preliminary approval verifies the card’s legitimacy and processes a pre-auth for \$15. A cardholder’s first transaction would always be allowed even if his/her account was not in good standing. The account status would be checked later when a series of fares were aggregated and submitted as a single transaction.

Another success story is that of LA Metro which began a 25,000-person pilot program in 2008 in conjunction with Visa and Ready Credit Corporation to offer special Visa payWave contactless cards that also incorporate the transit system’s Transit Access Pass (TAP) fare application. These dual-use prepaid cards allow riders to pay their fares and purchase fare products using their Visa account, while also allowing cardholders to make purchases anywhere Visa debit is accepted.

Generally transport systems in different countries offer different kinds of payments for their transport systems. One of the common options is electronic card that is rechargeable. These cards are contactless and customers will only need to tap at gates to enter. Customers can recharge these cards at kiosks or stations using unattended machines. Customers will

insert or put the card on the machine and choose amount to recharge and insert that amount in cash into the machine. Transit system providers offer discounts for users of these cards. The problem with this and similar cards is since the value or available balance is stored offline (inside the card) it is difficult to recover when the card is either stolen or damaged. Another type of electronic card is also contactless but this one is not rechargeable and can only be used for few times. These cards compared to the rechargeable cards are expensive. The system will authenticate the cards within 1 to 2 seconds in most cases. People who want to use these cards can get them at stations or other kiosks. Most transit systems offer a third option for those who don't want to use electronic cards. Here they will need to use token disposing machines. Customers will need to insert cash into the machine and the machine will then dispose tokens based on the inserted amount. The problem with this is that it takes time compared to using cards to get authenticated and allowed entry. Another problem is the disposing machines are easily damaged and become out of order because of misuse and unfit cash being inserted to it.

In some countries customers are able to use their bank cards for transport payment services. The cards have to be contactless and have an offline capability. These cards also have limits so they can only be used up to a fixed amount. It took many years and many obstacles for many cities to integrate electronic payment into their transit system costing them billions of dollars through time. But the advantage of being a late developer is that we can learn from both the mistakes and successes of other countries and introduce electronic payment for our transit system that suits the city of Addis Ababa.

3. The Proposed Solution

Transportation is one of the necessities of our day-to-day life. This transportation needs a modern way of handling its commuters. This card based fare collection system will be able to provide this and

play a major role in creating awareness of using electronic payment methods.

The proposed system consists of a central station and many POS terminals with card reading and network communication capabilities deployed at different entry and exit points of the transit stations. The central station will be responsible for customers' registration, transaction processing, terminal management, fare and tariff management as well as topping up of customer's credit. The POS terminals located at stations are used to accept cards of customers and process them by communicating with the central station.

Qualities Attribute Consideration and Architectural Decision

The following are system requirements and objectives that have some significant impact on the architecture and design of the system.

- a. *Technical Platform:* The system application will be deployed onto a Windows platform.
- b. *Communication:* The system will use TCP Server to handle incoming and outgoing connections. The POS system will use built-in communication libraries to handle its communication. The POS communication will handle both Ethernet and GPRS communications. Communication between remote components outside the LAN of the central station will be via VPN to be implemented by ethio telecom.
- c. *Security:* The system must be secured because it is storing customer's card number information. Basic security behaviors are stated below.
 - Every user is assigned an access level.
 - *Authentication:* Login using at least a username and a password and a user's account will be automatically disabled after three wrong attempts.
 - *Confidentiality:* Sensitive data must be encrypted and must not be shared with

third parties without prior agreements and security clearances.

- *Safety*: All the data must not be kept at a local database. It should be backed up every day.
 - *Data Integrity*: Data sent across the network must not be modified by a middle person.
 - *Auditing*: Every sensitive action must be logged and be audited.
- d. *Reliability/Availability*: High availability is required since there are monetary issues related to system availability. When the system is not available, POS system will work offline and settles the transactions when the system with central station is back on. When there is a problem of Ethernet connectivity, POS will automatically revert to GPRS connectivity. Ethernet connectivity is much faster than GPRS connectivity hence priority is given to Ethernet. Targeted availability is 18 hours a day 7 days a week while maintenances and system updates are done after midnight.
- e. *Performance*: Transit systems are very critical of the time it takes for a customer to use his/her card and enter into the transit medium. With that in mind, the system will respond in less than 3 seconds. The response time is calculated beginning from once the customer inserts or swipes a card at the POS located at the stations, send the transaction to central station and receive the transaction response and passes it to the fare gate.
- f. *Extensibility*: Initially the system is designed mostly taking consideration of the Addis Ababa Light railway transit system. The system with some modification can be transferred into other modes of transit systems like busses and taxis. The system is also open to handle and connect with customer's bank account and also accept contactless cards in the future.

4. Prototype

4.1. Overview

A prototype was developed to test that the proposed solution meets the requirements set in the Requirement Specification document and the design goals and quality attribute considerations set in the System Architecture Design. The programming language used to develop the PC side of the system is C# with SQL server 2008TM. For the POS side to be deployed at stations, C programming language is used. The general objective of this paper is to come up with a card based fare collection system that is open to any standard payment card solution while using the current infrastructure implemented in the country. The system is based on a Client Server architecture that addresses the research problems and shows the constraints of the existing transit fare collection system in Addis Ababa. The Home Page is shown in Figure 1.

In the new system customers will take advantage of the modern fare collection system by going to registration stations with their existing bank cards (expired or not expired) and get enrolled with the system. This is a one-time process unless they want to change cards at a later time. The customers will top up or credit their balance. To use the system any customer will swipe or insert his/her card at the entry of the stations. If the customer has positive balance then s/he will be allowed entry if not a declined response is received. While departing the station the customer will again swipe/insert his/her card at the station and the system will again communicate with the central server and will deduct the fare amount from the customer's existing balance. In addition customers of the Addis Ababa public transit system will be able to recharge (top up) their available balances remotely using POSs found in designated stations. There is a system in place to set Fares between two stations. In the current public transit system in Addis Ababa the customer has to pay the whole price of the travel even if s/he gets off at the next stop and this forces the customer to pay extra

fare for the ride. The proposed solution solves this problem as it only calculates the number of stations the commuter traveled in. Transit authorities will be able to monitor real-time transactions, disable, edit or delete a particular customer's account, manage and settle disputes based on available transaction reports

4.2. Implementation

In order to implement the proposed system and put it to use different hardware and software components need to be in place. As shown in Figure 2, which is the high level deployment diagram, these are RS232 Cable used to connect and transfer data from the POS device to the PC, TopUp or customer registration POS which is used to either enroll/manage customer accounts or credit customer's balance and is connected to the system user's PC via RS232 Cable or remotely using Ethernet cable and GPRS. In addition to the above components LAN Switch is used to connect devices in a Local Area Network while TCP Server is used to handle incoming TCP connections and transactions.

SQL Database Server is used to store customers and transaction data with ADSL router providing remote access together with ethio telecom's VPN connection. Transaction POSs are deployed in every station and they are used by commuters to pay for their ride using their cards.

The proposed solution uses a TCP application server that handles incoming transactions originating from POS terminals whenever a customer swipes/inserts his/her card and performs account balance checking and debiting the customer's account by calculating fare. The application server is also responsible for responding with the appropriate message which is then sent to the POS devices located at the station. The database system is based on SQL Server. The POS system handles card reading and transaction sending and receiving as well as topping up of customer's balance. The POS can accept any standard bank issued card whether it is credit card or debit card.



Figure 1: Administration Home Page of Card Based Transit Fare Collection System

5. Conclusion and Future Work

Even though we are seeing progress in infrastructure and digitalization we are yet to see any

modern way of payment for our public transit system in Addis Ababa. Our transit system uses the same methods it has been using for decades with only

minor changes. This is causing disadvantages for customers as well as the management of these transit companies or authorities. In the current Addis Ababa Public Transits system, customers will have to wait on queue to buy their paper based tickets and waste time while deciding how much the transit might cost. The cashiers that work nearby stations often don't have changes when customers come with larger notes. This paper tried to address these issues and come up with a modern system for handling transits.

The new system will be able to give administrators abundant data on the day-to-day transit. The generated data/report can be used in identifying key places for improvements and assigning more transport vehicles when there is too much queue in some areas. The reports can also be used by security officials to track down criminals that could be using the public transit system.

The developed system can be deployed and be used as it is but the following future works need to be added to get the most out of the system. As Ethiopia is currently working on a national switch with ATM interoperability already in action, the integration of the system with the actual available balance of the customer's bank account when the POS

interoperability is completed is required. In addition to that currently all cards available in the country are either EMV contact or magnetic stripe only. The system has to support contactless cards when they began to come into the country's electronic payment environment.

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Application of Soft Systems Methodology (SSM) to develop Information Systems Security Model for Ethiopian Banking Industry

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Abstract

Information Systems (IS) security protects all information assets from misuse, harm or any other unintended results. Literature suggests that focusing on the technical aspects of IS security without due consideration of how a human interacts with the system is insufficient in safeguarding Ethiopian banks' information assets. To fill this gap, this paper adopts a broader perspective and presents an understanding of IS security in terms of a social and organizational perspective using the Checkland's Soft Systems Methodology as an approach in order to achieve a greater insight of the problem situation and with the aim of identifying changes which could improve it. Mixed research method is used as a research paradigm and survey questionnaire and interview are used as methods of data collection. By applying SSM, this paper identified and explored IS security problems and obstacles facing the Ethiopian banking industry. A conceptual model has been proposed. The solutions derived then form the basis upon which recommendations are presented that are both systemically desirable and culturally feasible.

Keywords: Soft Systems Methodology; Information Systems; Information Systems Security

1. Introduction

Information has become the most valuable asset to protect from insiders, outsiders and competitors. As defined by Lee [1] "an information system is not the information technology alone, but the system that emerges from the mutually transformational interaction between the information technology and the organization". Organizations continue to witness information-related crime and damage becoming the choice of a growing global criminal element. Existing institutions burdened by countless conflicting jurisdictions and inadequate resources have not been successful in reducing the amount or impact of these activities. Maintaining information security requires support and co-operation from all employees within the organization. Even though the technical aspect of IS security needs due attention, a more serious and under-rated aspect of IS security is the human element. Martins and Eloff [2] underline that the behavior of employees and their interaction

with computer systems have a significant impact on the security of information. Many losses are not caused by lack of technology or defective technology rather by users of technology and flawed human behavior. The importance of non-technical issues related to information security hasn't been given attention in many studies [3]. Consequently, little attention has been given to the role of human factor like individual choice and behavior or to organizational factors such as national and organizational culture, environment, information security awareness level of employees and how the factors relate to attitudes of employees about information security. However, empirical studies [3, 4, 5] have revealed that non-technical issues are very important in safeguarding an organizational sensitive information.

A bank's ability to take advantage of new opportunities often depends on its ability to provide open, accessible, available, and secure network

services. Having a good reputation for safeguarding information will increase market share and profit. Nowadays, banks are implementing different types of practices to protect information and information systems from fraudulent attacks.

The banking industry in Ethiopia is one of the rapidly growing sectors of the country's economy. In addition, the banking service has shifted from local branch banks to national and global existence and anywhere-anytime banking. The Banking business competition has motivated the advancement of services enabled by IT which in turn increased the information security risk. These threats to information and information systems can include purposeful attacks, environmental disruptions, and human/machine errors and result in great harm to the national and economic security interests of the country [6].

Ethiopian banking system is still underdeveloped compared to the rest of the world regarding electronic payment, Internet banking, Mobile banking, online shopping, etc. Such systems are at early stage. The reasons for this weak or evolutionary development are numerous. The main one that is cited by different scholars is security threat or poor implementation of information systems security [7, 8, 9]. Currently, for the banking industry, there is no information security standard and there is no clear guidance regarding what would establish an acceptable minimum baseline body of information security knowledge for end users [7].

Literature survey and from our experience it is revealed that many Banks in Ethiopia do not have a comprehensive IS security framework or baseline which serves as a guide to develop and implement their own information security policy based on their own requirement in line with notional information security policy. There is no regulatory organ that supervises activities of the banks regarding information security. There is no functional cyberspace security policy in Ethiopia [9]. Security has not been given a considerable attention in Ethiopian banks. Even most of the banks do not have

security department or officers [10]. There is lack of research in the area that can support the industry to compete with technologically advanced commercial systems of the rest of the world [10]. A study in [8] revealed that Information security awareness in the banking sector in Ethiopia is unsatisfactory. Consequently, the level of proper information security governance in the banking sector is a critical area for improvement.

In addition, major international information security standards applicable in the world are written from a Western perspective, without knowing how applicable Information Security Management (ISM) concepts and practices are to other cultures, which have different social, organizational, and security cultures [11]. The standards do not mention how this can be attained. They do not clearly show the steps or methods that any bank can follow in their requirement identification process when they develop IS security model.

Different literatures and empirical studies have revealed that IS security is unexplored area and complex and dramatically changing. IS security challenges in the banking industry are numerous and inherently diverse [7, 8, 9].

Those kinds of situations are the objectives of this paper, which has been addressed by adopting a holistic system approach which is Soft Systems Methodology (SSM). SSM is a systematic approach for tackling real-world problem situations. It was developed in the 1970s by a team of academics from the University of Lancaster led by Prof. Checkland. SSM is defined by Checkland [12] as "*Soft systems methodology (SSM) is an approach for tackling problematical, messy situations of all kinds. It is an action-oriented process of inquiry into problematic situations in which users learn their way from finding out about the situation, to taking action to improve it.*"

The main reasons why we adopt SSM as an approach is to explore problem situations in the banks of Ethiopia and to develop IS security model. SSM by its nature is practical, highly participative,

used as a learning tool and flexible approach to manage changes by perceiving a holistic approach that takes a wider range of factors into account including social and political aspects aiming to suggest change that is meaningful and feasible in the organizational context. In addition, as defined by Checkland, SSM is not a system development methodology rather it is a methodology to identify changes and also it is human problem and process oriented not technique oriented.

From literature and empirical studies, application of SSM for developing IS security model is not implemented so far. Taking these facts into consideration, we apply SSM as an approach to identify and explore IS security issues, assess the current status and practices of IS security processes in the banking industry in Ethiopia and develop IS security model which serves as a guide for developing and implementing IS security baseline.

2. Related Work

Ula *et al.* [13] proposed specific Information Security Governance Framework (ISGF) for governing information security in the banking environment. The framework is categorized into three levels which are Strategic, Tactical and Operational, and Technical level. Essentially, the framework is still a general approach to information security governance. It needs to be reviewed by professionals and comprehensively tested in a real banking environment.

The main objective of the work in [14] is to demonstrate the application of SSM to issues and obstacles facing Saudi Arabian government organizations that use ICT. A number of techniques and approaches were used in achieving these objectives including quantitative and qualitative techniques of data analysis. By applying SSM a conceptual model has been proposed. Even if the approach used is useful for our purpose, the proposed model is directly applicable for ICT issues and problems which do not specifically address information security aspects.

SSM is used as a diagnostic tool to analyze a real case information security incident in [15]. The authors used qualitative methodology to collect data by conducting unstructured interview. SSM is used as a diagnostic tool to analyze a real case information security incident not to propose a comprehensive information security conceptual model.

The main objective of the work in [16] is to propose applicable information systems security auditing framework to support people in the area of IT Auditing. It mainly focuses on developing information systems security auditing framework for the respected banks of Ethiopia.

The purpose of the work in [8] is to investigate the extent of information security culture in Ethiopia and indicated that, even big banks in the world that generally do better on security are victims of security breaches. Finally, the authors concluded that there is a significant space to enhance the trust environment between managers and employees that can promote change in information security culture and more rigorous researches are needed to frame practical strategies to enhance the information security culture in the banking sector in Ethiopia.

The work in [17] was to develop and propose Internet banking security framework. The main objective was to develop Internet banking security framework and its major five models aiming to overcome major security issues, specifically for social engineering attacks. However, security breaches and incidents are not only social engineering attacks. There are a variety of attacks, incidents, issues and problems that need to be considered as IS security issues and problems.

The work in [18] focuses on the effect of strong corporate culture and organizational commitment as important aspects for enhancing information security. The research tries to examine the extent to which information security behaviors, as part of an organizational culture, relate to a common work attitude variable known as organizational commitment. The authors used survey questionnaire for employees of a large sized bank in Greece. They

concluded that in order to ensure effective and proactive information security, all staff must be active participants rather than passive observers of information security. However, no model, guideline, or framework is proposed to be followed or practiced.

3. The Proposed Solution

By applying SSM we developed a conceptual model for Information Systems Security for the Ethiopian banking industry as shown in Figure 1. In the proposed model there are nine inter dependent activities that must be performed for modeling Information systems security system for the banking sectors.

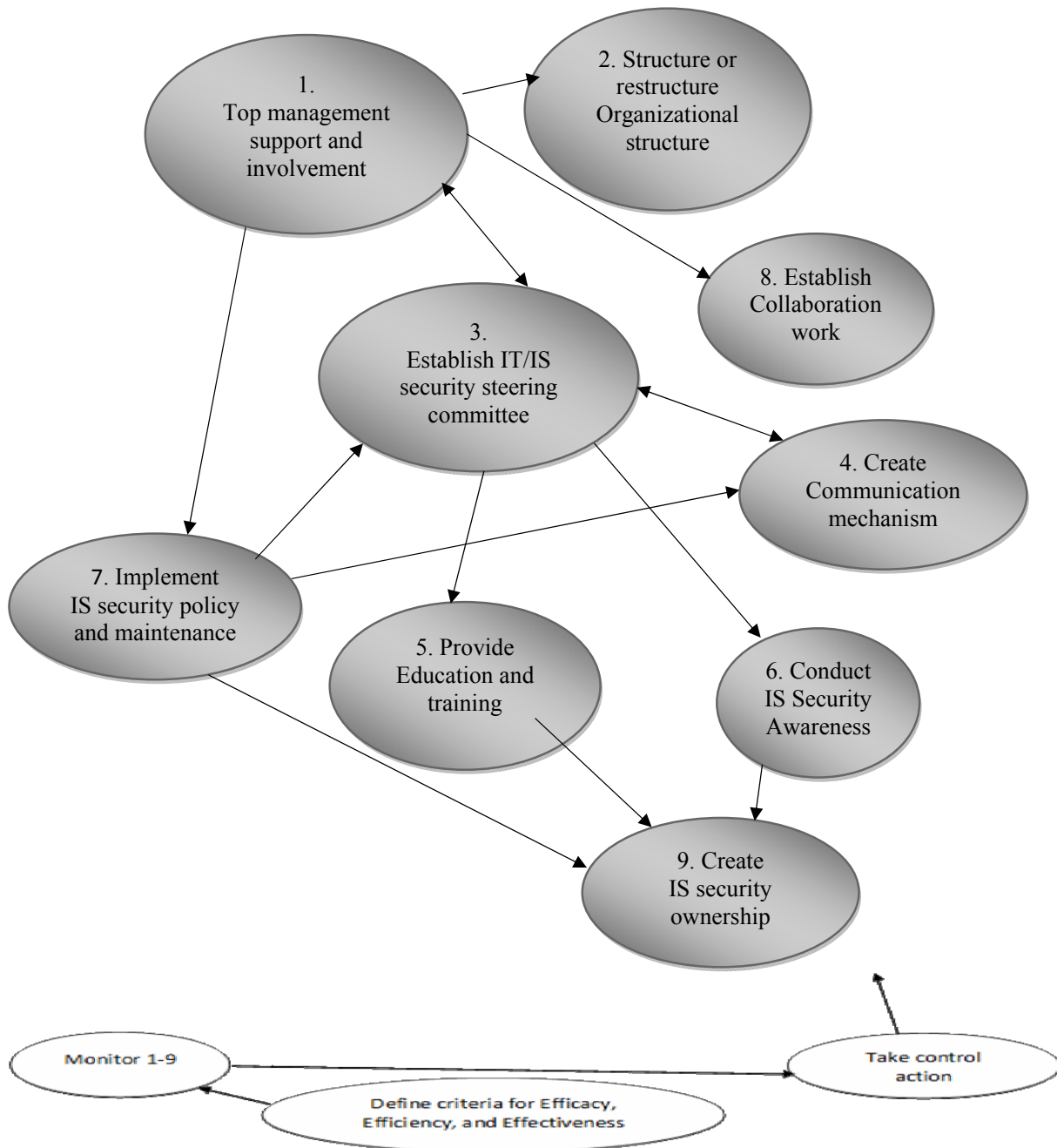


Figure 1: Conceptual Model of Information Systems Security for the Ethiopian Banking Industry

Possible recommendations which are systemically desirable and culturally feasible solutions for the situation are proposed for the Ethiopian banking industry as follows.

- Conducting an awareness about IS security objectives to the top management is very essential in order to get top management's attention, because top management is the one to have the most influence in a bank. The awareness program must focus on business benefits that can be gained from improving IS security activities of a bank.
- Top management support and involvement is also the main activity for the success of effective implementation of IS security in a bank. This activity is also accepted and suggested by the SSM group discussion as a primary change in the banking industry.
- Another area of possible change in the banking industry in Ethiopia suggested by the SSM group discussion is organizational structure of IT security office. IT security office should report directly to the President or Chief Executive Officer of a bank.
- Result obtained from the discussion and data collected shows that there is no IT security steering committee in the Ethiopian banking industry. Discussion in the SSM group strongly suggested the need to establish IT/IS security steering committee that has actors from the concerned departments and executives of a bank.
- It has been manifested from group discussion and data collected (questionnaire and interview findings) that the banking industry in Ethiopia encounters a problem in implementing and enforcing IS security policy. The SSM group discussion agreed and suggested to establish and implement IS security policy, guidelines, procedure, manuals, etc. throughout policy enforcement, review and update the policy periodically.
- It has been marked from the group discussion and data collected (questionnaire and interview findings) that banks in Ethiopia are weak in providing advanced education and training for IT security experts. Therefore, banks of Ethiopia should provide sufficient tools and facilitate information security related training for IT security experts, and supply instruction guidance and manuals that can be easily understood.
- SSM group discussion agreed on an acceptable idea and suggested that Banks in Ethiopia should deliver strong and consistent communication mechanisms for communicating IS security policy, procedures, guidelines, manuals, etc.
- The SSM group discussion suggested that it is advisable for top management to establish strong and consistent cooperation and collaboration among the three business units of a bank which are IT department, IT security office and IT audit division.
- Participants of the SSM group discussion suggested that it is a must to aware and train all staff of a bank about their IS security roles and responsibilities continuously and to hold them accountable in order to enhance their bank's performance.

4. Discussion

We obtained a clear picture through a discussion with key participants (SSM group) and from the data collected (questionnaire and interview) at each site of the surveyed banks of Ethiopia. This research clearly identifies IS security issues and challenges in banks of Ethiopia which are: absence of IT security steering committee, communication gap with the management and staff, lack of IS security awareness, lack of financial and human (IS security qualified experts) resource, lack of IS security governance, inefficiency of IS security risk management processes, lack of advanced training for IT security experts, disorganization of IT security office in the

organizational structure, and implementation of informal and unapproved IS security policy.

By applying SSM we identified social and political issues and obstacles in the Ethiopian banks like: lack of IS security awareness, high level of power distance cultural factor within the top management and IT security office of the bank resulted a challenge in order to convince and aware top management of the banks of Ethiopia about the importance and necessity of IS security objectives in safeguarding the banks data and the need for continual improvement, lack of policy enforcement due to lack of IT security office empowerment and so on.

5. Conclusion

When banks in Ethiopia want to develop and implement information systems security framework or baseline, it is advisable to consider the following issues primarily which means without the issues listed below, it is difficult to construct or develop any organizations Information Systems Security model. Therefore, the basic nine concerns to develop Information Systems Security model for an organization are listed below:

1. Top management support and involvement.
2. Structuring or restructuring IT security office.
3. Establishing IT/IS security steering committee for the bank.
4. Creating a Communication mechanism throughout the bank.
5. Providing adequate education and training for IT security experts.
6. Conducting IS security awareness.
7. Implementing IS security policy through policy enforcement.
8. Establishing a strong collaboration with three business units (IT security office, IT audit division and IT/IS department).

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An Investigation on the Current Information System Security Maturity Level of the Banking Industry in Ethiopia

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Abstract

The banking sector is one of the pioneers in Ethiopia in adopting new technologies to deliver quality service to customers. However, this would not have been without considering information security management to better handle the risk, system failure, and any other attacks that could interrupt the information system operation. Currently, information security risk is increasing with the advancement of technology. Therefore, companies in the financial industry need to check their information security capability periodically.

The objective of this paper is to assess the existing information security maturity level in the banking industry in Ethiopia. The widely used framework in financial organizations in The Netherlands, De Nederlandsche Bank (DNB) assessment framework, is employed to help information security maturity assessment.

The result of the study indicated that the maturity level of information security management in the Ethiopian banking industry is below the expected standard and there is weak information security control and management. The study also identified that there is no information security framework or standard used by banks, and there is no regulatory framework enforced from the banking regulatory body as well.

Therefore, we suggest adapting an information security framework closing the gap by assessing information security maturity level periodically. In addition, banks should give security awareness training to their employees and should develop information security policy and procedures.

Keywords: Information Security; Information Security Management; Information Security Maturity Level

1. Introduction

Information security refers to the processes or controls that are in place by organizations or owners to protect the information assets from unauthorized access, modification, disruption, disclosure, and deletion. Protecting information assets in an organization is now becoming the highest priority.

The banking sector is one of the influential industries in the Ethiopian economy. In the banking business with the increase of technology and advancement of services, the level of information security risk has increased correspondingly [1]. The attack in an organization's information assets will result in the organization to lose money, to face a loss of customer confidence and negative business

reputation [2]. To overcome this issue, banks should have effective system security in place. This is achieved by attaining a high level of maturity by implementing good information security management and doing continuous assessment on the information security management gaps. Studying and evaluating the maturity level of system security would help an organization to have an enhanced system security management.

A few years back, banks were not operating their service centrally where their branches were operating independently. These days due to the advancement of technology, high availability of the banking services has become inevitable. To meet this purpose the National Bank of Ethiopia (NBE) has set a

requirement to all banks to implement Core banking systems by the end of June 2011 and integrate electronic interbank money transactions with the EthSwitch or the National Payment Switch (NPS) [5]. Accordingly, almost all banks acquired a Core Banking system and they already integrated their payment solutions with NPS. At this stage, they are using advanced technology to provide better e-banking services. When we are thinking of the advancement of technologies, the information security controls also need to be advanced; otherwise banks may encounter a huge amount of monetary and non-monetary loss. In the banking business, the information security risk has increased in proportion to the advancement of technology [1].

In Ethiopia, almost all banks are delivering their banking services using different products or Electronic Channels such as ATM, Mobile banking, Online banking, SMS banking and other channels anywhere and anytime. These channels have their own associated security risk. As a result, the banks' strategy should be readjusted so that it meets the new challenges with risk balance.

All banks have implemented their own information security controls to protect against cyber attack. However, they are managing the IT security as per their requirement and there is also a gap in managing the implemented security controls. A research by Balcha Reba [4] identified that cyber security and standards do not present in Ethiopia at the time of the study. Therefore, the author suggested professional training on information security management to be given and indicated that information security issue cannot be addressed alone with technology and attention should be given to information security management as well. So far there is no study on information security maturity level assessment in the banking industry in Ethiopia. In line with the issues discussed above, this study has closed the gap by answering the following research questions.

- What is the current information security management maturity level?

- How does it agree with the expected average information security maturity level in the industry?
- What are the challenges in implementing effective information security management?

Previous researchers in the area revealed that most of the Ethiopian banks have not yet implemented information system security management (ISSM) standard and the maturity of information security is not assessed.

2. Related Work

There is few literature on information system security specific to the Ethiopian context. However, related research works are discussed to show their similarities, differences and their contribution to this research.

According to Lema Lessa [1], financial institutions are exposed to threats due to the wide spread of technology and their interconnection to the Internet. Technical controls have been used to minimize the threat. However, using technical controls alone does not help to bring a solution. The author claims that many losses are not caused by lack of technology control. Rather it is caused by faulty human behavior. The researcher aimed at assessing the information security culture and identified the gap that needs management and policy intervention. Therefore, a survey research method was employed to collect quantitative data from 11 banks in Addis Ababa. Using the auditing process, the information security culture was audited. The paper revealed that the information security awareness in the banking industry was unsatisfactory. The findings mainly focused on the need for effective information security culture which enables proper information security governance and implementations that comply with local and international standards.

The work in [3] discusses the benefit of using cloud computing and associated concern. Cloud computing is storing and managing data on virtualized environment so that organizations can have the ability to store data and compute anywhere

and anytime. However, banks are not able to use cloud service due to the security issue and absence of clear standard and framework that guides the banking industry to address compliance and security concerns. The aim of the research was to address this problem by proposing cloud computing security framework for the banking industry. The paper proposed applicable Conceptual Cloud Computing Security Framework for Banking Industry. A model named Sherwood Applied Business Security Architecture (SABSA) is used as a guide for designing the newly proposed security framework based on five basic security questions; namely What, Who, Why, Where, and How. The paper proposed a framework that integrates major components that address security, privacy, legal and compliance and regulatory issues.

Mengistu Bogale and Donald Amoroso [6] addressed the problem of how Ethiopian companies are handling IT Governance program and how IT auditing can be used. First, the authors assessed how IT governance performance influences organizational performance. The aim of the study was to understand the contribution of IT auditing for organizations' overall performance. They used a survey method targeting banking and insurance companies and categorized after clustering into two based on their age and ownership. From the target population, they selected 12 banks and 9 insurance companies for data collection. Quantitative data were gathered with the help of questionnaires. After analyzing the quantitative data gathered, they concluded that IT audit practices are strongly correlated with IT governance performance. IT governance performance and maturity would improve both operational and financial performance of firms.

Kelemie Tebkew [7] assessed the existing Information Security Management (ISM) practices of the banking sector and proposed and developed an ISM framework. The researcher tried to study and compare the available information security management frameworks and best practices. To assess the ISM practices in the banking industry, the

researcher used ISO audit checklist and own experience. Both qualitative and quantitative research approaches were used. Data collections were done using questionnaire, document analysis, and interviews. Findings of the assessment show that existing information security management in the surveyed banks lack a formalized comprehensive framework-based information security policy which would result in poor performance in information security management. The researcher proposed an ISM Framework for the banking sector to be used as a starting point to manage information security by developing guidelines and implementing controls to protect banking information assets from threats. The proposed framework has two major components, viz. information security requirement identification mechanism which is the combination of Entity Relationship Model, and Information Security Management System process model with supporting template and countermeasures (controls). Further, 16 main ISM domains are identified. These are further grouped under three categories, viz. Administrative, Technical, and Physical & Environmental security. The suggested framework is still a general approach to ISM. It needs detailed policies and procedures and comprehensive test in a real banking environment. As the researcher stated, the proposed framework requires extra work in order to be implemented. Therefore, it is difficult to conclude the developed framework is valid and applicable in the banking industry to address the challenges related to information security.

3. Approach, Result and the Proposed Solution

This Section discusses the methodology and approaches used to assess the information security maturity level of the banking industry in Ethiopia. Based on the analysis and results of findings, recommendation are made.

3.1 General Approach

We followed DNB's assessment framework, the widely used framework in financial organizations in

the Netherlands. DNB assessment framework was employed to help the information security maturity assessment. It is based on COBIT (Control Objectives for Information and Related Technologies) which includes control objectives and measures to assess the maturity of an organization's IT processes [8]. The DNB framework includes 21 control objectives which are derived from COBIT and ISO and are divided into the following six areas: Strategy, Organization, People, Processes, Technology, and Facility.

Mixed research approach is used and purposive sampling technique was employed to select the respondents from each of the 18 banks that are currently operating in Ethiopia. Data was gathered

through survey questionnaire and interview. SPSS is used for data encoding and analysis.

3.2 Information Security Management Maturity Level Result

In this Section, findings related to Information Security Management maturity level of each bank is categorized based on strategic and planning, organization, people, process, technologies, and facilities, as shown in Figure 1.

AS can be seen from Figure 1, 40% of the banks' information security maturity level is at the initial/ad-hoc (level 1) stage, 40% of them are at initiative stage (level 2) and the rest 20% are at the defined stage (level 3).

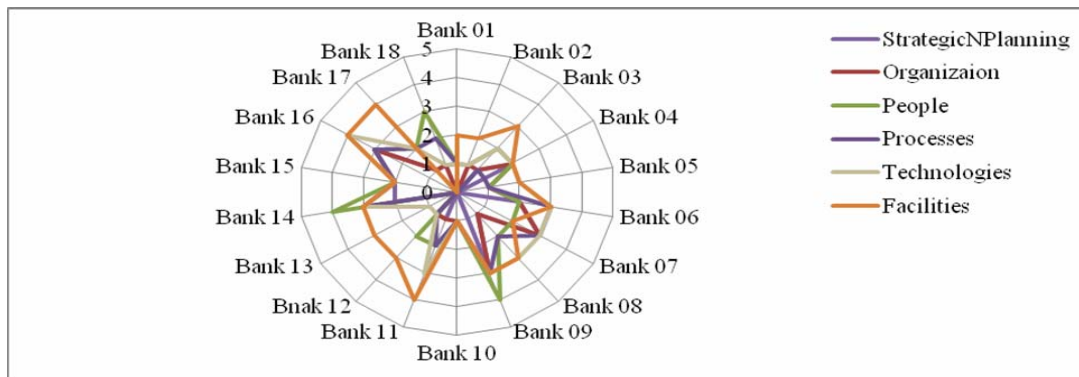


Figure 1: Maturity Level of the Banking Industry in the Aspects of Strategic and Planning, Organization, People, Process, Technologies, and Facilities

Figure 2 shows the mean maturity level of the information security in the banking industry on a radar graph.

As shown in Figure 2, from the total of 18 banks, 4 of them are at level 3 (defined), 7 of them at level 2

(initiative) and the remaining 7 are at level 1 (initial) stage. Generally, there is no bank that passes the industry average information security level.

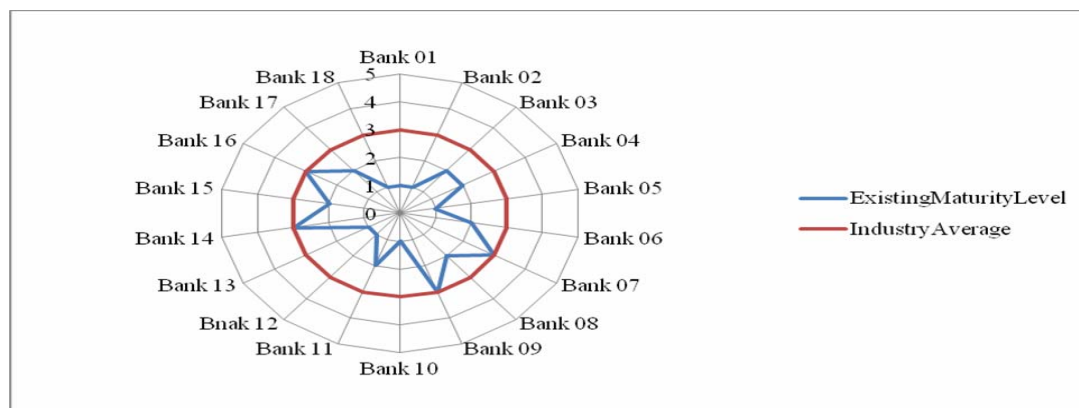


Figure 2: Information Security Management Maturity Level of the Banking Industry

3.3 Suggested Solutions

According to the study result and the concepts learned from the literature review, a recommendation which the Ethiopian banking industry should follow in order to address the stated information security gaps are stated as follows.

- Increase IT security maturity level by setting a benchmark and assessing the maturity of information security periodically.
- Develop information security policy and procedure.
- Train both users and technical staff periodically.
- Empower information security management.
- Periodically make a risk assessment and penetration testing.
- Establish Security Operation Center to centrally manage, analyze and mitigate an information security attack.
- Adapt an information security standard as outlined below.

Recommended Information Security Standard for The Banking Industry

Information security standards and best practices can be the best solution for effective information security management [10]. This is because they have their own focus areas, advantages, and drawbacks. The existing preferable standards which are mostly used for information security management and compliance are ISO 27K, COBIT and PCI DSS [9]. Usability of ISO and COBIT standards have scored 163 and 160 respectively out of the total of 203 countries in the world. Payment Card Industry Data Security Standard (PCI DSS) has scored 125 and ranked third [9]. PCI DSS controls are mandatory for organizations that collect and store credit card data. Therefore, financial institutions are required to be compliance with this requirement in order to give an international card payment service. To manage information system security effectively and to comply with the regulation requirement, many organizations adopt different information security

management models but each information security management model or standard has its own advantages and drawbacks. So, best practices should be adopted based on the business context focusing where their use benefits the organization most [10]. Therefore, there is no any information security model that fulfills the entire organization's requirement. However, an organization can adopt the three major standards by aligning the security control requirements of one on another.

To suit information security management to the business needs, formal processes with good IT governance support should be used. So, COBIT can be used at a higher level of IT governance providing an overall control framework process model that generally suits every enterprise [10]. ISO 27001 and PCI DSS can be mapped into COBIT to address concerns that have special focus on security and cardholder data. The purpose of the mapping is providing an integrated way for complementary use of COBIT, ISO 27001, and PCI DSS for information security management [11, 12].

In order to align ISO 27001 to COBIT 4.1, an approach in [11] shows how to use both standards' functionality by mapping ISO into COBIT control objectives. This result combines an aligned COBIT 4.1 and ISO 27001 control objectives in one. Finally, PCI DSS control requirements were identified and mapped to the correspondent domain of the two control objectives. This will create an alignment between the control objectives of COBIT, ISO 27001, and PCI DSS.

4. Discussion

According to the survey we made, the majority of the banks interviewed do not have a formal information security standard adopted, 83.3% of the banks have not implemented information security management standard, while 16.7% of them have implemented COBIT, ISO and PCI DSS separately. A previous study by Kelemie Tebkew [7] also corresponds to this finding. This finding shows lack of use of information security management standard

in the banking industry in Ethiopia. The study also identified the challenges in adopting information security which are lack of understanding of the value of information security standard, lack of training, lack of technical staff, and lack of management support.

As per the assessment made based on the DNB assessment framework, the Information security maturity assessment indicators are categorized as Strategic and Planning, Organization, People, Process, Technology, and Facility [8] from 18 banks. All the indicators are below the expected industry average, whereas physical security is relatively in a better state, which also corresponds with previous studies [7].

Generally, we found that Information Security Management Maturity level of the banking industry is unsatisfactory or below the expected average. This is due to weak information security controls and poor information security management.

5. Conclusion and Future Works

In recent years, the banking industry in Ethiopia has been on the rise in delivering new technological e-banking products, currently the competition has become delivering quality service to customers. To provide a good service quality, banks should maintain the confidentiality, integrity and availability of their information systems. Financial service has been one of the major targets for electronic criminals along with the advancement of technology. Preserving the information security will help banks to increase their market share, customer trust and to keep their business reputation.

Considering this fact, the research assessed the current maturity level of information security management in the banking industry and recommended a suitable information security management standard to close the gap. Related researches and documents have been reviewed to compare and inspect the information security management standards widely used. This research used DNB assessment framework which consists

COBIT 4.1 and ISO 27001 standards for the purpose of maturity level assessment. The findings of the assessment indicate that the information security maturity level of the banking industry is very low or below average. The banking industry has weak information security controls and management system due to lack of technical experts, absence of management support and user awareness.

This study has been carried out on information security maturity assessment which is not studied in this area in the Ethiopia context. There are pieces of literature in information security in general. However, it is difficult to find literature specific to this purpose. There are limitations on this research. So in future work further studies will be done on assessing the maturity level after a period of time and compare the result, study on how to implement security operation center in the banking industry in Ethiopia, and incorporating Information Technology Infrastructure Library (ITIL) control objectives on the proposed framework to address IT Service management requirement.

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Mobile Enabled Aviation Personnel Licensing System for Ethiopian Civil Aviation Authority

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Abstract

According to various literatures, mobile applications are one of the most convenient and fastest ways of making communication for licensing application with a licensing authority. A standardized mobile enabled licensing system which has integration with existing examination system is very important for the aviation crew and authority as well. But, Ethiopian Civil Aviation Authority (ECAA) is currently handling the licensing process through manual based system which is dependent on paper and humans.

The main objective of this paper is to design and develop a mobile enabled aviation licensing system for Ethiopian Civil Aviation Authority. Developing this system is very important to make the authority as well as the country competitive in the aviation industry over the world and also will make the aviation crew to use their time appropriately and effectively.

Keywords: Mobile Enabled Aviation Personnel Licensing System; Responsive Design; Integration

1. Introduction

Ethiopia is working to become a competitive and leading aviation group in Africa by providing safe, market driven and customer focused passenger and cargo transport, aviation training, flight catering, MRO (Maintenance, Repair and Operating) and ground services by 2025 [1]. It is implementing strategies which help to achieve its goal. Building the capacity of aviation personnel with new technology is one of the crucial pillars. Developing the capacity of aviation personnel ranges from teaching to licensing.

The International Civil Aviation Organization (ICAO) is a UN specialized agency, established by States in 1944 to manage the administration and governance of the convention on International Civil Aviation. ICAO works with the convention's 191 member states and industry groups to reach consensus on international Civil Aviation Standards and Recommended Practices (SARPs) and policies in support of a safe, efficient, secure, economically sustainable and environmentally responsible civil

aviation sector. These SARPs and policies are used by ICAO member states to ensure that their local civil aviation operations and regulations conform to global norms, which in turn permits more than 100,000 daily flights in aviation's global network to operate safely and reliably in every region of the world [2].

Standards and Recommended Practices for personnel licensing were first adopted by the council on 14 April 1948 pursuant to the provisions of Article 37 of the Convention on International Civil Aviation (Chicago 1944) and designated as annex to the convention. They became effective on 15 September 1948 [3].

ECAA is authorized, under parliamentary legislation, as the State's regulatory authority and, as such, is empowered to grant, renew, suspend, revoke and cancel personnel licenses or permits granted to individuals that give those individuals various privileges in the Ethiopian civil aviation system [4].

Civil aviation authorities throughout the world have implemented an automated licensing system in

one or other ways by outsourcing automation or by developing the system in house.

Personnel licensing system is a set of integrated tools, optimized to meet efficient handling of license request, and automatic processes like registering a new application request, managing existing applications, managing the status of the application, handling of application and producing a printable license and informative reports. It allows all team members to work in a collaborative manner.

One promising area of mobile application is to offer aviation crew convenient and fast way of requesting for a license. Aviation personnel licensing system supports mobility of users so that it becomes convenient and widely used by crew.

Most of the time the crew, especially pilots, are out of office on duty. Because of this, they don't have time for computer access. Hence, a mobile application as a licensing application method can be used by the crew.

This paper intends to design and develop a mobile enabled licensing management system for ECAA.

2. Related Work

There are various approaches for mobile application development and the choice of the client architecture for any mobile application depends on the demands of the application and business considerations [5]. For instance, when the application should not target only one platform and needs to reach the widest audience, mobile web application approach is appropriate as it is designed to run on a mobile web browser. HTML5 is the most popular and promising technology for 'Write once Run anywhere'. As a result, in this paper we use HTML5 as the technology of choice for developing mobile web applications.

Responsive web design emerged to make a web application usable by different screen size devices using various techniques including CSS3 and HTML5 technologies. Basically there are two basic responsive web design techniques. The first one is "flexible grid". The idea is to create a layout where

all elements are based on the calculated percentage width and so all elements in the layout are resizable in relation to one another. Another essential part of responsive web design technique is "media queries". There would be no real responsive web design without media queries. Media queries allow getting the user screen's size to apply the CSS styles that can provide the best user experience to the visitor. It is introduced in CSS3. It extends the functionality of media types by allowing more precise labeling of style sheets. In this paper, we adopt both flexible grid and media query techniques of responsive web design.

Data integration is the combination of technical and business processes used to combine data from disparate sources into meaningful and valuable information. The process of data integration is about taking data from many disparate sources (such as files, databases, etc.) and combining them to provide a unified view of the data for business intelligence.

Direct access data integration is perceived to be a key enabling technology for the exchange of information and is the defacto data integration standard [6].

In this paper we have seen two licensing systems who meet the licensing standard and recommendations of ICAO. The solutions is aimed to bridge the communication gap between the civil aviation authority and the crew and to provide crew a platform through which they can get their licensing request in a timely and transparent manner. Additionally, it is also shown that the basic purpose behind a licensing management mechanism is to provide a platform to the crew to log their application and also enable the operators to make a decision on the need of skilled human resources.

CAAi (Civil Aviation Authority), an e-Licensing management solution developed by civil aviation of the United Kingdom [7], is a web-based system and adaptive for mobile devices. Even if CAAi uses email for notification it has shortcomings as compared to checking the status of the application within the system.

CAASL (Civil Aviation Authority of Sri-Lanka) [8] is a web based system but is not adaptive for mobile devices. The functionality provided by CAASL is not integrated with the examination system. This will make the licensing system time taking and prone to error.

From CAAi licensing management solution, we adopt the mobile adaptive feature and integration part with examination system and from CAASL we adopt the feature of reminding expiry date of license.

The common drawback of the two licensing systems is that they look great on the desktop screen but not true medium on small size screens. This is because the applications are device specific and not adaptive to various device capabilities.

Moreover, one of the systems lacks integration with the existing system which used to share resources of the existing system such as examination result of the crew and prevent the new system from being isolated and standalone.

This paper tries to improve limitations mentioned in the above mentioned solutions by developing a mobile-first responsive web application which is platform independent and adaptive for every screen size of devices like smart phone, tablet, notebook or any size desktop monitor. The system has a Data level integration with the existing system of the

company which is a key to obtain accurate and exact information of the crew examination result to respond to the licensing request of the crew. Moreover, the system conforms well to the ECAA unique requirements, workflow and procedures as it is developed after careful requirement analysis.

3. The Proposed Solution

To improve the current personnel licensing system, a responsive system which supports different devices and simplifies both the application and licensing process is proposed.

3.1 Architectural Representation

The system is implemented using a three tiered architecture as shown in Figure 1.

3.2 Deployment View

As shown in Figure 2, the database server contains database of aviation personnel and the web application server contains the new M-APLS system.

The system has two types of users: external users that use the system wherever they are (aviation crew) and internal users using a company network to access the application in the application servers (personnel licensing officer, director and administrator). External users will get access through Internet using a browser. For security, there will be a firewall between the web server and the Internet.

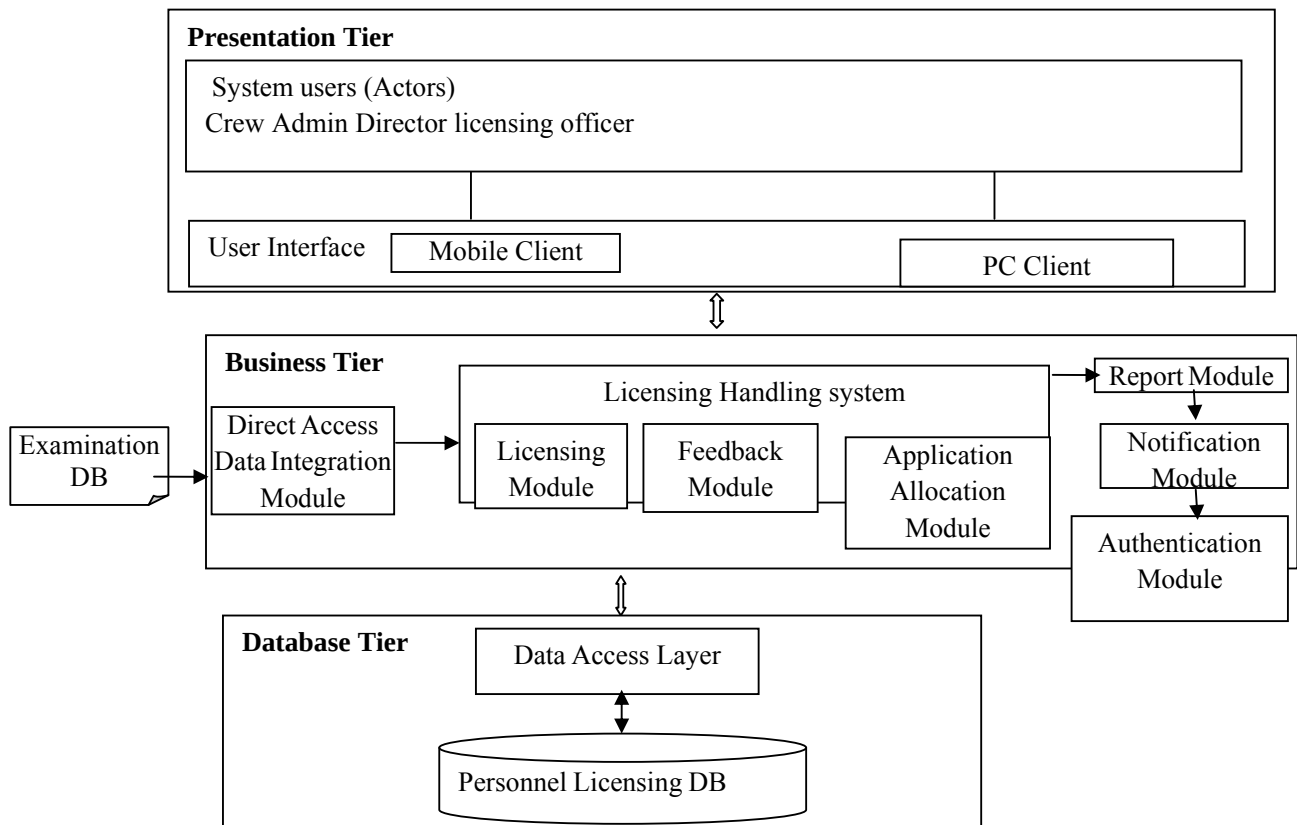


Figure 1: System Logical View

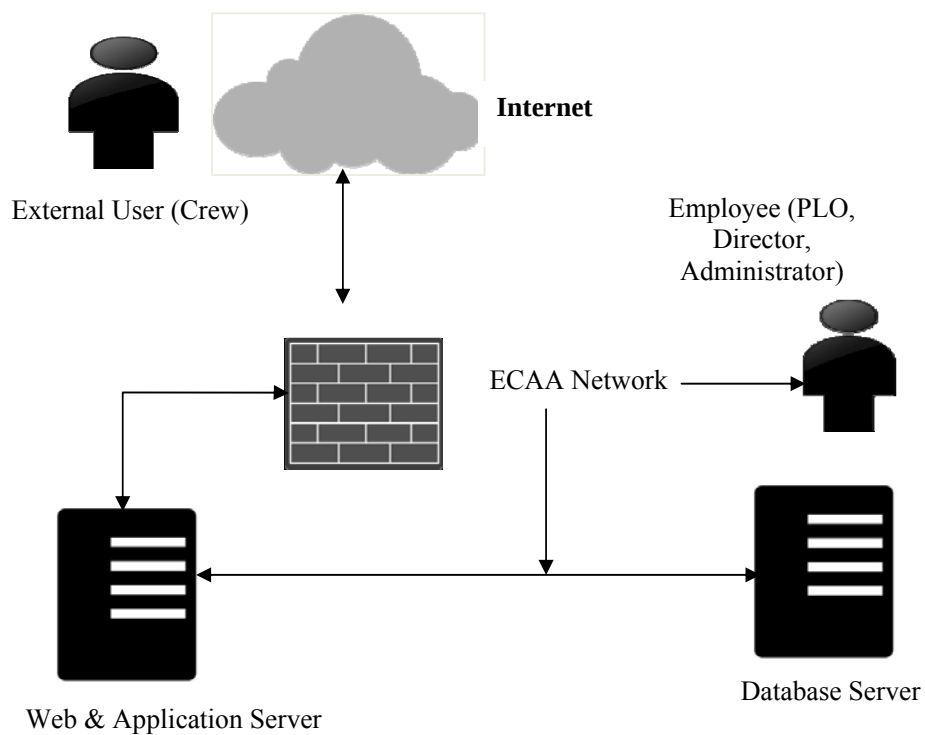


Figure 2: System Deployment Diagram

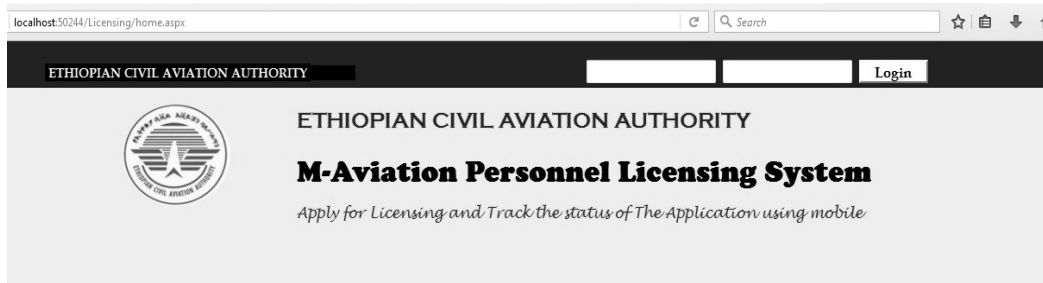


Figure 3: Home Page on a Desktop Browser

4. Prototype

To realize the feasibility and validity of the proposed solution, attributes and methods of the identified solutions are converted to a source code.

Figure 3 shows the home page of the application on a desktop browser. The page also allows users to log into the system using a valid username and password.

Basically, crew are supposed to use their mobile devices to access the application so that the system is designed as mobile-first responsive web application which prioritizes the need of mobile context while creating user experiences. As shown in Figure 4, the home page is displayed on a mobile browser, but it appears differently than a desktop browser. When the page is displayed on medium/large screen sizes, it has two or more columns, whereas it is always displayed with single column while the screen/browser size is small. However, responsive web design is not only meant adapting the page contents to the screen sizes. One of the main goals of responsive design is simplifying page elements for mobile use. In order to achieve this, the system uses lower bandwidth images and avoids non-essential elements to mobile devices.

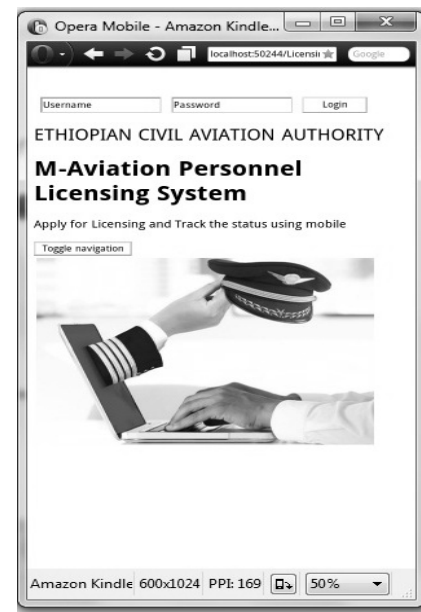


Figure 4: Home Page in a Mobile Browser

5. Conclusion and Future Works

Aviation personnel licensing system is a set of integrated tools optimized to meet efficient handling of licensing requests and automate the process of licensing request. Aviation companies who are audited by the International Civil Aviation Authority should create a suitable system. Mobile applications are one of the most convenient and fast way for applications, especially for aviation crew.

The main objective of this paper is to design and develop a mobile enabled aviation licensing system for Ethiopian Civil Aviation Authority. Developing the system is very important to make the Authority as well as the country competitive in the aviation industry and also will make the aviation crew to use their time appropriately and effectively. To achieve the objective, interview, direct observation and document review are used for data collection. As an analysis and design approach, object oriented methodology was chosen and UML was used. Moreover, HTML5 with ASP.Net C# programming language have been used to develop the system.

The developed system supports various devices' screen resolution in both portrait and landscape format. The system also has a data level integration with existing examination system of the Authority in order to retrieve the examination and rating result of aviation personnel.

When the proposed system is implemented, the Authority will be a beneficiary of a mobile enabled licensing system, and this will have a significant contribution to the country's aviation industry.

It would be interesting to do further work to enhance the functionality of the system. One major task that can be done is making the examination system of the authority mobile enabled, so that the examination and licensing will be consolidated and give the service online.

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Assessment of ERP Assimilation: The Case of ethio telecom

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Abstract

All ERP projects, i.e., the adoption, implementation and assimilation of ERP systems, are done with the aim of getting the intended benefits from the ERP system. Moreover, many researches have shown that effective ERP assimilation plays greater role in order to achieve intended benefits of the ERP system. Since ERP projects are very expensive, for countries like Ethiopia, it is intolerable to accept failure to get return over investment (ROI). Thus, in order to reduce failures, especially due to assimilation problems, and to realize the intended benefit of an ERP system, first it needs to be assimilated well with its users.

This explanatory case based study assesses the ERP assimilation in Ethio telecom based on the technology acceptance model and theory of interference. The research identified success factors that predict ERP assimilation. These are Perceived usefulness (PU), user attitude (UA), and unlearning. In addition, training, empowering users, separate operation support, promoting ERP system are external factors that support the above factors. Finally, this study proposed ERP assimilation model called TAMI, which considered the combined elements of Interference theory and technology acceptance model.

Keywords: ERP; ERP Assimilation; Technology Acceptance; Interference Theory

1. Introduction

ERP is business process management software that allows an organization to use a system of integrated applications to manage its business and automate many back office functions related to technology, services and human resources. According to [5], an ERP system mainly consists of multiple enterprise software modules that are purchased individually, based on what best meets the specific needs and technical capabilities of the organization.

Technology assimilation in general is defined as “the extent to which the use of technology diffuses across the organizational projects or work processes and becomes routinized in the activities of those projects and processes [3]. Hawari and Heeks [10] define ERP assimilation at organizational level as “the extent to which the ERP technology is used in facilitating business processes and the degree it is routinely used to support business operations”.

According to Fichman [7], diffusion is “the process by which a technology spreads across a population of organizations”.

An ERP system provides many benefits to enterprises. It has the ability to empower users if it is assimilated well; it provides accountability and responsibility in a way not available before [5]. With the integration and flow of data, more information is available to users, thus users can decide based on that information and they can be less prone to error. For example, when users want to use their annual leave, they can find all the necessary information on the ERP system without the need to ask their supervisor. By accessing the information, they can know available annual leave days and make informed decision.

ERP systems could be considered as the most difficult systems to be assimilated [2]. ERP systems are complex, need huge budget investment [1] and company re-arrangements and the implementation

success depends on different social, cultural and technical factors of the companies and countries [4].

According to [6], assimilation of ERP systems in organizations has been considered as one of the critical steps towards the realization of the intended benefits. Companies allocate huge amount of budget in order to gain the promising benefits of implemented ERP systems, thus effective ERP assimilation helps to achieve return over investment (ROI).

This paper begins with a brief literature review on the basic concepts of ERP system, benefits, implementation phases and factors that are considered in the process of ERP assimilation. This is followed by a case study illustrating the operation of ERP system in ethio telecom. At the end, the results of a questionnaire survey are shown and major findings are discussed. It also prioritizes critical success factors. The paper also proposes the ERP assimilation causal model.

2. Related Work

Researchers have been interested in ERP studies, but recently ERP assimilation in particular is the focus area of ERP researches. Along with the development of information technology, many companies implement ERP systems because ERP systems promise lots of benefits.

Implementing ERP systems in a company is not easy. One-third of ERP implementation projects are not successful and 60-70% of the ERP implementation cases failed in obtaining the expected benefits [20]. To realize the anticipated benefits after its implementation phase, an ERP system must be assimilated with a company's daily business processes in the post implementation stage. ERP implementation cycle consists of the following three phases.

- *Primary Phase:* A decision to implement ERP systems is made and the preparations of ERP implementation begins.
- *Secondary Phase:* Employees receive and start using the ERP system.

- *Assimilation Phase:* The ERP system has been able to diffuse to the tasks of the organization and has become a routine activity. ERP systems assimilation phase is defined as an extension of the ERP implementation phase in which the technology/ERP system is diffused to the work processes in the organization. In this phase, the use of the ERP system has become a regular activity in the enterprise.

The study in [20] is done on ERP assimilation and benefit realization based on Diffusion Of Innovation (DOI) theory. DOI is a theory that explains how, why, and at what rate new ideas and technology spread through cultures operating at the individual and firm level. DOI theory is considered suitable to be used in developing ERP assimilation model in this study. Because DOI helps to address the ways of assimilating new technology in an organization through analyzing organizational ways of working.

They formulated 7 hypotheses and the following are the accepted ones based on data processing result:

Hypothesis 1: ERP assimilation has a positive impact on the achievement of overall ERP benefit.

Hypothesis 2: Outcome orientation positively affects the success of ERP assimilation.

Hypothesis 3: Communication process positively affects the success of ERP assimilation.

Based on the result of analysis, the authors recommended that (1) organizations should be motivated to raise awareness in providing the best performance, (2) organizations should always distribute the latest information related to ERP systems, (3) organizations should integrate the ERP system with other applications used by the organization, (4) utilization of ERP systems in the organization's operational activity should be enhanced because with the absence of the need to use ERP systems in day-to-day operations, the ERP system will not be used, and (5) actualization of data in the ERP system should be improved by always

inserting new data into the ERP system, so that the user can use the data of the ERP system in real time.

According to [20], the influence of ERP assimilation on ERP benefit realization was examined. The result shows that ERP assimilation significantly influences overall ERP benefit. This study also examined the influence of 6 antecedents on ERP assimilation and found that outcome orientation and communication process influence ERP assimilation process significantly.

Kouki, *et al.* [19] identified some determining factors of ERP assimilation and they explained that the worldwide popularity of ERP system is because the software application could improve business efficiency and productivity and streamline operations. Deep and extensive assimilation of the system in an organization is the key in realizing these benefits.

According to [19], there is limited research about ERP post implementation and ERP assimilation. Similarly, no research investigated ERP experiences in developing countries. Based on a qualitative research methodology grounded in the diffusion of innovations theory, the paper aims at investigating the factors that would promote ERP assimilation. A comparative case study analysis of six firms in a developed and a developing country suggest in both contexts the primary factor for supporting and encouraging a successful ERP assimilation. Other factors such as training and education, IT support, organizational culture, managers' and users' involvement and strategic alignment were also identified that foster ERP.

Bonner and Chae [12] revealed that, while there is a rich body of literature on ERP adoption and implementation, there is limited research on the post-implementation effects of ERP assimilation on process agility, business intelligence maturity, and innovation. They hypothesize that ERP assimilation is positively related to business process agility.

According to [8], as ERP systems are deeply embedded in the business processes, diffusion and

routinization of ERP systems in organizations rise as well. Business process agility is related to the ease and speed with which firms can reconfigure, redesign and realign their processes to respond to new needs, threats, and opportunities. Through the mediation of business process agility, ERP assimilation is positively related to incremental innovation performance as firms with strong process agility can respond to customer needs and improve operational flexibility and customer retention. A high level of agility can be manifested in increased product customization, improved delivery performance, and reduced response time to meet new customer demands. The author also revealed that, despite a rich body of literature on ERP adoption and implementation, they do not adequately understand the post-implementation effects of ERP systems on process agility, Behavioral Intention (BI) maturity, and innovation.

3. Methodology

This research is a qualitative type case-based exploratory study focused on ERP assimilation of ethio telecom. In this method the researcher provides a description of the behavior that comes from interviews and other sources, such as observation [13]. The client also reports details of events from his/her point of view. Moreover, this type of research method is considered for this study because of the following reasons and justifications. First, this type of research aims to identify key issues and variables and it is suited to exploration of issues in depth. Hence, the results of a case study of some organization and context can be extended and applied to other similar organizations and contexts [4]. The case study research design is also useful for testing whether scientific theories and models actually work in the real world [14]. This study assessed ERP assimilation in ethio telecom and identified critical success factors of ERP assimilation. TAM (Technology Acceptance Model) is used as a reference in order to investigate those factors. Interviews, document reviews, group discussions and

observations are used to extract the necessary information which help to assess the ERP assimilation in the case company.

4. Theoretical Framework

This study uses two theoretical models in order to assess the constructs. These theories were used as a reference frame in order to investigate the ERP assimilation success factors and to come up with the proposed model. According to [15], depending on the type of research design, the role of theory varies. For instance, the case study research method intends to survey how an issue is discovered through one or more cases within a bound. In a case study, a particular individual, program or event, for instance, is deeply and thoroughly studied in a specific time [15]. Unlike other qualitative research designs, it is argued that the case study research needs identification of the theoretical perspective at the beginning of the investigation because it affects the research questions, analysis, and interpretation of findings [15]. In other words, “the complete (case study) research design embodies a theory of what is being studied drawn from the existing knowledge base. In this respect, attention is paid to the role that theory plays in a research design and falls into the domain of methodologies or theoretical perspectives [15].

4.1 Technology Acceptance Model

TAM’s usefulness and perceived ease of use determines an individual’s intention to use a system with intention to use serving as a mediator of actual system use [8]. It is one of the most widely used theories in Information Systems literature. The two beliefs (perceived usefulness and perceived ease of use) predict attitudes, which in turn influence intended use of a technology. This intention consequently influences behavior of actual system usage. Perceived usefulness is the degree to which a user thinks a technology would enhance performance or productivity in the workplace and it is also seen as being directly impacted by perceived ease of use. Perceived ease of use is the degree of lack of effort

required by the user in adopting a given technology [9]. According to TAM, one’s actual use of a technology is influenced directly or indirectly by the user’s behavioral intentions, attitude, perceived usefulness of the system, and perceived ease of the system. TAM also proposes that external factors affect intention and actual use through mediated effects on perceived usefulness and perceived ease of use [11]. Figure 1 shows the technology acceptance model as demonstrated in [9].

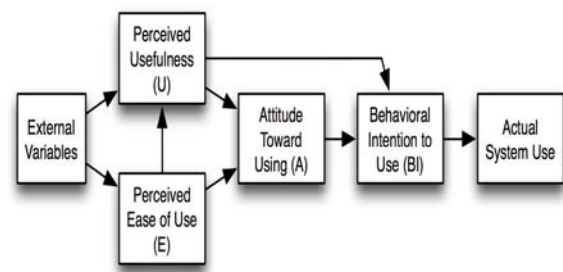


Figure 1: Technology Acceptance Model

According to [17], user acceptance is defined as the demonstrable willingness within a user group to employ information technology for the tasks it is designed to support. Thus, the designers or procurers are not applying to situations in which users claim they will employ it without providing evidence of use, or to the use of a technology for unintended purposes (e.g., using the Internet for personal entertainment in a work situation) [17].

TAM is a robust but parsimonious theory and it is useful to explain a particular information system or technology [16]. Therefore, many studies have proposed extended models for revising Technology Acceptance Model [16]. According to [16] learning the critical role of TAM can guide researchers to design different user interfaces for different online customers, and consequently achieve high user usage in different application areas.

4.2 Interference Theory

Interference theory is a popular and well-studied theory of forgetting and this theory’s cliques are categorized into two encampments. One camp supports the changed trace hypothesis - that is a

memory trace is altered by subsequent information resulting in forgetting of the initial stimulus. The second camp supports the multiple-trace hypothesis, in which a memory trace is created for each stimulus, but having multiple similar stimuli interferes with the retrieval of the correct stimulus. For this study, we took the first camp which is the changed trace hypothesis as its optimistic side. The changed trace hypothesis is also called Retroactive Interference Theory. Retroactive interference in particular involves unlearning. When retroactive interference occurs, we not only learn new information, but we also may unlearn the previous information.

The need to use Interference Theory is that the researcher believes that highly sticking with legacy system leads users to resist for new technologies and ideas. Thus, unlearning the existing work processes and philosophies could contribute for high assimilation results. Not decommissioning legacy applications is one of the common mistakes done by organizations during ERP implementation. According to [18], "If organizations do not actively work to decommission applications during implementation, the end result is an ERP with all of the original legacy applications hanging off of it". The end result is another piece of software that one is paying maintenance and support on, paying for hardware and upgrades, and paying for interfaces back into the core ERP, when the point of getting an ERP system was to streamline workflow and reduce costs and waste.

4.3 The combination of TAM and Interference Theory

Grounded on the above model and theory, we assumed the combined model as shown in Figure 2.

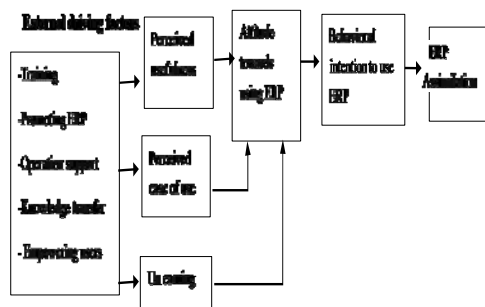


Figure 2: Assumed ERP Assimilation Model

5. Findings

This study confirmed TAM to be a useful theoretical model in helping to understand and explain ERP assimilation. According to the assessment based on TAM model, most of the respondents agreed that the ERP assimilation in ethio telecom was successful.

Table 1: Pearson's Correlation between ERP Assimilation and ERP Assimilation Factors

		Assimilation
PEU	Pearson Correlation	0.224
	Sig. (2-tailed)	0.159
	N	41
PU	Pearson Correlation	.555**
	Sig. (2-tailed)	0
	N	41
UA	Pearson Correlation	.564**
	Sig. (2-tailed)	0
	N	41
BI	Pearson Correlation	.587**
	Sig. (2-tailed)	0
	N	41
UL	Pearson Correlation	.587**
	Sig. (2-tailed)	0
	N	41
Assimilation	Pearson Correlation	1
	Sig. (2-tailed)	
	N	41

The results in Table 1 show that the correlations between factors and Assimilation have a Pearson value of $r = 0.555$, $r = 0.564$, $r = 0.587$ and $r = 0.587$ for variables of Perceived usefulness (PU), user attitude (UA), BI and unlearning (UL) variables respectively. They all have a strong association and integration with the dependent variable Assimilation. PU, UA, and UL significantly influence ERP assimilation. Yet, TAM's perceived ease of use (PEU) has lower association with $r = 0.224$ that is found to be statistically insignificant and BI is excluded from the proposed model. Another interesting result of the study is that both forgetting the existing system and being efficient on the new system have undeniable role in affecting users'

attitude towards ERP and behavioral intention to use ERP.

Hence, theory of interference is involved here in its positive side in order to justify enabling employees to stick with the new system and take all the anticipated benefits can be a result of totally detaching from the legacy system which is against the productivity of the case company. In Korea, people are encouraged to use IT in every field to catch up with the social change caused by IT [11]. We believe that it is important to learn from such an experience and organizations need to encourage their employees to use the implemented system and to be beneficial. The results also exposed that the employees' perceived usefulness is high in ethio telecom and this created good chance for assimilation and also it is reasonable to consider that this may be because a significant number of sampled individuals are masters holders and hence are aware of corporate applications and how better to use the systems. Therefore, this has implication for effective ERP assimilation in ethio telecom.

This case study has attempted to identify the critical success factors of ERP assimilation. Based on the data from interview, group discussions, questionnaire, observations and document review, this study has identified critical success factors of ERP assimilation and proposed the ERP assimilation model based on the results. The study revealed that commitment of top management in scheduling training, effective knowledge transfer, promoting ERP system, good operation support, and quality control and feedback are external factors which affect ERP assimilation.

This study has also identified somewhat new idea of assimilation, which conceptualizes that unlearning an existing trend positively contributes to reach optimal assimilation level.

6. The Proposed Model

TAM and Interference Theory were used as theoretical lenses to assess ERP assimilation in ethio telecom. The theory and model give a guide to

identify factors that facilitate ERP assimilation. Figure 3 shows the proposed model which is derived from the two models.

External driving factors

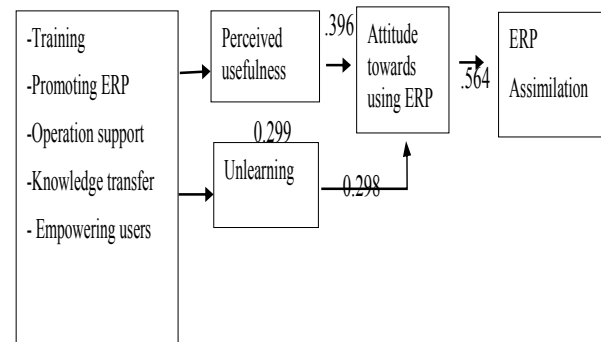


Figure 3: TAMI ERP Assimilation Model

The TAMI assimilation model is developed based on four constructs that are Perceived Usefulness (PU), Unlearning (UL), User Attitude (UA), and ERP assimilation.

Perceived usefulness (PU): is the users' perception that the ERP system would improve their work efficiency. PU directly influences users' attitude of ERP use and it indirectly affects ERP assimilation. PU is influenced by other external factors such as training, promoting ERP system, operation support, UL and empowering users.

User attitude (UA): is a judgment of an ERP system by users, which can be positive or negative. In the current study, user attitude is directly influenced by perceived usefulness and unlearning and it influences ERP assimilation. Users' attitude determines their choice of action or their readiness to use ERP.

Unlearning (UL): is to make an effort to forget the usual way of doing something so that one can learn a new and sometimes better way. Unlearning of the existing old-fashioned and inefficient system positively influences the user's attitude of using ERP system. So this could create effective ERP assimilation.

ERP Assimilation: is the degree in which an ERP system is immersed in its users and serves individual users as well as the company at its optimum. It is

dependent construct which is influenced by perceived usefulness, user attitude and unlearning.

In addition to the three constructs, TAMI assimilation model allows to describe additional single potential factors which seem minor, but that build the major factors.

7. Conclusion and Future Work

ERP is capable of increasing a company's performance. However, the rate of ERP system failure to get benefits is very high among organizations which implement an ERP system.

Implementation of ERP projects within schedule and on budget does not imply that organizations are realizing the benefits of ERP system. Before an ERP system becomes important to an organization, it has to be routinized and embedded in each business activity. This study proposed a model based on Interference Theory and Technology Acceptance Model that is used to assess the factors that contribute for successful ERP assimilation. As the model is based on two theories, it gives a better picture for managers and practitioners to identify what factors affect ERP assimilation in their organization. This model can also be used by other similar organizations. Therefore, the recommendations of this study can be generalized and extended to be applied and shared by other organizations in Ethiopia with similar contexts and environments. In addition, the research can be used to contribute to related researches.

The following are future research works:

- Different scientific theories and models should be used to conduct such kind of behavioral study and they may give better result with integration.
- Multiple case studies of ERP assimilation should be conducted in Ethiopian organizations to strengthen the findings of success factors.
- Researches on ERP assimilation especially on Return over Investment (ROI) of ERP system implementation are required.

The following are recommended.

- Being organized and resourceful to deliver timely training and the transparent knowledge transfer process is recommended.
- Other Ethiopian organizations planning to implement ERP system can consider the success factors identified in this study as input for managing their ERP project.
- ethio telecom can also use this study as post project lessons assessment.
- The proper and independent ERP operation support is necessary to make the system operational and to be well assimilated.
- Empowering users and promoting the new system helps to develop behavioral intention to use the new system, which is shown weakened in this study.

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Predictive SIM Box Fraud Detection Model for ethio telecom

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Abstract

Fraud in communication has been increasing dramatically due to the new modern technologies and the global super highways of communication, resulting in loss of revenue and quality of service in telecommunication providers. One of the dominant types of fraud is SIM box bypass fraud whereby the SIM cards in the SIM box are used to channel international calls away from mobile operators and deliver as local calls. The major focus of this paper is to design a predictive SIM box fraud detection model by taking a total of 15,000 records from a telecom service provider company in Ethiopia. The research also use 12 selected attributes from a Customer Database Record (CDR). Four classification techniques from WEKA tool have been used to conduct the experiments. These are Artificial Neural Network (ANN), Decision tree learning, K nearest neighbor and function based Support Vector Machine (SVM). The classification algorithms use 12 selected features of data extracted from Customer Database Record (CDR). Comparison of the performance of each algorithm is made to select the algorithm with the best performance. As a result of the experiments, it is found that BFTree algorithm from decision tree model gives higher accuracy compared to the others with a classification accuracy of 99.9%. Using the pattern/output of this algorithm, a prototype is developed.

Keywords: SIM box fraud; Artificial Neural Network; Support Vector Machine; Decision Tree Learning; K Nearest Neighbor Classification; CRISP

1. Introduction

Nowadays, there has been a significant growth in the development of universal cellular network technology. All countries across the world use mobile phones with subscriber identity module (SIM) cards for communication among individuals. However, this phenomenal growth has brought an increase in variety and complexity of fraudulent activities on mobile networks. Some of the different types of telecom frauds that may cause gigantic loss of company's financial revenue are [2]:

- Interconnect Bypass Fraud (SIM box fraud),
- International Revenue Sharing Fraud (IRSF),
- False Answer Fraud,
- "A" Number Pass-through/Interconnect Agreement Compliance Testing,
- Superimposed Fraud, and
- Subscription Fraud.

The primary goal of any telecom company is to make sure that all calls that are directly or indirectly routed through the SIM must be legal and authorized. Especially, in developing countries, it is very easy for fraudsters to make unauthorized access and use the company asset. The reasons why fraudsters commit frauds are:

- Failure to understand the complexity of new technologies,
- Dissatisfaction of employees due to lack of experience with new technology,
- Weaknesses in systems (some operational systems are prone to fraudsters to commit frauds),
- International call termination fee is very expensive compared to local call,
- Political and ideological difference, and
- The fast growth in technology and the fraudsters have varieties of ways in committing frauds.

There are different fraud detection technologies proposed in ethio telecom to detect or reduce the losses caused by fraud but the problem has continued to pose significant revenue loss to the company.

Fraud is wrongful or criminal deception intended to result in financial or personal gain. Fraud can happen in most industrial sectors including health, telecommunication and banking institutes. In companies where there is more than one service provider, the actions of the fraudsters cause lots of inconveniences to subscribers and might encourage customers to switch to another competing provider. Again, large number of revenue losses in a country is a cause of fraud. These fraudsters may have different motives in order to commit fraud.

Different researchers define fraud in different ways. According to Levi and Burrows [1], fraud is “a mechanism through which the fraudster gains an unlawful advantage or causes unlawful loss”.

According to the Cambridge Advanced Learner’s Dictionary, fraud is “an intentional deception or cheating intended to gain an advantage.

One of the most severe threats to revenue and quality of service in telecom providers is fraud. The arrival of new technologies has provided fraudsters new techniques to commit fraud. SIM box fraud is one of such fraud that has emerged with the use of Voice over IP (VoIP) technologies.

SIM box or international bypass fraud is the most popular fraud type. This fraud also causes large number of revenue loss in a telecom company. SIM box fraud occurs when an international call is terminated with a local call tariff. Mostly SIM box fraud takes place when the cost of terminating domestic or international calls exceeds the cost of a local mobile-to-mobile call in a particular region or country. Fraudulent SIM boxes hijack international voice calls and transfer them over the Internet to a cellular device, which injects them back into the cellular network. As a result, the calls become local at the destination network [3].

Fraudsters gain some profit by providing low international call tariff at the time they buy bulk SIM cards and put those SIM cards in hardware devices which are SIM box in the recipient country. Moreover, every time there is a new international call arrival, they redirect the international call to the SIM cards in the SIM box using voice over IP. Finally the call reaches to the destination route with local numbers with local call tariff. Due to this, the operator loses the revenue that it should have received from international calls.

2. Related Work

Several researches have been done in the domain of fraud detection. They include fraud detection in credit cards, telecommunications, money laundering, and intrusion detection. This section reviews some prominent works related to fraud detection methodologies in the telecommunication industry. Most of the researches follow different Data mining approach to detect fraud. This techniques include machine learning algorithms and rule based systems.

The researchers in [4] analyze fraudulent SIM box traffic based on communication data from one of the major tier-1 network operators in the United States. The SIM boxes operate with a large number of SIM cards from foreign and national operators. If an operator detects and shuts down a fraudulent account, the researchers made their observation and do some analysis on some fields of the CDR. Also, they noticed that fraudulent SIM boxes have almost static physical locations and generate disproportionately large number of outgoing calls (100 times as many as incoming calls). Based on these observations, they introduced three classifiers for fraudulent SIM boxes and combine their outputs into a classification rule, which has a high detection rate and correctly filters out mobile network probes with traffic patterns similar to those of SIM boxes.

A comparison is made between SVM and ANN technologies to detect SIM box fraud in [5]. In this work, two classification techniques, namely, Artificial Neural Network (ANN) and Support

Vector Machine (SVM) were used to detect this type of fraud. These classifications use nine selected features of data extracted from CDR. In the experiments, the dataset used consists of 2126 fraud subscribers, 4289 normal, and 9 fields from CDR records and it is found that SVM gives higher accuracy compared to ANN with a classification accuracy of 99.06% compared to ANN which has 98.71% accuracy. Besides better accuracy, SVM also requires less computational time compared to ANN since it takes lesser amount of time in model building and training.

Six features extracted from CDR data are utilized to build decision tree that can be used to distinguish between legitimate and SIM box (fraud) accounts in [6]. The features include the total number of outgoing and incoming calls, the total number of SMS originating and SMS terminating, the total number of hand over and the total number of different locations. The proposed decision tree algorithm has shown accuracy of 97.95% when it was tested using sample data from Almadar Aljadid company.

In [7], a total of nine features found to be useful in identifying SIM box fraud subscriber are derived from the attributes of CDR. Artificial Neural Networks (ANN) have shown promising results in classification problems due to their generalization capabilities. Therefore, supervised learning method was applied using Multilayer perception (MLP) as a classifier. Dataset obtained from a mobile communication company was used for the experiments. ANN showed classification accuracy of 98.71 %.

In [8], a new fraud detection technique is proposed. The proposed technique depends on user profiling and using fuzzy logic. Fuzzy logic was used in decision making process by utilizing fuzzy logic

membership function. A database from a mobile operator company (Almadar Aljadid) in Libya is used in this investigation. Five features are extracted and employed as detection patterns in the proposed technique. The five features or detection patterns are, subscriber's mobility, incoming to outgoing calls ratio, suspicious cell activity, irregular calls, and service type.

After reviewing the above listed related literature we found that CDR data is mostly used and it is a relevant source for analyzing and determining fraudulent calls and also it is known that different features (attributes) from the CDR data can be used. We also found different data mining techniques can be used to detect fraudulent activities by analyzing call patterns.

The limitation of the above listed works is that there is no way of updating the existing patterns which makes fraudsters to know the existing patterns and come up with a committing fraud. This paper tries to address this gap and find a way of updating the existing patterns by integrating pattern based fraud detection method with a test call generation method.

3. Findings and the Proposed Model

Four classification algorithms selected from WEKA tool are used in this research. These are Decision tree learning, Neural networks, K nearest neighbor and function base techniques. A total of eight experiments have been done and Table 1 shows the comparison of each result from the experiments.

Table 1: Comparison of Different Models

Algorithm	Using Cross Validation Testing			Using Separate Test Set Testing		
	Time Taken to Build Model (Sec)	Correctly Classified Instance %	Incorrectly Classified Instance %	Correctly Classified Instance %	Incorrectly Classified Instance %	Average False Positive Rate
BFTree	1	100%	0%	99.99%	0.08%	0
SMO	9.44	86.38%	13.61%	86.54%	11.54%	0.555
MLP	27.6	93.13%	6.866%	92.026%	7.97%	0.222
IBK	0.01	78.447%	22.552%	88.72%	11.27%	0.136

Using four different algorithms, 8 experiments have been done and among those the classification accuracy level of BFTree is very high. It correctly classifies 99.92%, so the pattern generated from BFTree is used to do the deployment. The rules are listed below.

RULE 1: if incoming to outgoing call ratio < 0.49603: Fraud

RULE 2: if Data usage in MB < 2.0: Fraud

RULE 3: if number of outgoing SMS < 5.5: Fraud

RULE 4: if number of incoming SMS <10.0: Fraud

RULE 5: if number of incoming SMS >= 10.0: Normal

RULE 6: if number of outgoing SMS >= 5.5: Normal

RULE 7: if Data usage in MB >= 2.0: Normal

RULE 8: if incoming to outgoing call ratio >= 0.49603: Normal

RULE 9: if Number of frequently called numbers <=5: Fraud

RULE10: if Number of frequently called numbers >=6: Normal

After analyzing the patterns generated from BFTree, a prototype is developed. This prototype will help ethiot elecom to predict SIM box Fraud. Figure1 shows the entire model.

4. Deployment

In the deployment stage a general procedure has been identified to create the relevant model(s).

The interface is developed using Microsoft Visual Studio 2012, ASPX.NET with C#, Developer Express and from the database side Microsoft SQL Server 2012 is used. Using this interface one can check a weather given number is fraud or not. This interface can be integrated with ethio telecom's CDR database and the data can be synchronized between both systems. This interface considers the patterns generated from BFTree algorithm.

The homepage shown in Figure 2 contains of search functionality. The user can insert an input and click the search button. To facilitate the user interaction, the system provides an advanced search facility. The advanced search facility allows users to retrieve data based on their desire with single or multiple fields. To use the advanced search facility, the user must select the field in which s/he would like to retrieve the data. After selecting the field the user should have to select the operator in which s/he would like to retrieve the data and insert the search criteria on the field provided. To use multiple field search functionality the user has to select the connector operator (Logical operator like AND, OR, NOT) that would be applied between the fields.

This new system can also be integrated with the current ethio telecom's fraud detection system which is TCG and the call patterns from the numbers which are found from the TCG are also registered in order to update the patterns of this system.

The advanced search functionality also allows users to filter records based on different criteria (like call number, call type, etc.) and different operator (like equal to, not equal to, less than, greater than, etc.).

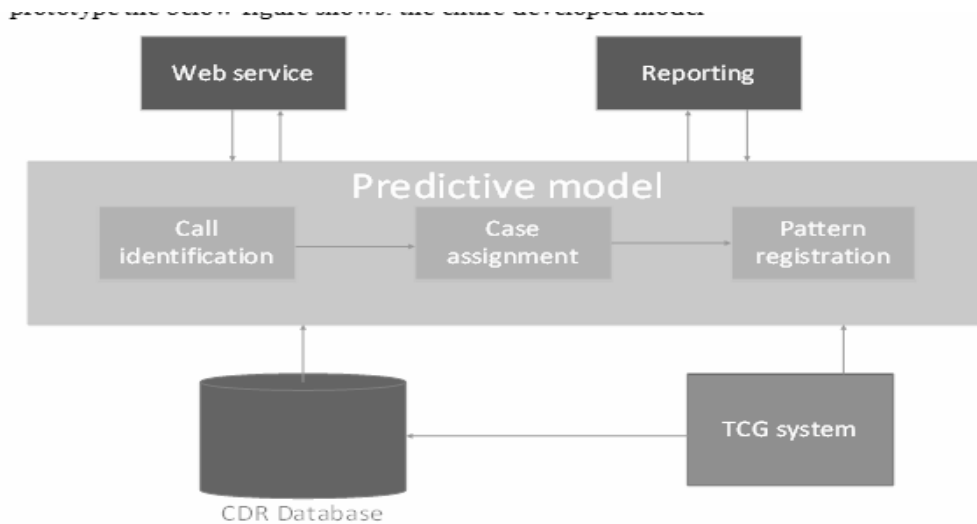


Figure 1: Architectural Design of Predictive SIM Box Fraud Detection Model

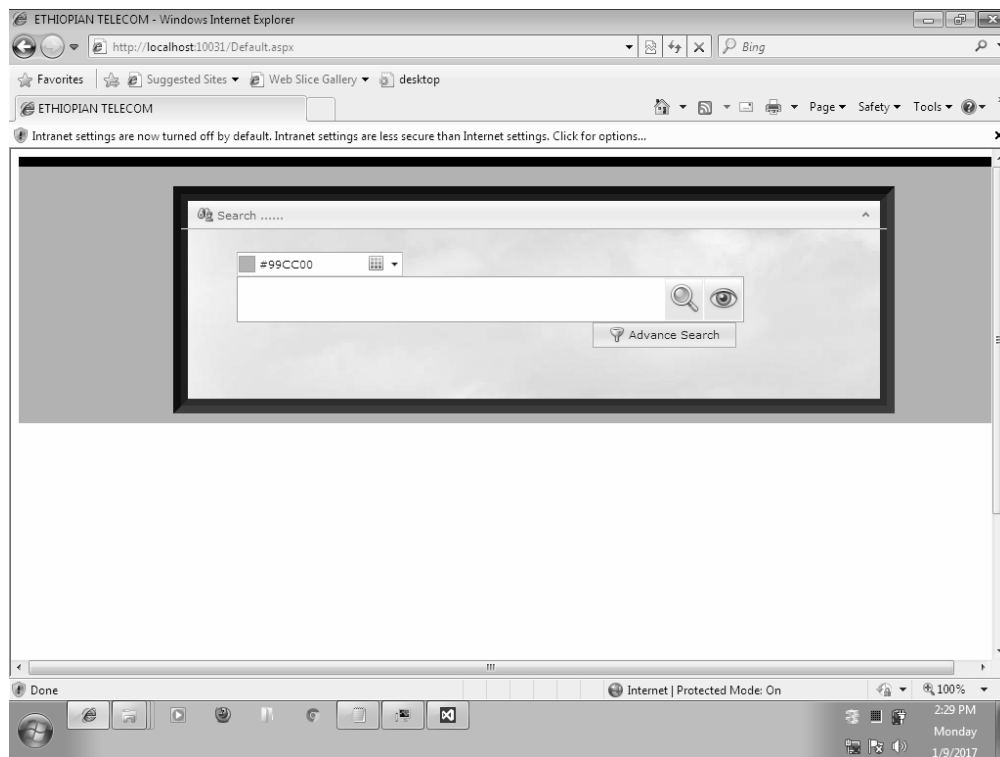


Figure 2: Starter Home Page

Figure 3 shows the advanced search screen. A user can search using different search criteria. The user can filter records by first selecting search criteria (i.e., the filed name that the user intended to filter records). Secondly, the user must select the operator that is to be applied on the search criteria. The operator may be Equal, Not Equal, Greater than, Less

than, between, is not between, etc. At last the user have to enter the search term on the provided text box. The user can input the Plus sign to insert more than one line search criteria. In this case the user must select the operand (i.e., the operator that connect the two search criteria).

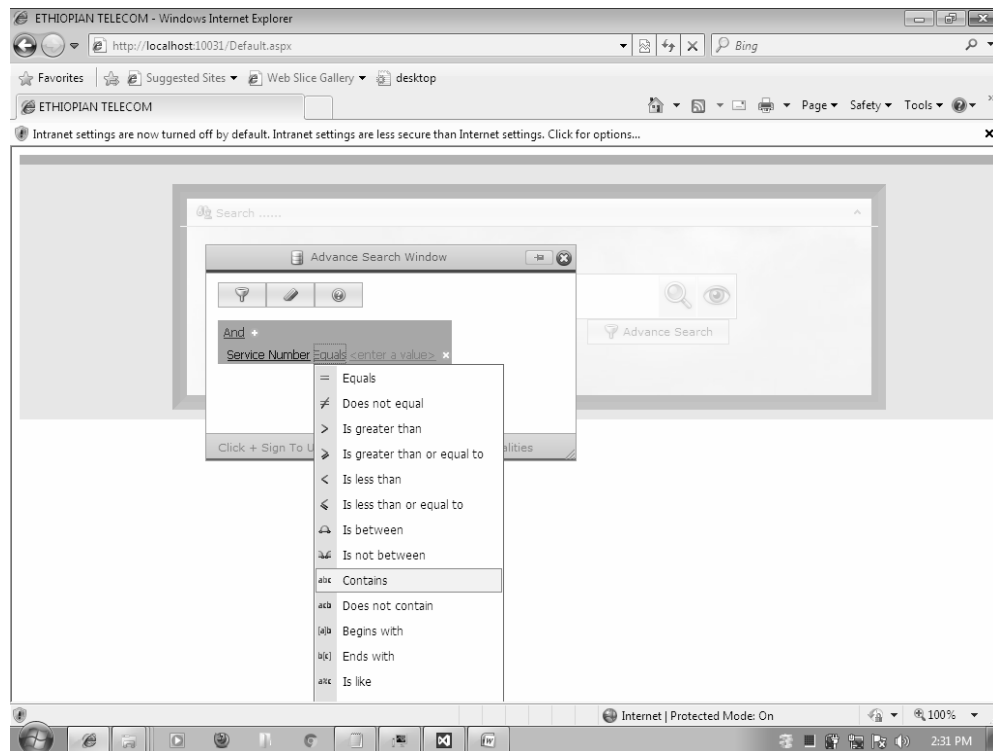


Figure 3: Advanced Search Screen

Figure 4 shows the page where a user can extract and view the report after specifying the searching criteria. On the report viewer, the system also incorporates a filtering mechanism that helps a user to filter and view the desired result based on all columns.

Service_Num	Number_Of	Number_Of	Activation_Da	Sum_Of_Num	Number_Of	Sum_Of_Num	Data_Usage	Sum_Of_Num	Incoming_To	Sum_Of_Dura	Call_Type
25190501434	13	4	9/21/2016	177	129	173	0	257	0.839869281	322.2666667	F
25190662120	2	0	9/21/2016	100	64	107	0	60	0.365853659	55.35	F
25190942221	61	19	9/21/2016	105	80	108	0	77	0.416216216	124.15	F
25194968055	18	0	9/21/2016	166	42	48	0	156	0.75	96.13333333	F
25196228344	2	5	9/21/2016	67	60	54	0	98	0.771653543	166	F
25196522970	0	0	9/21/2016	1	226	227	0	41	0.18061674	4.583333333	F
25196538313	0	1	9/21/2016	82	80	93	0	97	0.598765432	151.5166667	F
25196555408	1	1	9/21/2016	102	34	94	0	129	0.948529412	178.6833333	F
25196858283	3	2	9/21/2016	104	40	121	57.47495556	187	1.298611111	344.5833333	F
25196911357	4	0	9/21/2016	163	41	62	0.033845901	63	0.308823529	76.28333333	F
25197075302	0	0	9/21/2016	74	36	55	0	82	0.745454545	208.75	F
25197230841	9	1	9/21/2016	139	49	92	8.715339661	103	0.54787234	72.1	F
25197314029	7	9	9/21/2016	30	29	43	16.85219669	40	0.677966102	45.9	F
25197707910	30	2	9/21/2016	30	63	71	68.686203	91	0.978494624	246.2	N
25197780779	0	1	9/21/2016	116	54	108	0.972019196	151	0.888235294	82.5	N
25197800595	35	15	9/21/2016	148	29	56	8.468398094	130	0.734463277	80.75	N
25197814236	23	12	9/21/2016	87	157	143	0.038976669	176	0.721311475	141.25	N

Figure 4: Report Viewer

Figure 5 shows the final page. After extracting the report the user can export it to Excel and view the detail. Here the user can open directly the report via Excel or save the result.

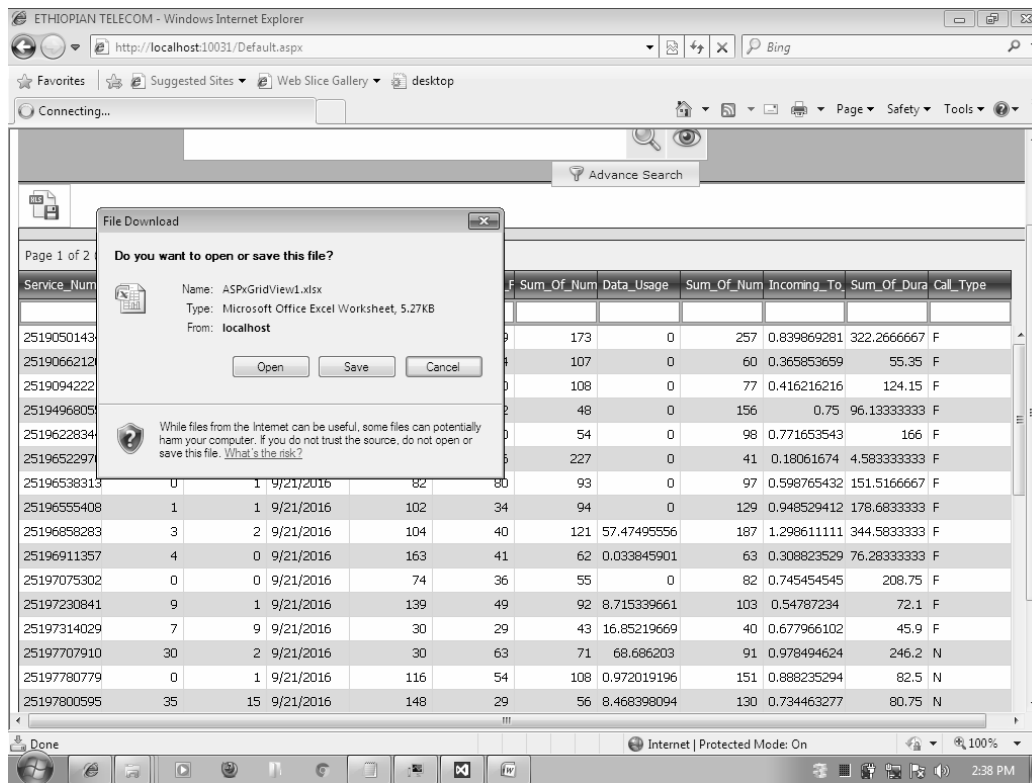


Figure 5: Export to Excel

5. Conclusion and Future Works

This research designs and implements a predictive model using data mining technology to detect SIM box or bypass fraud cases targeting ethio telecom. To achieve the objective, we used Call Detail Record (CDR) data. We selected a total of 15,000 customers based on the recharge amount (more than Birr 3000). 12 attributes have been selected.

CRISP-DM process model was used while undertaking the experimentation. The study was conducted using WEKA software version 3.6.3 and four data mining algorithms for classification were used. The rule generated from BFTree algorithm is chosen to develop the prototype.

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Predicting Factors which Determine Customer Transaction Pattern and Transaction Type Using Data Mining

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Abstract

The introduction of Mobile Phones dates back to 1995. Until recently, the use of mobile phones was mainly as a communication device. With the recent innovation, however, phone-based financial services are introduced as new features of mobile technology. Mobile money has been also introduced to Ethiopia in 2010. With the introduction of the service, Ethiopian banks and microfinance institutions are presented with new opportunities in which clients could make and receive payments using mobile devices.

The overall objective of this paper is to identify customer transaction pattern to improve the M-Birr system and to identify factors which determine the type of service used. In order to achieve the overall objective, the research employed CRISP data mining model, the practice of determining interesting knowledge from large amounts of data, which can be found from data warehouses, databases, or other information sources. The tools and application software used to accomplish the research are Association Rule Mining, Apriori algorithm, FP-Growth algorithm, Id3, J48, Prune, and WEKA. The review of the operation of M-Birr indicates that there are pre unexplored opportunities related to the use of the available transactions for improved business related decision making.

Keywords: Mobile Money; M-Birr; Association Rule Mining; Classification; CRISP

1. Introduction

Mobile money will allow Ethiopia to leap from the intermediate step between old paper-based systems and network of branches [5]. It brings financial services to the unbanked population of Ethiopia through branchless banking without incurring the substantial operating costs associated with the traditional banking approach [4]. M-Birr has been implemented over the past five years in Ethiopian financial sector, mainly in microfinance and very recently in one bank. Yet, there is not any system evaluation that has been done in terms of its adoption and use. As a result, much is not known about the extent and pattern of its adoption and use [2].

There is a huge electronic data stored in the financial transactions that could help an informed and systematic business related decision making.

Because of the fact that, on the daily basis, there are large number of users as well as a large amount of financial transaction, the need for developing methods that analyze these transactions cannot be underestimated. The stored data should be manipulated using statistical techniques and software which are based on statistical theory. The processed data, coupled with the user's judgment based on his/her experience and knowledge, increases the quality of decision making. To this end, some degree of simplification and automation is inevitable [1].

The review of the operation of M-Birr indicates that there are unexplored opportunities related to the use of available transactions for improved business related decision making like which M-Birr outlets are open on time, which M-Birr outlets close on time, which M-Birr outlets should be closed, where do we need more M-Birr outlets, which M-Birr outlets have

a demographic profile and which are the peak times for transactions [3].

The M-Birr system has different functionalities which are deposit cash at an agent, deposit cash at branch, withdraw cash at an agent, withdraw cash at branch, transfer money, buy mobile top-up, pay bills, buy goods, repay loans, check balance, and get a statement. The M-Birr provider has indicated that the M-Birr system is not working as expected and the factors that determine the type of transaction remained unexplored. In order to make the system more accessible and reach the targeted potential customer, there is a need for empirical study that uncovers the transaction usage pattern and that identifies factors that determine the type of the services. A review of the system indicates that there are no expert analysts that could effectively use the available data for improving business related decisions and this study hopes to provide an expert analysis.

The available set of transactions are also large and yet not analyzed. Any attempt to do system evaluation using statistical methods poses a challenge [1]. The problem is the available transactional data are time-stamped and to be utilized it should be converted into time series data. Converting to time series data, however, is time consuming and not effective. Therefore, data mining techniques help to overcome the predicament of statistical methods by reducing the time it takes and being efficient. Besides, there are no regular updates about the status of the M-Birr operation. These problems should be turned into opportunities to enhance the value of the M-Birr operation.

The above-mentioned problems, however, are not insurmountable. Data mining techniques could help to effectively tackle the above-mentioned challenges [3]. Data mining is the process of searching and examining data in order to find hidden, but potentially useful, information [5]. This research employed the association rule and classification mining which are the most known data mining techniques [3]. Association rule is used to extract

useful patterns from the M-Birr system customer transaction data, and classification is used to predict factors which determine type of transaction services [6].

2. Related Work

Electronic money (E-money) is a wider concept and refers to payments made using credit and debit cards, loyalty cards, prepaid cards, automated teller machine (ATM) cards, Near-field communication (NFC) enabled cards, store cards, gift cards and mobile phones [6]. Mobile money (M-money), thus, is a subsection of e-money. It refers to transactions and financial services completed on a mobile phone. A person who does not have personal bank account can use this service [2].

The term Mobile money (M-money) refers to the use of mobile phones to carry out financial and banking transactions. The scheme can be used to reach more than a billion people in the world who have little or no access to traditional financial services [1]. More than half households do not have access to financial services in the world [8]. The poor often must rely on informal financial services that may be more costly and less reliable. Low levels of financial presence present an obstacle to economic development. Availing mobile money services, however, ensures that users can receive funds securely, pay their bills, make bank transactions, transfer funds, and purchase goods and services. Consequently, in the development agenda financial presence has become an important topic [7].

Mobile Money facilities work by offering users an electronic wallet (e-wallet) service [6]. Access to the e-wallet is performed from the mobile phone and a number of basic functions can be performed such as putting money in e-wallet, withdrawing money from e-wallet, transferring money from one e-wallet to another, and checking balance or statement. Unlike saving deposits, e-wallets are interest free [10]. But users can opt to transfer their electronic money to a savings account whenever they want. Additional services will allow consumers to transfer money

from their e-wallet into a loan account or even pay a utility bill or buy goods [9].

3. The Proposed Solution

3.1 Data Understanding and Collection

It is a bare fact that the concept of data mining doesn't exist without data. There is some real benefit if the data is already part of a data warehouse. If the data has already been cleaned for a data warehouse, then it most likely does not need further cleaning in order to be mined. Furthermore, in most of the data warehouses, many of the problems of data consolidation have already been addressed and maintenance procedures have been put in place. This does not mean, however, a data warehouse is a requirement for data mining. It is to emphasize the fact that setting up a large data warehouse that consolidates data from multiple sources resolves data integrity problems [3].

The data source for this research is the M-Birr system data of five independent service providers, each having its own M-Birr system data. The data stored is automated in M-Birr system. M-Birr system stores transaction data, customer information data, and agent information data. The total data obtained are 17,101 transactions from three different database tables, namely, agent registration table, customer registration table, and transaction table. The data has

been stored since 2010. We selected age of customer, gender of customer, transaction year, opening time, closing time, time of transaction, type of transaction, transaction date, M-Birr outlet and amount of transaction and merged them into a new data table.

3.2 Feature Selection

After the initial data collection, the next step was describing the data set. The M-Birr data has 42 attributes of text, number, date and time formats. Among these attributes, 23 attributes are not accessible due to their private nature. The exclusion of these attributes, however, does not affect the result since they are not relevant for the realization of the envisioned research objectives. Nineteen attributes are taken from customer, agent and transaction data. Further refinement is done based on the research objective and in consultation with domain experts [7].

Attribute selection involves searching through all possible combinations of attributes in the data to find which subset of attributes works best for prediction. The best way to select relevant attributes is manually, based on a deep understanding of the learning problem and what the attributes actually mean as shown in Table 1 [1].

Table 1: Attribute Selection Table

No.	Attribute Name	Data Type	Attribute Description
1.	Opening time of the outlet	Time	This attribute describes the opening hour of the outlet. There are two kinds of outlets, namely, branch and agent outlet.
2.	Closing time of the outlet	Time	This attribute describes the opening hour of the outlet. There are two kinds of outlets, namely, branch and agent outlet.
3.	Time of transaction	Time	This attribute includes the transaction time described in the system as time using 3+ GMT.
4.	Gender of Customer	Character	This attribute includes the gender of the.
5.	Age of customer	Number	This attribute includes the age of the customer which is above 18 years old since in Ethiopia customers less than 18 are not allowed to open account.
6.	Type of transaction	Character	This attribute includes 11 different types of transactions.

No.	Attribute Name	Data Type	Attribute Description
7.	Transaction date	Date	This attribute includes the date of the transaction.
8.	Transaction year	Date	This attribute includes the year of the transaction.
9	MFI	Character	This attribute includes the MFI of the transaction.
10.	M-Birr outlet	Character	This attribute includes the outlet of the transaction.
11.	Amount of transaction	Number	This attribute includes the amount of transaction.

3.3 Data Cleaning

Since all the data in the M-Birr system are mandatory, the data is free from missing element. As a result, further data cleaning was not done.

3.4 Data Transformation for Analysis

Data transformation can involve smoothing or feature (attribute) construction. The overall intent is to minimize data redundancy. Smoothing techniques include binning, regression, and clustering. Attribute construction, on the other hand, is a process where new attributes are constructed and added from the given set of attributes to help the mining process. Smoothing can also serve as data reduction. For example, in the case of smoothing, the number of distinct values for a certain attribute is reduced [4].

Data transformation aims to manipulate the data so that its content and its format are suitable for the data mining process. In this paper, data transformation was done using smoothing through binning for time of transaction, type of transaction and transaction date.

4. Experimentation and Discussion

As presented in the previous section, the data is well understood, explored, selected and cleaned enough to be used for rule generation and model building. This Section presents the detailed activities carried out in selecting a modeling technique. It also identifies the implementation of the technique selected using the most appropriate algorithms in order to select the best rule for description and evaluation of the models and to find out the best one for prediction.

The study focuses on identifying determinant factors of customer transaction that lead to building a

description model and prediction model. Association rule mining has been done using Apriori and FP-Growth algorithms. The rule is generated by changing the support and confidence value. Finally, the best rules are selected with acceptable confidence and support value. The classification models have been built using decision tree and PART rules. The models have been tested on the selected attributes and the significance of the outputs of the most important model is presented for analysis to domain experts. Finally, the model with the best performance is selected.

4.1 Experimental Setting

According to the CRISP data mining standard methodology employed in this research, selecting the actual association rule mining algorithm is the first step in modeling [2]. The most powerful associative and classification modeling are used. For association modeling, we included Apriori algorithm and FP-Growth algorithm.

Accordingly, Apriori and FP-Growth rule algorithm of WEKA were used to represent the knowledge/pattern identified. In an attempt to come up with significant rules, Apriori and FP-Growth algorithms were run on the M-Birr dataset with different support and confidence values. Different rules are generated using these algorithms by changing the support and confidence to discover the most interesting rules.

In order to accomplish this research part of classification, we used two data mining techniques. These are decision trees (using J48 and ID3 algorithm) and rule induction (using PART algorithm) for knowledge representation.

4.2 Result Evaluation and Comparison

Evaluation is a key step in any data mining process. It serves two purposes. The first purpose is the description of how well the final rule will work in the future and it is an integral part of many learning methods. The second purpose is to find the rule that best represents the data. In the series of experiments, evaluation of generated rule are selected in consultation with the domain expert and based on the soundness of the rules generated. The rules are:

Rule 1:

If Transaction_type = WC and Age = 24 and Gender_customer = Male
Then transaction date is the first ten days of the month

Rule 2:

If Transaction_type = TC AND Age = 40
Then transaction_date = third

Rule 3:

IF transaction date = third AND transaction type = DC
Then Amount_transaction = 300 Birr

Rule 4:

IF Amount_transaction = 300 Birr AND transaction type = WC
Then transaction_date = first

Rule 5:

If Amount_transaction = 300 Birr AND Closing_time = 11PM AND Time_transaction = first AND Gender_customer = Male then WC

5. Discussion

The objective of this paper is to find interesting pattern in the customer transaction of M-Birr system and predicting the factors that determine the type of transaction.

From the association rule mining, we found four interesting rules using Apriori algorithm on M-Birr customer transaction system data in terms of type of transaction, age, amount of transaction and gender of

a customer. From the classification mining, we found four interesting rules by making type of transaction the target attribute with accuracy approximately 89.6 using J48 algorithm and rules with accuracy 89.51 using prune.

The research results indicate that there are practical ramifications for M-Birr in that it could further investigate the nature M-Birr system transaction. The M-Birr system has 11 different facilities. From the experiment we did, most commonly used ones are transferring money and withdrawing money but the main purpose of M-Birr is to be different from the traditional banking so more marketing campaign should be done in terms of the use of M-Birr. The M-BIRR system also revealed that, despite the fact that the demography of women and men is proportional, men dominate as customers. When M-Birr started in Ethiopia their target was to help people to use mobile phone and access their money easily but from the experiment we did the average payment is around 300 which indicates also that the pricing system should enable small payments.

6. Conclusion and Future Work

Managers generally do not have time to go through all records and data collections of their organization in order to make an informed decision. Moreover, the amount of data is bulky having several variables. In such contexts, it is extremely difficult to visualize patterns and relationships. As a result, managers of various levels need filtered and simplified data from their large amount of records. Knowledge discovery systems come handy to surmount the gap between the available huge data and limited time and thereby help managers of various levels to pass correct decisions or improve their plan. One tool is data mining that finds out hidden pattern from vast amount of data.

The research results indicate that there are practical ramifications for M-Birr operations. As the research indicated, despite the M-Birr system has 11 different facilities, the most commonly used ones are

transferring money and withdrawing money out it. The implication is that the other facilities remain unutilized. Even these two frequent services, transferring money and withdrawing money, are conducted mainly within the first ten days and within the last 10 days. Uncovering the underlying reason requires an ethnographic approach so that M-Birr customers also remain active throughout the month. Based on the results, various campaigns that increase both the customer base and frequency by which the current customers are undertaking business via M-Birr should be launched.

Despite the demography of women and men is proportional, men dominate as customers. There has to be a further study that uncovers why men are the majority of the customers. Based on the result, a strategy should be designed to increase the customer base by appealing also to women. The fact that the average payment is around 300 indicates also that the pricing system should enable small payments. The M-Birr system, thus, should be designed in a way that it collects low-value deposits. The M-Birr system should revisit its pricing system to be conducive of small transactions. If the M-Birr system intent is to compete with traditional banks, which have branches, the system must show its user friendliness given that most of the people using this product are advanced in age and do not easily feel at ease with mobile technologies.

In this paper we did not look through why women are not users of the system so further study could be done to understand the reason why majority of the users are men.

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Developing Web and Mobile Based Relationship Management System for Microfinance Institutions

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Abstract

Microfinance in Ethiopia came to existence to help low income people create their own job and improve their lifestyle. Currently there are 30 licensed microfinance institutions (MFIs) working in the country and they are serving more than 2.7 million clients, with a total asset of Birr 10.2 Billion and outstanding loan of net Birr 6.8 Billion which is a big amount of money for these institutions.

Currently these MFIs are facing a problem while giving service to low income citizens. This is because after they give loan service they can't get the outstanding money since customers don't pay their loan on time and also have no time to personally go to the office and pay their loan. This problem is vital because MFIs use traditional way of communication making contact using telephone and going directly to the customers' work place or by contacting the guarantee of the customer.

The main objective of this paper is to enable customers to use mobile application to get notification message about due date of their payment and get payment information. The other feature is online payment which saves time, energy and also increases accessibility.

The study used design science research which undergoes through different stages like gathering requirement from the institutions' employees and their customers using interviews and questionnaire. After the requirement is gathered and the problem of the existing system is known, then designing the new system was done.

An implementation has been done which includes two parts: due date reminder that notifies customers whose due date is on for loan collection using customers mobile phone and online payment system using mobile and computers per users convenience.

Keywords: Microfinance Institutions; Mobile Network Operator; Microfinance Customer Interaction

1. Introduction

The delivery of financial services to low income people in Ethiopia was performed in an ON and OFF manner, especially through non-government organizations (NGOs). Such credit programs were not well organized and hence could not serve the public on continuous and sustainable basis. Through the passage of time, however, after making sufficient analysis on their pros and cons, the government of Ethiopia issued proclamation No. 40/1996 to establish and supervise MFIs [3].

The purpose of all MFIs in Ethiopia is to help low income people create their own job and improve their

lifestyle [3]. Currently there are 30 licensed microfinance institutions working in the country and they are serving more than 2.7 million clients, with a total asset of Birr 10.2 Billion and outstanding loan of net Birr 6.8 Billion [3].

Currently these MFIs are facing a critical problem of late repayment while giving service to these low income citizens. This problem is critical because the institutions use traditional way of communication (make contact using telephone and going directly to the customers' work place or by contacting the responsible person of the specific customer which is a guarantee). For this problem, there has to be a

solution and this research studied the core problem inside and outside the institutions to find a solution.

After customers get service from MFIs, they face difficulties in paying their loans on time because of different reasons mainly forgetting the day they have to repay their loan, they don't have time to pay their loan personally by going to the office and this makes them pay extra penalty and extra interest. This results for the microfinances to have large amount of money as an arrear which makes MFIs more vulnerable to portfolio quality risks.

The general objective of this paper is to develop a web/mobile based microfinance customer interaction through mobile System (MCITS) for microfinances and their customers that would allow customers to pay their loan repayment through their mobile easily and providing notification to enable to get notification of the due date of their payment.

2. Related Work

In the past decade or so, many MFIs have experimented alternative delivery channels to reduce costs, facilitate greater outreach to hard-to-reach areas, and increase customer convenience. In theory, mobile phones could be used to reach many more customers at a lower cost than any existing delivery channel. Yet despite this potential and in the vast majority of countries, there is not yet an m-banking service that MFIs can leverage. M-banking to date has largely been driven by Mobile Network Operator (MNOs) and, to a lesser extent, by some large banks. MFIs have by and large not played a significant role in the implementation of m-banking services [1].

In January 2013, Swadhaar, a microfinance institution in India, and Accion, an international NGO, launched a mobile money pilot project in partnership with Airtel Money and Axis Bank [4]. In January 2014, Accion and Swadhaar were awarded a GSMA Connected Women Innovation Fund grant to improve the pilot mobile money solution, in particular by revising customer education materials and implementing a Peer Educator Connection Programme [4].

The Super Account service allowed Swadhaar's clients to repay their monthly loan installments through their mobile handsets rather than paying a Swadhaar loan officer who collects payments in cash door-to-door. Customers can repay their monthly loan installments using mobile money that saves their time in going to the office.

Thirty seven percent of customers in the pilot reported using mobile money for loan repayment and only 5% reported making other mobile money transactions besides loan repayment. Low uptake was, in part, a function of the nascent nature of mobile money in India with Swadhaar being the first microfinance institution to adopt mobile money in partnership with an MNO.

Swadhaar FinAccess also revised the training modules to teach customers on how to repay their loans using Airtel Money, and eventually use their mobile money account for savings and a variety of other financial transactions. The revised training materials included new content featuring visuals, different pedagogical approaches such as storytelling and demonstrations, and a new customer education journey with multiple touch points.

In a survey after the changes, 69%, 29%, and 36% of new customers reported using mobile money for loan repayment, saving and other transactions, respectively. Among the group of new customers who were assisted directly by peer educators, these figures increased to 84%, 41% and 47%, respectively. This is a big improvement over the earlier version of the materials. In addition, 30% of new mobile money users reported being able to use the service independently [4].

After being in the wholesale microfinance lending business for two years in Philippines, BanKO (which is licensed as a savings and thrift bank) was ready to jump into retail microfinance using mobile phone as its main channel [2].

The MFI invested in technology that links customers' mobile wallets (m-wallets) to their MFI accounts providing the following advantages.

- It allows customers to access their MFI accounts via their mobile phones and to move money between the account and m-wallet.
- The MFI leverages the network of the existing m-banking provider to facilitate cash-in and cash-out transactions into the customer's m-wallet and subsequently into the MFI account.
- This option may provide more attractive solution for MFIs trying to mobilize savings than the first strategy since savings transferred into the MFI account are still accessible through the customer's m-wallet and at the existing m-banking provider's agent network [2].

SMEP DTM Limited is a Kenyan MFI that offers its 168,000 customers the ability to use M-PESA for loan repayments, loan disbursements, and savings mobilization. SMEP DTM initially started out in 2009 merely using the M-PESA bill pay functionality [5].

The MFI had all of the common concerns about the potential impact on group cohesion, and therefore, repayment rates, and whether mobile repayments would increase efficiency or complicate the lives of the loan officers by introducing time-consuming manual reconciliation processes.

After several years of experience, SMEP DTM reports that despite reducing the frequency of group meetings from weekly to monthly, customers have successfully made transition without negatively impacting repayment performance.

To overcome concerns with manual reconciliation, SMEP DTM invested in a middleware that better integrates its MIS with M-PESA. This has significantly reduced the requirement for manual reconciliation and eased loan officers' concerns. Loan officers now fully support the use of M-PESA, which has had positive influence on the willingness of group members to adopt this payment option.

Before offering loan repayments via M-PESA, group customers went through a lengthy repayment process that involved depositing cash into a Faulu

account at a commercial bank branch and attaching the deposit slip to the repayment form to present at a Faulu branch or group meeting. Now customers can repay loans or make deposits using their mobile phone through M-PESA.

Within two years of launching this service in December 2010, almost 54% of Faulu's 300,000 customers had registered for m-banking, although only 15,000 of them were using the service regularly.

3. The Proposed Solution

The proposed solution for the above stated problems is designing a new interaction method between microfinances and customers through mobile which replaces the traditional face to face and interaction using phone line. These interaction method is chosen as a solution based on the data that is collected from both sides which they prefer this interaction method. From the data analysis, the following outcomes are obtained.

- From the site observation (about 7 branches were under site observation) it is concluded that the customers of these institutions are paying extra amount of money because of their late repayment due to not remembering the exact date of payment for their loan.
- From questionnaire very useful information has been gathered. 100% of the respondents from employees side have answered their customers are paying penalty because of their late repayment, 47% of these customers are paying penalty because they forget the date of repayment for their loan, and 78% of the respondents want a modern way of communication with their clients which have a feature of mobile application that provides due date notification and online payment.
- For further clarification interviewing the higher authorities of the institution has been held and gathered all the necessary information regarding the interaction method with their customers and the payment process.

- Prototyping: for the process of developing a new interaction method for MFIs and their customers Demo has been prepared and very useful feedback has been collected. For these demonstration different stakeholders have been involved like selected customers, employees and also ICT experts of the institution.

After the analysis of the data subsystem decomposition of Microfinance Customer Interaction Through Mobile (MCITM) has been done. Each subsystem has its own specific task to be performed by users. To mention:

- System Access Subsystem: handles log in, exit, and checks for access permissions.
- Registration Subsystem: Handles registration process of customers.
- Payment process Subsystem: Handles order payment, payment conformation or failure, canceling payment orders.
- Schedule info Subsystem: Schedules time information of the loan process.
- Payment info Subsystem: Payment information of the loan process.
- Database Subsystem: Contains the data we need to store for the application. It provides

standard store, retrieve and order functions for the data that is stored.

The customer first creates the interaction initiation process with the microfinance institution which provides the loan service. After the loan process is finalized, the customer will be registered (profile and payment detail) and the payment process and payment detail information will be provided based on the specific request that comes from the customer. If it is payment details information request, the system displays the requested schedule information and if it is payment process request, the system directs them to the mobile payment application and checks for the balance and sends confirmation message to the customer and the institution.

3.1 High Level System Platform Architecture

The extension of the payment franchise to mobile can be as simple as a bank channel enablement or as complex as a complete bank system implementation depending on what infrastructure already exists, that can be re-used as part of the implementation. A typical microfinance and customer interaction system will have the platform architecture as shown in Figure 1.

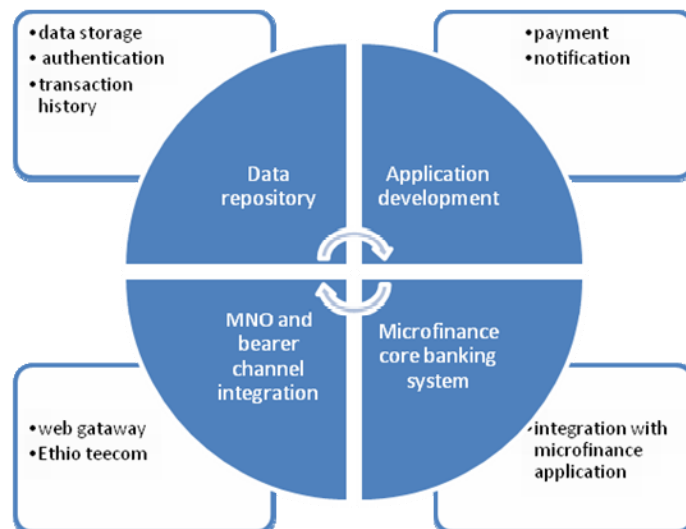


Figure 1: MCITM System Platform Architecture

Figure 1 reflects a typical mobile interaction system service. The service would require integration into an MNO to facilitate in the usage of the

network's bearer channels in order to access the customer's mobile phone.

The Data Repository stores enough customer information to facilitate the processing of financial transactions information. The data repository would also house sufficient information to authenticate the customer in transaction. By housing transactional and customer's data, the repository would also facilitate customer information, and payment schedule, payment detail and financial transactions that use the application development environment to fulfill those services.

The Application Development Environment facilitates the actual service development to the customer, such as payment and notification. It may house the integration of third parties in supporting value added services such as payments. The application development environment fosters the

intelligence delivered to the customers handset, whether client or server side.

The microfinance core banking system would act as the interface to the MCITM system. Instructions (requests) collected by the application development environment through the MNO interface, and using data from the data repository, are translated into a transaction format that the customer and the microfinance can use.

3.2 Deployment Architecture

This view defines the physical environment in which the system is intended to run, including the hardware environment, the technical environment requirements for each node (or node type) in the system, and the mapping of the system elements to the runtime environment that will execute them.

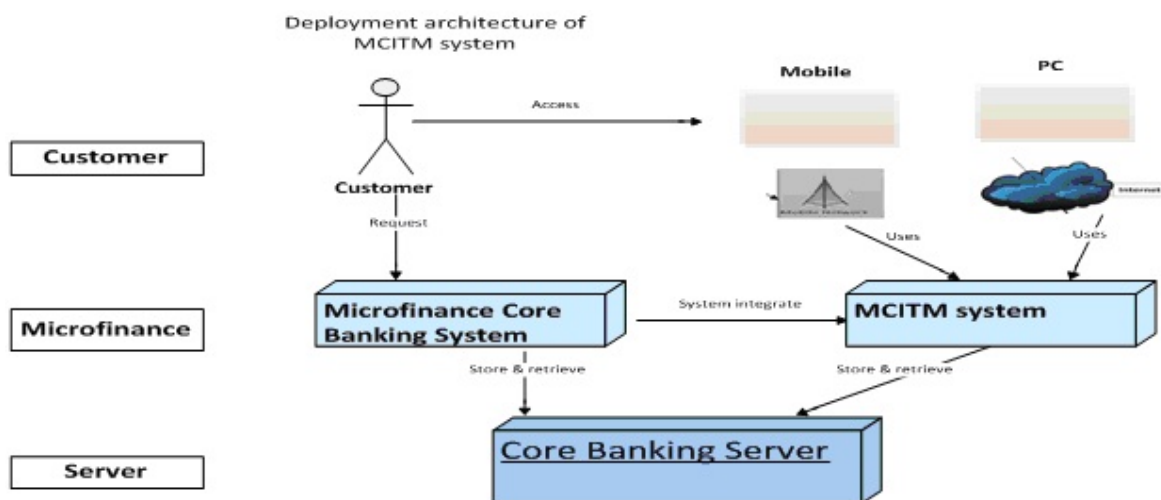


Figure 2: MCITM Deployment Interaction Architecture

Figure 2 shows how a customer accesses the system from the start to the end. When a customer comes to the microfinance institution and requests for a service, s/he can use a mobile or a computer. Then the microfinance registers the customer to the microfinance core banking system. The MCITM system integrates with core banking server either through database or getting web service from the core banking interface, and fetch the necessary information and give back the service (due date notification and online payment) to its customers.

4. Implementation

a. User login page

The super Admin logs into the system and registers different types of users as shown in Figure 3.

Figure 3: User login page

b. User Registration Page

Here all users of users are registered according to their role.

Figure 4: User Registration Page

c. Customer Registration Page

Customers profile information is registered in this page. All the customer information is filled.

Figure 5: Customer registration page

d. Loan Detail Registration Page

After completing profile registration of the loan customer, the loan detail information is recorded and move to the next step.

Figure 6: Loan Detail Registration Page

e. Payment Process Page

After the completion of the above two, loan and profile registration, the next part will be online payment and sending due date notification to customers.

Figure 7: Payment Process Page

5. Conclusion and Future Work

Nowadays Microfinances are increasing in number all over the world (mostly in Africa and Asia) because of small and medium works that are owned by poor people.

As observed from these MFIs in Ethiopia, the collection of outstanding money on time from their customers is becoming a problem from time to time. This paper identified the main challenges of MFIs and customers by collecting data from these target groups regarding their communication gaps. From these gaps, the functionality of the system is identified and implemented. Features of the system include integration with the core banking system of the microfinance and sending and receiving notification of due date of the payment through mobile. The last feature is online repayment of loan.

Different stakeholders will benefit from this work including MFIs, customers, and NGOs (that have a direct connection with the community which provide loan service through these microfinances).

Institution and customer interaction problems are more than what is stated in this paper. Further studies will be done to add more features to this application to solve more problems.

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Smart Pay Using Distributed Gateway

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Abstract

Electronic payment system is a way of making cash transactions through an electronic medium. Consumers using mobile payment today still carry the cards in their wallets to use them at least in ATM. The objective of this paper is to design a new payment system called Smart Payment System (SPS) to improve usability, efficiency, anonymity, security and interoperability of electronic payment system. The main purpose is to eliminate payment cards, gateways and payment network from the process of electronic payment systems, and to help users to withdraw cash from ATM without cards. Design science research approach is used in this work. A prototype is developed to show the improvement in security, ease of use, trust and efficiency in electronic payment systems. It is developed using Java, MySQL and Android technologies to develop core bank, ATM and mobile application to test the prototype. SPS is used to withdraw cash from ATM without card and to improve security, usability, privacy and efficiency in electronic payment systems. We believe that the results obtained are encouraging.

Keywords: E-commerce; Electronic Payment System; Smart Payment System; One Time Password

1. Introduction

E-commerce has become a dynamic force, changing all kinds of business operations worldwide. A payment is a transfer of funds from a payer to a beneficiary. A payer is the party to a payment transaction which issues the payment order or agrees to the transfer of funds to the acceptor. A beneficiary is the final recipient of funds [1]. A well-designed payment system contributes to the proper functioning of markets and helps to eliminate conflicts and distrust in trade and brings peace of mind to all genuine participants [2].

E-commerce is the transmitting of funds over the Internet for the exchange of goods and services. These business transactions occur in the form of business-to-business, business-to-consumer, consumer-to-consumer and consumer-to-business. Payment systems were not growing as expected because most people who work on payment systems have started by focusing on a business model that was centered around their self-interest instead of focusing on user experience [3].

Currently Apple Pay, Samsung pay and Google wallet are putting all kinds of cards together, so one can use all cards from a single smart phone. The drawback of using such wallets is that all the cards are of different banks so the user has to deal with all of them even though they are on the same wallet. So we need to further adapt all the wallets in one system.

This paper will first review major achievements and constraints in payment systems and their features. Based on this understanding, the main constraints will be identified. In the second stage of this paper, we will examine the existing methods, industry practices, and academic researches on electronic payment systems. Finally, once the best practices and challenges are identified, a new payment system will be designed, a prototype developed and tested. To achieve the objective, we will design mobile payment system that uses OTP (One Time Password) for cash transaction regardless of the customer and merchants accounts. To test the system, we will develop an ATM (Automated Teller

Machine) system for banks and Android mobile application for customers.

Design science research approach is used to design the system and we follow the steps in design science research approach to identify the problem, to define the objectives for a solution, to design SPS (Smart Payment System), to develop SPS and test SPS.

2. Related Work

As reported in [4] ATM as self-served machine improves the ability of bank's clients easy access to cash at any time. With all its advantages, the risk of losing money in the use of ATM is also possible. Criminals use several attack methods to steal customer's money and identity. The main objective of the paper is tightening the security of an ATM using three factor authentication methods. In addition to the traditional method of ATM authentication, present card plus knowing the pin they add OTP or finger print as the third authentication method. Although producing fingerprint is very difficult, once implemented, users cannot have a chance to change their fingerprint. ATM cards can't be shared. OTP method looks good in terms of enhancing security but still customers will be forced to carry their cards and their cell phones to access ATMs.

As reported in [5] interoperable payment systems will produce efficient markets and as a result enforce reliable and secure international transaction in the globe. Currently the world owns interconnecting networks containing Payment System Infrastructure (PSI). So we will not begin from scratch. We can use the unavoidable but important interoperable payment system. The paper also studies the effects of PSI interlinking and global interoperability for central bank oversight policy. At the moment we do everything we need to start interoperable payment system in respect to technical ability and we already started enjoying the benefit of interoperability in small size at national and regional level. The paper also concluded that central banks are not playing crucial role in shaping interoperable payment

systems. An interoperable payment system with all its expected benefits to civilization will introduce more risks. The main objective of the paper was using interoperability to enable customers to perform trade in convenient, affordable, fast and secure way using single transaction from any corner of the globe with single account.

The method used in the paper is by examining possible technical and legal challenges and opportunities with focus group from ITU (International Telecommunication Union) and evaluating using leading experts. The study can be used as a guide to build an interoperable payment system nationally, regionally and even globally. The paper also examines every possible challenges and opportunities using an interoperable payment system. The basic weakness of the paper is that it is not detailed enough to explain how interoperability can work in the real world using a demo or real world example.

As reported in [6], it is not debatable that electronic transaction development is growing exponentially and the current authentication methods are poor and cannot solve the growing frauds. Traditional methods of authentication should be replaced with new and bullet proof methods. Despite several benefits of ATMs, they are not free from fraud. Because of fraud, despite their significance in life, they are equally sources of trouble. The main objective of the paper was to design best identification, authentication and authorization method for ATMs for Ghanaians.

After detecting and analyzing the most critical frauds in ATMs, they propose to adapt client server architecture, and the user interaction to be finger print instead of pin for authentication. They recommended descriptive conceptual approach, and they designed a cardholder interface with ATM. They developed 16-item questionnaire using interview of experts and concepts from literature review. They randomly selected customers and staff of local banks to fill the questionnaire. They analyzed the survey using descriptive statistical

methods and show the result for industry experts for certainty. They tested their instrument reliability using Cronbach alpha. The achievement of the paper was they assure that pin is near to obsolete and they focus on local solution (for Ghanaians). They have developed good methodology. The weakness of the paper is that they focus just on security. Scanning and transmitting each fingerprint, and sending it to the server for processing is expensive. Another weakness is a card should be carried to access ATM.

3. The Proposed Solution

Online payment systems are growing throughout the entire globe. We are heading to cashless and smartcard-less society if we push hard the movement of mobile payment to the next level. This paper will focus on improving mobile payment system. Nowadays if we want to tie ourselves only on mobile payment systems then we end up not getting cash if we wish from ATMs nearby. At the moment we must use cards to get cash from ATMs and this is the weakest point of mobile payment. M-Birr and Hello Cash in Ethiopia and many applications in the entire world are able to transfer money through bank retailers and agents but still unable to have money using mobile from ATM.

3.1 What is Smart Payment System (SPS)

SPS is a way of making inter-banking cash transactions through electronic medium using just mobile phones (preferably smart phones) without using cash, checks or any payment cards. The philosophy behind SPS is if anybody has single account and smart phone then it will be enough to him/her to enjoy any service available using SPS using OTP (one-time password).

3.2 Components of SPS

As we already discussed above we have mentioned smart phone and single account to use Smart Payment System but it is worth discussing all the components in more detail.

a. Smart Phones

According to Wikipedia [7] smart phone is a mobile phone (also known as cell phone or cell mobile) with an advanced mobile operating system that combines features of a personal computer operating system with other features useful for mobile or handheld use. We can use other mobile phones in order to use SPS using USSD (USSD is a menu-based service which runs as a real-time open session between the application and the end-user) but we recommend smart phones for additional usability - using NFC (Near Field Communication) to connect with POS - and security (like using fingerprint sensor).

b. One-Time Password (OTP)

A one-time password (OTP) is a password that is valid for a single transaction, on different digital systems [8].

c. Address Database

This database could be owned by the bank union or telecom union and must be distributed on country level. The address database collects all personal information to locate the customer in case of delivery of goods or services. We can use telephone number as primary key. For simplicity and convenience, we can allow customers to edit their address.

d. DLS Server

The Domain Link System (DLS) is like DNS a technology standard for managing links of banks in SPS network. DLS allows banks to automatically change ids into links and helps bank servers to automatically find the address of other banks. A DLS server is any computer registered to join the Domain Link System. A DLS server runs an application that matches the link for an id. DLS could be owned by an individual bank or by banks union.

3.3 How SPS Works

In SPS customers will always initiate the trade. Customers choose the service or goods they need then requesting to the issuing bank for OTP by sending (1) identification number of the customer, (2) identification number of the merchant, and (3) the

amount of cash needed. The issuing bank stores the id, the amount of cash and the telephone number of the customer (used as customer id) and sends the OTP to the customer. Each financial institution can have its own method to generate the OTP but must follow the standard of smart pay. For example, all OTP must be only digits and the same length. The generated OTP works only for the owner (customer) and beneficiary (merchant). The OTP generated must have a prefix of a bank id to help the acquirer bank to locate the issuing bank. Each bank and merchant registered to the SPS must have SPS id.

Online Payment and POS: Then the customer uses the OTP for purchase. The merchant sends the OTP and the amount of the service or goods to the merchant bank. The merchant bank identifies the owner of the OTP by the prefix of the OPT and sends the OTP and the amount to the customer bank. The customer replays accept or reject. The merchant bank forwards the message to the merchant.

ATM: The OTP will be generated using ATM id instead of customer id. Customers can use the OTP to collect the cash without ATM card. Using this method, we can even go further and use the OTP to transfer cash from person to person using SPS.

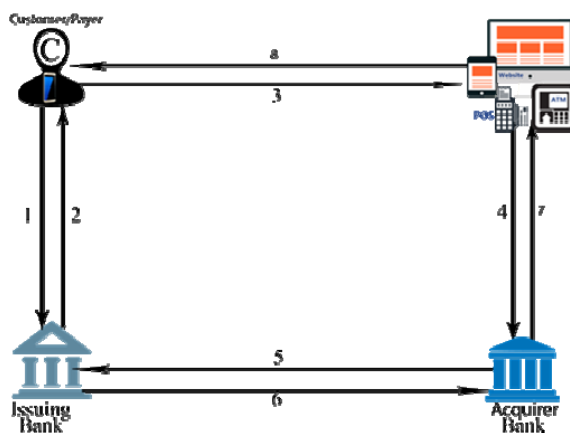


Figure 1: General Overview of SPS for multi bank

As shown in Figure 1, SPS (ATM specific) can be summarized in the following steps.

Step 1: The payer sends a request for OTP to the issuing bank along with id of the ATM,

amount and phone number (phone number is automatic using app or USSD).

Step 2: The issuing bank sends OTP for the amount requested and temporarily deducts from the account for the amount requested. Temporary deduction could be permanent if the OTP is used or adjust the account by increasing amount deducted otherwise.

Step 3: The customer will enter the OTP to the ATM.

Step 4: The ATM sends the OTP to the bank (ATM's bank).

Step 5: The ATM's bank sends the OTP to the issuing bank.

Step 6: The issuing bank sends the amount and the id of the ATM to the ATM's bank.

Step 7: The ATM's bank orders the ATM to withdraw cash to the customer.

Step 8: The customer collects the cash.

To elaborate it using a real world scenario let us say a customer whose name is Abebe wants to buy hundred Birr airtime from ethio-telecom. Abebe is a customer of Dashen bank and his telephone number is 0911000000. Abebe opens his smartphone and uses an app called Smart Pay and fills the form id of ethio-telecom which is 11001100, hundred Birr and presses generate OTP using USSD. Then Dashen bank receives the phone number 0911000000 and id of the merchant in this case ethio-telecom whose id is 11001100 and hundred Birr. Dashen bank stores all the three attributes and the current time and then sends OTP to Abebe, let us say 9999 prefixed by the Dashen bank id, let us say 22. Now Abebe has the OTP, he opens the webpage of ethiotelecom to buy airtime. He fills the amount in this case 100 Birr and the OTP 229999. Ethio-telecom sends the 229999 and the 100 Birr to Commercial Bank of Ethiopia (CBE) and ethio telecom which is 11001100 are also received by CBE. CBE sends the id of ethio telecom 11001100; amount 100 Birr and OTP 229999, CBE sends the credentials received from ethio telecom to Dashen bank. Dashen bank checks if the OTP was

initially generated with the received attributes. If it is OK, then sends phone number of the owner of OTP 0911000000 to CBE. Then CBE sends OK along with 0911000000. Then ethio telecom sends the airtime to 0911000000.

If Abebe wants to buy a product let us say shoe, then when the shoe shop receives the phone number then the shoe shop should use the phone number for shipment.

If Abebe wants to buy software, then the company should send the license key using the phone number received from the bank.

SPS also works the same way if both acquiring and issuing banks are the same, when both merchant and customer from the same bank (we call it single bank SPS). Single bank SPS is a very simplified form of SPS when the customer and merchant/PAW (POS, ATM and Website) accounts are from same bank. The same bank will generate the OTP, process the OTP and did clearing and settlement process. The advantage of single bank SPS is that banks that do not trust other banks or banks that do not want to work with other banks can use the system with limited benefit.

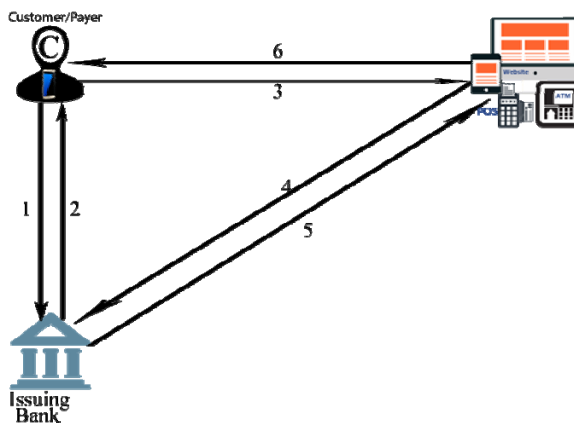


Figure 2: General Overview of SPS for Single Bank

As shown in Figure 2, in Single Bank SPS the OTP generator and verifier is a single bank. We can get every advantage of the SPS for multi bank but without interoperability.

4. Discussion

The reason why cash still exists is mostly because there is no cost of transaction, suitability, anonymity and acceptance. So any new electronic payment system should keep the most important features of cash in mind. Whatever the next development in online payment, electronic payment system will remain a key factor in e-commerce. Currently online businesses are growing regardless of the growing attacks in online systems. So the need of cost effective and convenient electronic payment system are quite significant. SPS applies Java's concept of "write once run everywhere". In SPS we can have a single account and make business with everybody. SPS eliminates integrators, network owners and leaves all financial institutions at the same stage. SPS helps customers to buy products or services regardless of the accounts of both the customers and merchants.

SPS solves ATM and POS frauds such as skimming attack (unauthorized capture of payment data to commit fraud) and card trapping attack (to trap the ATM card in cash dispenser and steal pin) by simply avoiding using cards. The target of criminals is the card and we avoid using them. So criminals have nothing to skim or trap. For attacks like phishing and malware we introduce OTP, use and throw approach. In case of criminals successfully getting access to the OTP before the user uses them, we use mapping concept, every OTP maps to a single machine id. So criminals should know the machine id to know which ATM or POS is referred. Even though it is impractical to know all these in ten minutes because the OTP expires in ten minutes, we make machine id to be randomized periodically to strengthen the security of SPS.

Customers with traditional type of payment system must find a merchant that accepts the payment system they have in order to purchase the product or service. Customers are forced to have many payment cards which basically did the same as a result of lack of interoperability between the

payment systems. SPS solves this problem by developing an open standard for financial institutions to make transaction without sharing sensitive information of the customer or the merchant. Not sharing sensitive information helps one financial institution to trust any registered financial institution without knowing their record of security compliance.

When users access ATM using SPS to withdraw cash or POS to purchase goods or services or purchasing goods or services online, SPS uses the same technique, i.e., request OTP and use them. As a result, users have short learning curve. Accessing ATM without card also improves the way we transfer money. Using SPS users can transfer the OTP at any time so beneficiaries can collect their cash from nearby ATMs regardless of place or time.

SPS is also highly likely to improve efficiency since the cost of transaction is a result of competition among payment systems and secured transactions. Competition is achieved by interoperability of the system and helps the cost of transaction to decrease. Cost of transaction falls when cash lost due to fraud drops.

Finally, we show SPS improves security in transactions, is able to trade without cards, eliminates third-party switches and networks that cost money for participants, privacy of users and trust among financial institutions due to not sharing sensitive information among them.

5. Conclusion and Future Work

SPS is open standard electronic payment system. The central philosophy behind SPS is a user needs just a single account to purchase a product or service regardless of the account of the merchant. Using SPS one will request an OTP for any amount and use the OTP at ATM, POS or online using the same concept. Even though the main purpose of SPS is to conduct

inter-banking transaction, it is also possible to be used by a single bank. Since a merchant and user have single account, every transaction will be lodged using the respective banks. Since no user data is transferred to the merchant, privacy will not be compromised. In SPS, OTP is generated using merchant id, so there is no possible loss of cash in the transaction. We believe the standard of the SPS will be accepted and transforms the payment system.

The results of this paper show that there is a need to refine SPS by including currency converter module in the design of the prototype and improve the privacy issue by avoiding to use phone number as primary key.

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A Framework for Adopting Hybrid Cloud Computing

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Abstract

The long way it comes, the dynamic change it has, the specialization and transparent nature of its services and the relative advantage it has over the previous computing technologies has provided, cloud computing has attained the maturity level and position where it is now. Security, privacy, trust and location risks are some of the factors that hinder the adoption of cloud computing and it is not well implemented in organizations of developing countries. But the adoption of cloud computing could transform the workflow of organizations to efficient, cost effective and manageable environment. To transform the current working environment to cloud computing environment, it needs to have a sound, comprehensive and agile adoption framework. Its room for keeping the computing and management of sensitive data and applications in house and going public for additional computing requirements, makes the hybrid cloud computing the best fit for construction companies. The proposed hybrid Cloud Computing Adoption framework can support construction companies to determine and understand the contexts they need to consider when adopting cloud computing.

Primary and secondary data are used to develop the proposed adoption framework. On top of that, the National Cloud Computing Policy, Strategy and Roadmap of Ethiopia, Technological, Organizational and Environmental cloud adoption framework was used as a theoretical lens in the study. This paper is proposed to support informed judgment rather than strict robotic rule based implementation. The study findings are believed to help organizations and researchers to understand cloud computing adoption contexts, requirements, to measure their risk, to migrate their services to cloud from all types and to connect and integrate different services as a single system. Future direction and security concerns have been addressed in our framework.

Keywords: Cloud Computing; Hybrid Cloud; Adoption Framework; Security; Privacy; Trust

1. Introduction

Computation power ranges from manual computing to sophisticated cloud computing technologies. The ability to collect, transport, process, store, and access data nearly anywhere in nearly any volume is the far end IT goal of any company [1]. It is described that outsourcing the access of information technology resources and services will have the potential to provide flexible, cost-effective, and proven delivery platform for business and consumer information services [2]. There is still an option to hire local IT infrastructure, but the investment on on-premises is costly and considered as a liability for many companies.

Cloud computing has become a hard core mechanism to have a cost effective and flexible computing environment that can combine and share computational resources. Previously some companies were building and maintaining their computational resources but in recent times, companies and information technology leaders realize the potential benefit in combining and sharing computing resources [3]. According to [4], long term plan for a business without thinking about cloud computing is a mare decision and a cloud-enabled enterprise is able to exploit cloud services to meet its information technology needs easily and effectively.

Cloud computing is a model for enabling ubiquitous, convenient, on-demand network access to

a shared pool of configurable computing resources (e.g., networks, servers, storage, applications, and services) that can be rapidly provisioned and released with minimal management effort or service provider interaction [5]. Cloud computing is the future and survival tool of every data, business, network and everything access to it.

Cloud computing has different deployment models: public cloud, private cloud, and hybrid cloud. Public clouds are run by third parties and applications from different customers are likely to be mixed together on the cloud's servers, storage systems, and networks. Less cost, scalability and availability are some of the benefits of public cloud [6]. Private cloud (or internal cloud) refers to cloud computing on private networks. Private clouds are built for the exclusive use of one client, providing full control over data, security, and quality of service. Private clouds can be built and managed by a company's own IT department or by a cloud provider. Security and privacy are the major benefits of private cloud [3]. Hybrid cloud combines multiple public and private cloud models. Hybrid cloud will give us the ability to secure the institution's critical applications and data by hosting them on the private cloud or in house [7].

There are three types of cloud computing services. These are SAAS (Software As A Service) which focuses on provision of software applications in the cloud, PAAS (Platform As A Service) which focuses on provision of services that enable customers to deploy applications created using programming languages and tools supported by the supplier, and IAAS (Infrastructure As A Service) which refers to services providing computer processing power, storage space and network capacity, which enable customers to run arbitrary software [1, 3, 6].

The construction industry in Ethiopia can be described as the sum of all economic activities related to civil and building works; their conception, planning, execution, and maintenance. The increasing complexity in computation, data storage

and system changes enforced the construction industry to have a better computing power that can cope up with the dynamically changing systems [8]. Using cloud computing in the construction industry has strong appeal because of the constant change of workers and frequent setup of new jobsite locations, many workers need better access to company data to aid in timely, well-supported decision making and reporting while working in the field [8]. The increasing requirement of construction companies for smarter, harder and more economical computing power and the booming emergence of hybrid cloud computing for ease, secured, less cost and shared computing power has motivated this study.

The construction industry is now embracing new technology and consuming IT services and solutions at an accelerating rate, needing to acquire more and more computing power, with bigger and faster servers to run the latest business critical applications and data [9]. The major scientific and technological problems of the construction sector in Ethiopia are inadequate planning and programming, nonsystematic way of working, non-conductive system of collection, usage and dissemination of information, low reporting culture and capability, nonstandard pricing and documentation, low capability and capacity in designing and supervising [10]. The current technological problems of the construction companies can be solved through the use of technologies like cloud computing that can facilitate their overall working culture effectively and efficiently [11]. Some IT resources, activities and processes in the construction industry are very sensitive and vital for the wellbeing of the company. They need more security and confidentiality. The company can never compromise for those resources and need to keep them as private as possible.

Hybrid cloud computing is generally best-of-breed that combines the security and comfort level of a private cloud or other on premises computing with the less costly, flexibility and versatility nature of the public cloud. It is possible to merge others with on premises private cloud for high security application

environments to leverage the best of both worlds [12].

The adoption of cloud computing requires a well-defined framework, needs to consider and discuss fundamental changes across the entire organization, requires communication and involvement of stakeholders both outside and within that will support these changes [13]. Currently, to the best of our knowledge, little attention is given to cloud adoption and there is no organized framework for adopting hybrid cloud computing. Technological aspects and processes, current computing capability, external capabilities, internal and external requirements, and frameworks are the central ideas this study considers when developing the adoption framework.

2. Related Work

Several studies have been conducted on cloud computing adoption framework and issues that are affecting cloud adoption process. A general framework for cloud computing adoption in an organization using TOE (Technological, Organizational, and Environmental) conceptual framework is proposed in [14]. The study is conducted using only literature review, in which it lacks real-life exposure and it is only aimed to address the adoption of cloud computing across multiple contexts by proposing a general cloud adoption framework.

A framework to guide companies on adopting cloud computing technologies proposed in [15] is a case study conducted on Kenyan small businesses context. The developed framework doesn't consider the specific requirements of hybrid cloud computing.

The study in [16] proposed hybrid cloud computing framework to optimize e-health activities and it identified privacy, security, interoperability and standards as the factors that influence cloud computing. It appears to be applicable in the health sector and is not adopted for other sectors, because the framework is developed based on the requirements of the health sector.

A framework for the implementation of cloud-based IT services in the construction domain is proposed in [17]. But it is more on the collaboration of construction companies using the cloud and it doesn't describe how to implement cloud based IT services.

Improved cloud computing adoption framework to deliver secure service is proposed in [18] and considered multi-layered security as a suitable security solution. However, the emphasis is on the update on security policy, technologies and techniques used. There is no detailed information from the design to implementation about hybrid cloud computing.

The work in [19] defined a framework for cloud adoption to establish a visual guideline to cloud adoption by considering consumer, provider and integrator as fundamental parties in cloud adoption. However, it is a vendor specific adoption framework that does not have detail on which type of cloud model and for which specific domain.

The hybrid cloud adoption framework proposed in this paper focuses on developing an adoption framework by considering the current internal and external computing capabilities, future requirements, conceptual framework and by making them aware of all the risks and preparedness associated with cloud computing adoption. The contribution of this paper not only raises issues inflicting cloud computing but also provides the aspects to be considered when adopting cloud computing.

3. The Proposed Solution

The proposed adoption framework is developed based on the primary data collected through interview and secondary data through review of literature. The TOE framework developed in [14] is used as a lens to the study and other cloud adoption strategies in [20, 21] are used to keep the alignment of the framework and provide it universality. The proposed framework is shown in Figure 1.

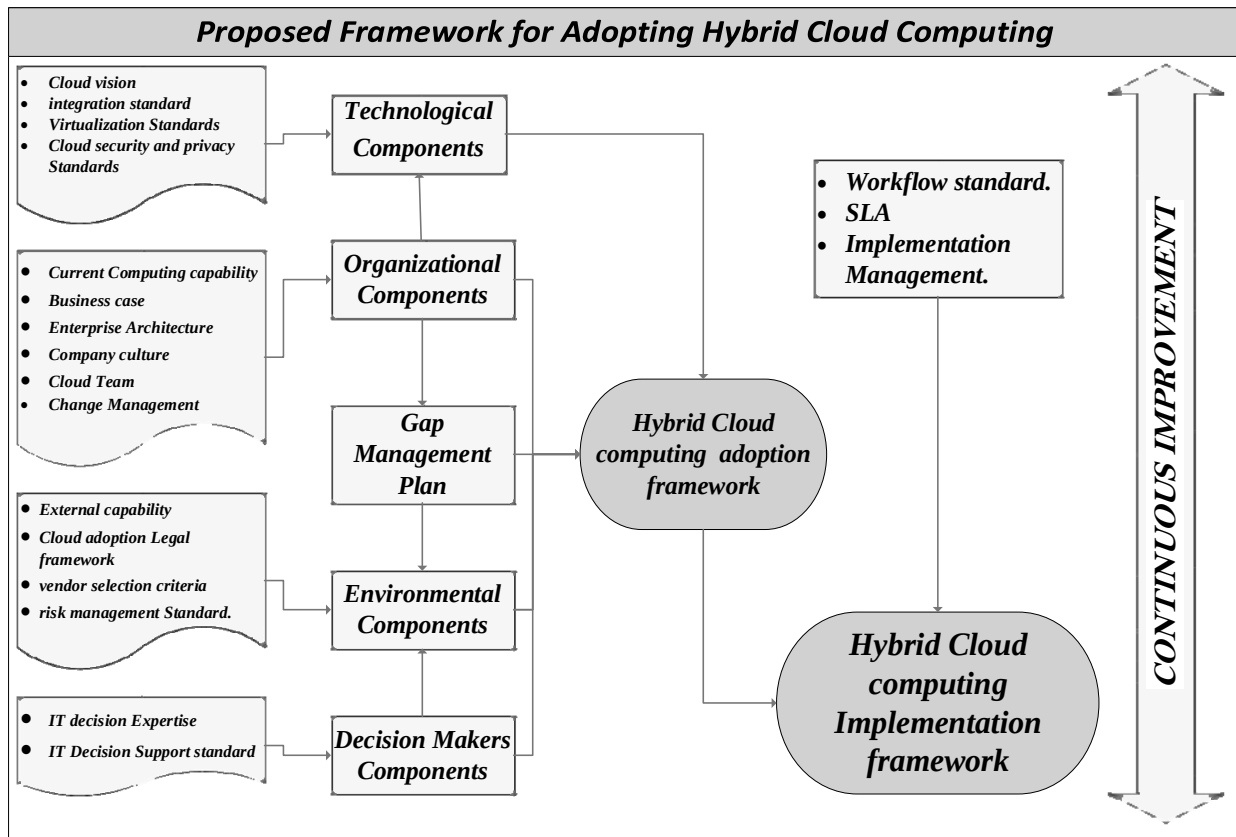


Figure 1: The Proposed Framework for Adoption of Hybrid Cloud Computing

The framework is developed based on the collected source documents, processing them, deriving the output documents and finding the components from the output document through the use of the cloud adoption conceptual framework in [14]. The current way of working and formal procedures for the daily operation, understanding of the business strategy and intents, the intent of IT managers and the identification of the involved stakeholders (internal and external) are some of the critical issues considered. On the other hand, documents that are derived on this process (example, technological, organizational, environmental, human components and adoption framework) are used as input to derive another document.

On the processing step, the collected documents and the identified stakeholders are refined based on the detail aspects of the cloud adoption conceptual framework in [14]. The perceived benefits and attributes of cloud computing, the challenges of cloud computing, the current computing capability of

construction companies, the intent of the government and providers, the innovativeness of decision makers, shortfall analysis and implementation techniques are some of the issues that are studied and analysis based on the perspectives described.

The output documents are the documents processed and derived from the analysis of the source document. These documents can be standard, policy, plan, model, enterprise architecture or memorandum that will be an integral part to build its respective components. The derived documents once again can be input documents so as to derive another document through another process.

On the framework/component derivation step, using the derived documents and other inputs, the components are derived and then using the components and other necessary inclusions the adoption framework is developed. The adoption framework and other implementation requirements are used to process and recommend an implementation framework.

Design science research evaluation strategy, called an ex post naturalistic strategy, developed in [22] is used to evaluate the proposed framework. It basically considers the time of evaluation, the nature of the artifact and form of the evaluation. In addition, the quality of the framework is evaluated based on the quality evaluation metrics in [23] and the evaluation result carried out appears to suggest that the framework is reliable and fine grain of the collected data and the specified methodology that will help to adopt hybrid cloud computing.

The proposed adoption framework can provide an insight on how to adopt cloud computing for other sectors that are operating on the same environment. The research can also provide a significant help to researchers, academicians and students who are keen to learn about cloud adoption in construction companies and other sectors in developing countries as well. This is due to the fact that the proposed framework used universal and acceptable tools and techniques to develop the adoption framework.

4. Discussion

From the primary data collected through interview, respondents believe that they need better computing power and they do have a better knowledge about cloud computing. Reliable network, trusted vendor, company culture, government legislation, and skilled manpower are some of the barriers when adopting cloud computing and integrity, interoperability, security, privacy and trust are some of the threats. They believe that refined strategy, cloud vision and frameworks are required to adopt cloud computing. On the other hand, for the problems raised and requirements identified, there is national broadband and national data center expansion plan, standard enterprise architecture, implementation plan, skilled IT expert development plan, strategy alignment plan, IT service outsourcing plan, IT industry development plan, incentives, standardization, consolidation, virtualization, optimization and governance standards for ICT equipment, integration, interoperability, security

standards, privacy standards, storage location plans that will support the adoption of cloud computing in the private sector.

Hybrid cloud is the optimal architecture for handling the inevitable complexity of a company's IT infrastructure and it is a catalogue of cloud services that allow the business to select the right cloud service for each application and data [24]. Different computing needs of a company require different security and privacy requirements and cloud deployment models. Sensitive resources where their security should not be compromised need to be kept and managed by a company's in-house computing and the non-sensitive resources can be computed using the public cloud to take its full advantage. The companies had already invested and owned their own ICT facility and resources. Thus hybrid cloud computing will enable them to exploit their current capacity and to go for third party provider for their additional computing requirements. The cloud policy and strategy of the country promotes the adoption of hybrid cloud computing in the time to come (2017-2019). Then it is better for the construction companies to align their cloud strategy with the future plan of the country. Adopting hybrid cloud computing will have a flavor of easy integration of distinct cloud infrastructures and services in the future. Hybrid cloud computing supports heterogeneity, dynamic and open systems, basic VM operation management, flexible scheduling policies, workload monitoring, and defense in depth [25]. Thus, when adopting hybrid cloud computing, construction companies will enjoy those features.

The proposed adoption framework is a step by step guideline that collects the necessary input based on the requirements from internal and external environment, analyses and processes the input based on the methodology selected and derive a formal document that can later be used to develop the adoption framework. Besides the cloud adoption conceptual framework in [14], we kept the framework's alignment using the cloud adoption strategies in [20, 21] at each perspective of the

framework development process. There will exist change on the internal as well as the external environment of the companies, thus the framework has a room for change management. The framework is a beta version and if some special requirement or change occurs, then the framework is open for continuous improvement.

5. Conclusion and Future Work

This paper tried to discuss cloud computing, i.e., a phenomenon changing the way of computing in a dynamic manner. The research has tried to grasp knowledge about cloud computing, its features, benefits and drawbacks and its current status in Ethiopia and the construction companies in particular. The main objective of the paper is to develop the adoption framework of cloud computing in Ethiopian construction companies. To do so we used both theoretical and empirical techniques.

The construction companies are well aware of the benefits of cloud computing and they have the tendency to adopt cloud computing when available. In fact they have a great concern on the security, privacy and trust factors. Based on their requirements hybrid cloud computing is designed in such a way that it matches with their needs. It will place sensitive resources that need special protection and treatment, within the local network by considering the security, privacy and trust requirements of those resources in parallel with the cost, availability, scalability and risk mitigation advantages of public cloud computing paradigm. Various authors figured out that the efficient and effective analysis, development and implementation of a sound and agile framework is one of the most significant factors for the adoption of cloud computing. For that matter we used different strategies, roadmaps, conceptual frameworks and input to develop the adoption framework.

Having its internal and external aspects, the adoption of cloud computing has uncountable benefits for the country in general and the construction companies in particular. In the years to come the Government initiated and promoted the

adoption of cloud computing in the private sector which in turn makes the adoption framework a significant resource.

We tried to investigate using the most relative scenario and conditions, and the framework will be generic that will support informed judgment for the construction companies. As technological experience and competence matters, migration to the cloud becomes fairly complicated in the case of construction companies in Ethiopia, thus a proper comprehensive framework is developed in order to minimize the risks, challenges and increase the potential benefits of cloud computing adoption.

The main focus of this study is on the stepwise process of adopting cloud computing by integrating the on-premise IT resources and other external cloud computing environment. Apart from this study, there are other important scenarios that can be a big concern and can support this study.

Virtualization, integration, security, enterprise architecture, cloud architectures, cloud automation, orchestration, communication between different clouds, standardization, cloud control, implementation and other technical and detailed low level studies are some of the future works.

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Implementation of Integrated Library System: The Case of Academic Libraries in Ethiopia

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Abstract

This paper aims to implement an Integrated Library System (ILS) and digitization for academic libraries in Ethiopia to improve quality of education. ILS is an enterprise resource planning system for a library, used to track items owned, orders made, bills paid, and patrons who have borrowed. Integrated refers to the ability of the system to manage library operations with separate modules which interact and share a central database of records. Academic libraries need ILS to improve the services they provide to their patrons to avoid traditional models of performing functions, which are the major problems that hinder efficient services. ILS helps to achieve maximum results with minimum input.

Quantitative and qualitative approach is adopted in the research and it was guided by five objectives and three research questions. The instruments used to generate data are interview and questionnaire and the data generated was analyzed using frequency tables and percentages. Six chief librarians and 30 students were randomly selected from 6 academic libraries.

It was found that 50% of the academic libraries are fully automated and 33.3% have taken initiatives for the creation of digitization of their libraries and 80% of the users of the implemented Koha ILS are satisfied.

Keywords: Integrated Library System; Digitization; Resource Sharing and Academic Libraries

1. Introduction

Libraries in developing countries have an important role to play in the development and maintenance of a democratic society. They provide the conditions by which people achieve free access to information and knowledge. They provide opportunities to participate actively in the country's further development into a democratic society. The strengthening of libraries in developing countries forms the most efficient weapon in the struggle against the digital divide. Libraries can provide access to global information via Internet. at all levels. They are tools for people to obtain better living conditions. Reading print and digital documents, whether for business or pleasure, is fundamental for any society in the modern world. It is the foundation of democracy, capacity building, and modernization. It is an important method for development as it offers visions and dreams, learning, skills and a creative

impetus to the individual. In order to protect the world against ignorance, disease and poverty, access to information via libraries is essential [1].

The problem of information storage and retrieval has become progressively more serious in recent years, especially in the areas of technology and science, where the volume of data and information is increasing at an unprecedented, nearly exponential rate. Keeping in view the tremendous flow of information, to organize information and to disseminate in systematic way automation and digitization are the answers. Computer aided system is more convenient, more flexible and more comprehensive and in the long run more economical.

According to Waters [2] "Library automation is beneficial to students, librarians, faculty members, and administrators for various reasons. The library is the resource center that supports and enhances the curriculum for the college. Students can expand their

horizons more effectively with an automated library. Instructors can reinforce their instruction with assignments that guide students to research opportunities within the library”.

The term library automation was generally used in the past for housekeeping operations of a library. Today it has expanded its scope and includes all those technologies which libraries and information centers use for collection, processing, storage, retrieval, dissemination, and transmission of all types of information.

We observed that the process of inquiring books and retrieving borrowed and returned books were done manually in academic libraries. Patrons spend more time in every process of retrieval and circulation of books. The activities of a library (cataloguing, circulation, acquisition, etc.) are manual and it is time consuming. Thus, it is interesting to study ILS candidate models to automate the activities to substantially improve satisfaction of the staff and users.

The research is guided by the following research questions:

- What are the problems encountered in implementing library automation?
- Why the need for an integrated library system for academic library automation?
- What are the possible solutions to these problems?

The hypothesis of this research is that the open source Koha integrated library system is the best solution for academic libraries in Ethiopia.

2. Related Work

An ILS usually comprises of a relational database, software to interact with that database, and two graphical user interfaces (one for patrons, one for staff) [3]. Most Integrated Library Systems separate software functions into discrete programs called modules, each of them integrated with a unified interface. Examples of modules might include:

- Acquisitions (ordering, receiving, and invoicing),
- Cataloging (classifying and indexing),
- Circulation (lending to patrons and receiving them back),
- Serials (tracking magazine and newspaper holdings), and
- The OPAC (public interface for users).

Each patron and item has a unique ID in the database that allows the ILS to track its activity.

Academic libraries should have the best software for fulfilling the entire activity and to satisfy users. Besides storage and retrieval, there are also other housekeeping functions. Computerization of operation requires procurement of hardware and software. The first step towards this will be the automation of individual libraries and information centers and for this each organization has to follow and maintain certain standards. Several options are available for acquiring or upgrading a library integrated system [4]:

1. Buy or license a commercial software package,
2. Join or make use of open source software package, and
3. Develop own system.

A software package used for library services should have at least the following qualities [5]: Database Management System (DBMS) features, high level integration, data entry facility, data updating/editing, search/inquiries, report/display/print, menu driven and user friendly, compatibility, reputation of the sponsoring and scope for local variation.

Software is the program that runs on a computer to produce the required results. “A computer without software is similar to a man without his brain, or a library with neither books nor librarians” [5]. Therefore, in principle, the selection of software comes before hardware. Hence, selection of a suitable software to use within an academic library is critical for overall success of a project. The key

issues to consider in selecting software include [6]: cost, availability of technical support, collaborative tools, ease of use, functionality, security, clarity, interoperability, scalability, integration and file-sharing features and administrator tools. It is also emphasized that issues such as hardware connections, right with respect to software, history of the supplier, possibility of preview or demonstration, pricing structure, level of sophistication, support issues, references sites, parameterization, teaching aids, system administration, and needs for documentation should be critically examined when selecting a software.

Based on the analyses Koha passed all the required criteria. It is a very mature ILS system with a very strong user community and presents similar features like commercial systems. The adoption of Koha represents significant license cost saving and the possibility to adapt the system to institutional needs.

3. The Proposed Solution

The objective of the paper is to select and implement integrated library system and digitization in academic libraries in Ethiopia to improve the services they provide for quality education. To achieve the stated objectives, we propose Koha ILS.

Koha is integrated with all the modules of the library management system. In administration module there is an option to generate barcodes, import and export BD (Bibliographic Descriptions) records, MARC (Machine readable catalog) Structure, Z39.50 servers and many more options. Statistics can be generated in Accounts and Reports module to see how the system will work effectively. The system consists of two interfaces which comprise the modules as shown in Figure 1 [10].

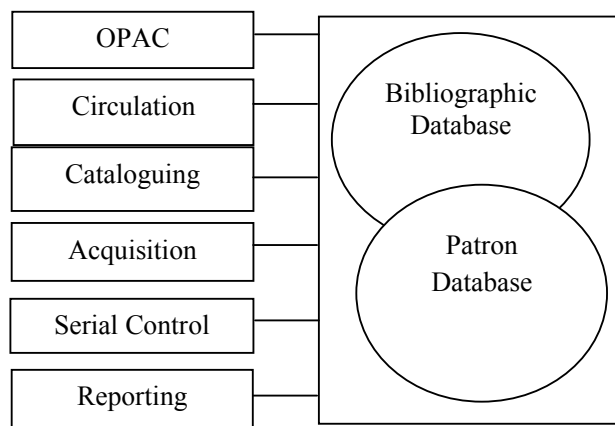


Figure 1: Koha Modules

Apache web server is required to serve Koha on the Web. The data entered in Koha are stored in MYSQL database backend with cataloguing data stored in MARC and accessible via Z39.50. Koha uses a dual database design that utilizes the strengths of the two major industry-standard database types (text-based and RDBMS). This design feature ensures that Koha is scalable enough to meet the transaction load of any library, no matter what the size. Perl is the programming language used in Koha. It is built using library standards and protocols that ensure interoperability between Koha and other systems and technologies, while supporting existing workflows and tools. The user interface is configurable and adaptable and has been translated into many languages. Koha's OPAC, circ, management and self-checkout interfaces are all based on standards-compliant Web technologies – XHTML, CSS and Javascript – making Koha a truly platform-independent solution. It is web-based ILS and the integration of the powerful Zebra indexing engine supports the software to become a viable and scalable solution and increased the speed of searches for libraries of all kinds [7].

The implemented prototype creates the complete single database for the library, collection search is made simple through OPAC, easy to handle circulation services (check-out and check-in), made effective control over the collection and resource sharing is simplified and data entry can be done using Z39.50 (import bibliographic description).

4. Methodology

In the introductory part of this research project, several reasons for computerizing the library activities were given. The major factor for computerization as compared with manual processing is the considerable saving in effort, time and resource. Basically, research is described as an active diligent and systematic process of inquiry aimed at discovering, interpreting and revising facts. The term research is also used to describe a collection of information about a particular subject. So, the application of procedure for research is known to be research methodology. One can also define research as a scientific and systematic search for pertinent information on a specific topic. The various functions and routines of research project section of HiLCoE Library operations have been studied and observed. Accordingly, the appropriate steps were followed to create an automated library system.

Research design is a plan, structure and strategy of investigation conceived so as to obtain answer to research questions. This paper used mainly two aspects, qualitative and quantitative. This design of study helps to improve an evaluation by ensuring that the limitations of one type of data are balanced by the strengths of another which ensure that understanding is improved by integrating different ways of knowing. The outline interviews for chief librarians and focus group discussion for student users are geared to collect both quantitative and qualitative data.

We first consulted secondary literature to find out what had been written on ILS and problems encountered in implementing it, (conducted between April and July 2016). Relevant primary data has been collected using interviews with librarians, focus group discussion with students and observation of the libraries.

The data from interview and focus group discussion was edited, coded, tabulated and classified for analysis. The data from both respondents was

analyzed. The results of the analyzed data were presented in the different form of tabulation. Qualitative data has been analyzed descriptively. Both qualitative and quantitative data collected during the field work and obtained from other secondary sources has been used to interpret the data. The data has been broadly categorized according to the research objectives. Collected data were analyzed and interpreted in a systematic way, mainly characterizing in various headings and sub-headings for the fulfillment of the research goal.

Percentage and thematic interpretation of collected data is applied and finally by way of conclusion, the major findings of the project research are included and based on it, recommendations and future work are forwarded.

5. Discussion

Based on the findings we selected Koha ILS which is an open source software to automate academic libraries in Ethiopia and implement it as a case study among the three options available: commercial ILS, open source ILS, and from scratch.

It is described in [8] that open source ILSs were more cost-effective than commercial ILSs. Libraries using open source ILSs choose them mainly for affordability, and they cost less than commercial ILSs. Although users of open source ILSs experience difficulties with installation and complete documentation, they were modestly more satisfied than users of commercial ILSs.

ILSs are multifunctional and adaptable software applications that allow libraries to manage, catalog and circulate their materials to patrons. In choosing ILS software, libraries must base their decision not only on the performance and efficiency of the system, but also on its fundamental flexibility to readily adapt to the future demands and needs of their patrons [6]. In the meantime, libraries are showing a growing interest in open source software solutions due to dissatisfaction with commercial library systems and the restriction of budget.

In [9] an integrated library system is described as "a library system that uses a common machine-readable database and has two or more subsystems operational and accessible online for increased efficiency." ILS provides academic libraries with efficient and user-friendly tools and workflow support they need to meet the increasing requirements of the library patrons. It also enables deliverance of excellent services as well as an enhanced patron experience.

For library staff, ILSs are very welcome and was approved by the users of our implementation (the librarians and the students). This type of application improves the efficiency of all the operations in a library. This kind of software has many advantages because it permits not only the control of library operations such as loans and requests, but it provides also an excellent set of tools to manage books and borrowers. The usage of an ILS requires only a single time entry of data (bibliographic and users).

6. Conclusion

There are many challenges ahead which should be solved in academic libraries in Ethiopia to attain quality education. The status of automation in academic libraries seen in Addis Ababa is expected to be similar throughout Ethiopia. Libraries, librarians, and academic library administrations must initiate automation and digitization of academic libraries in order to provide effective and efficient services to users and improve quality of education by facilitating resource sharing among them.

Library and Information Science professionals should keep eyes on development in order to choose appropriate technology depending upon the institution's needs. Many libraries worldwide are using open source software for managing their library systems more economically and effectively. Librarians and programmers should work together in order to implement open source integrated library systems and at the same time, library professionals are also required to acquire new skills for developing and managing a library using open source Library

Management System (LMS). For taking benefit from open source software additional technology, education, and training of the professionals is required.

The academic library is an important component of any educational institution, which is the hub of the teaching and learning activities where students, instructors and researchers can explore the vast resources of information. In traditional libraries, patrons have to spend more time for searching a small piece of information and for that they have to depend mainly on the library professional or library staff. But in automated and digitized academic libraries, information retrieval is easy, which saves the time of the end users, and library professionals also and at the same time avoid duplication of work and make the library service smooth and effective.

Our study confirmed that borrowing time was short and the OPAC has made library resources accessible from different angles. Automation and digitization enables easy access; that is users are able to search for materials within the library and from remote locations via search items such as author, title, subject, call number and keyword and allows staff to better serve users and facilitate a multitude of tasks.

The advent of computers and other information technologies has brought new era in library and information services. The use of these new technologies has tackled the century long problems of libraries and improved the quality and diversity of services. In the developed countries all its functional areas are automated and automation turned academic libraries into upgraded user friendliness. Some of the academic libraries in Ethiopia began automating their activities recently.

From proper analysis and evaluation of Koha ILS it can be safely concluded that the system is an efficient, usable and reliable LMS. The system proved to give benefits to users and librarians in terms of efficiency in the usage of a library system.

In this period of digitization, however, an effective information service is unthinkable without digital library. Due to the increasing cost of printing most of the paper based information sources are appearing in converted digital format and accessed at the time of need directly from a computer networked with a digital library.

Resource sharing is one of the distinct features of academic libraries and this is facilitated by automation and digitization of a library which ultimately helps to achieve maximum results with minimum input.

Digital technology has raised the hopes and expectations of the academic community to face the challenges of not only bridging the gap between the information rich and the information poor in the country, but also uplifting the level of development in all its different facets. Major responsibility now rests on decision makers, technological experts, librarians, educationists, the publishing industry as well as the local institutions to play their respective roles in bringing digital information in need-based comprehensible form and language to the diverse clientele of the academic community. No academic library can work in isolation to reach the expected goal in the right manner. Library professionals must upgrade their skills in order to meet the growing expectations of users from libraries.

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Adaptive Multimedia Content Repository Framework

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Abstract

In the current trend of computing knowledge transfer, multimedia service delivery is increasing due to Internet explosion. Concurrently, with continuous increase of multimedia content access, user expectations of content access have also increased. Thus, this mismatch between rich content and user experience is a challenge in providing content accessibility and user preference. To address this challenge, this paper aims to design an adaptive multimedia content repository framework based on content adaptation approach. To achieve this aim the realm of multimedia content adaptation related work review analysis, prototype development and evaluation of the prototype are conducted.

Multimedia services delivery system is typically a massive scheme that is expensive and challenging to maintain and develop. Via advances of Service Oriented Architecture, a content-based approach can be applied to multimedia services delivery development. A complex and large scale multimedia service delivery scheme can be split into smaller and reusable contents. These contents can be composed in diverse ways so that the development of multimedia services delivery model can be flexible and the resulting content-based system is more maintainable, reliable and scalable. As a result, an adaptive multimedia content repository framework is proposed. It uses context of multimedia content to address content serviceability and variability to satisfy user preference and accessibility need.

The prototype, which illustrates an adaptive multimedia content repository, is developed and evaluated by individuals from different professions. The evaluation result shows that the prototype provides an efficient content accessibility with 81.1% accuracy in overall prototype evaluation.

Keywords: Multimedia Content; Content Adaptation; Pervasive Computing; Semantic Content

1. Introduction

Recently application demanding multimedia service delivery models are increasing. The main factor for such service delivery model is Internet which has been extended rapidly to pervasive access. In multiform, a pervasive device processes combination of characteristics such as memory space, network bandwidth utility, CPU power, screen size, data transfer rate, and user input interface. Hence, in content delivery process, the presentation must be modified as per the capability of the target device to suit format and features. Such process not only experiences the overhead on content authoring,

but also delays the dissemination of information over pervasive computing platforms.

As stated in recent research works, emerging multimedia services, such as video conferencing, media on demand and multimedia streaming demand scalable and adaptable architecture for providing better multimedia service [1]. The adaptable service architecture enables the flexible composition of multimedia services and improves quality of non-functional requirements. The quality requirements of multimedia services and the Quality of Experience (QoE) of end users regarding the perceived service quality are becoming major concerns for multimedia service providers. The guaranteed quality of service provisioning, even in case of failures and reliable

multimedia services composition are challenging tasks that are to be addressed at various layers such as service provider, request, and business process.

When the need of depending on pervasive computing devices is increasing intensely, there is a growing need for applications to bring multimedia content to the devices. Conversely, by the reason of limited device capabilities in terms of display size, storage, processing power, and network access there are new challenges for designing applications that allow these devices to successfully access, store and process multimedia content. The developments of pervasive computing, advances in storage, networking and authoring tools are driving the production of large amounts of rich multimedia content. The result is a growing mismatch between the available multimedia content and the capabilities of the client devices to access and process it. This mismatch impacts several multimedia applications.

Content adaptation is effective in solving the mismatch problem, resource limitation and satisfy users' preferences in heterogeneous environments such as pervasive systems [2]. Multimedia content adaptation refers to the process of improving content to suit to the user's computing environment such as location, device capability, network bandwidth, user's preferences and usage context [3].

Since content adaptation has become one of the research interests in pervasive computing, different approaches have been proposed: server-based [4], client-based [5], and proxy based [6]. Server-based adaptation degrades the performance of the server and client-based adaptation is very difficult and sometimes impossible due to limited processing power of pervasive devices such as Smart phones. Hence, most of the existing adaptation systems choose the proxy-based approach. To alleviate the overload problem of content adaptation processes, distributed approaches were proposed in [7, 8, 9].

Nevertheless, these approaches do not provide a general adaptation solution. This leads to a service-based distributed adaptation where adaptation tools are developed externally as services and accessible

through standard web protocol [10]. The main reasons for the need to externalize adaptation processes are (1) it is not simple to have a single complete computing solution that can provide all the required multimedia content adaptation tools in one system; (2) using Web technologies such as Web Services, adaptation tools can be easily developed and make them accessible via standard web protocols; and (3) using third party specialized adaptation tools, an adaptation need can be realized as a composition of several adaptation services.

2. Related Work

A number of research works have been conducted to address multimedia service delivery model to be adaptive in terms of context in the pervasive computing environment. Multimedia content should have to be adaptable for accessibility and flexible management of specific multimedia content in case of user experiences. In this section, review of related research is done.

CLAM framework [11] offers a complete development and research platform for the audio and music domain. It offers an abstract model for audio systems and includes a repository of processing algorithms and data types as well as all the necessary tools for audio and control input/output. However, CLAM framework is not clear with content adaptation in terms of user preferences and content accessibility. The provision of an essential content access is needed to satisfy potential requirements, which will be driven by the heterogeneity of the technical environment and the expectation of the end user to have access to personalized content.

XML-based framework for semantics-based integration and management of multimedia data as an adaptation and extension of the federated database technology is proposed in [12]. The framework is based on the XML/M data model composed of media objects, relationship objects, and container objects. Work on XML warehouses or XML-based mediator is still not mature, with many problems remaining to be solved [13]. Thus, semantic description of

multimedia items is not sufficient in addressing multimedia content adaptation in terms of user preferences and content delivery. According to [14], a vital issue of multimedia frameworks is content adaptation to achieve universal multimedia access (UMA), i.e., to enable consumption of multimedia content independently of the given resource limitations, terminal capabilities, and user preferences. Most adaptive multimedia frameworks targeting the UMA vision do not consider utility aspects in their adaptation decisions. In this modeling scheme there are no adaptation methods for different contexts in terms of content accessibility need rather than adapting network characteristics. In terms of scalable context usage and presentation, multimedia content need synthesis contextually in line with user experiences via adaptive user interface to address seamless access.

A system that dynamically selects and plays multimedia files from a large data repository to produce a presentation is proposed in [15]. The presentation is generated based on the technical, semantic and relational textual annotation of the data as well as context-sensitive rules and patterns of selection during the preparation phase. However, this work has limitation in articulating multimedia context coordination to enhance multimedia content repository accessibility at the client-user interface. According to Scherp *et al.* [16], multimedia content today can be considered as the composition of media elements into an interactive multimedia presentation. Personalization of such multimedia content means that the content reflects the users' context, their specific background and interest as well as the heterogeneous infrastructure to which the content is delivered and in which it is presented. However, in this work, the proposed scheme is not evaluated in manifesting user expectation and content accessibility.

In [17] multimedia services such as media retrieval, transcoding, scaling, and display services are combined based on the preferences of the user to create Video-on-Demand multimedia service. But, in

this work, content accessibility in case of context utilization specifically rather than adapting network characteristics is not addressed.

There are some limitations in the reviewed related works. There is no systematic approach that takes different types of context into consideration at the same time. Most of the approaches use only specific adaptation method, instead of a variety of adaptation methods for different contexts. There has been some research on adapting multimedia content to achieve the characteristics of networks and devices, but adaptation of user experiences and content accessibility needs have been rarely addressed. In this paper, adaptive multimedia content repository framework that focuses on addressing this gap is proposed.

3. The Proposed Solution

A multimedia service delivery should be able to be published, discovered and consumed like any other Web service. However, there is a major difference between multimedia service delivery and an ordinary Web service in the way that the data is transmitted between the two endpoints. A multimedia service delivery involves multimedia content. If the size of the multimedia content is small, it can be delivered as a binary attachment within the response.

However, if the size of the content is large, it will not be possible to transfer it in its entirety within the response. For massive multimedia content, it is appropriate to have an adaptive content framework capability between the two endpoints of the multimedia service delivery.

3.1 The Proposed Architecture

Figure 1 shows the adaptive multimedia content repository framework that is proposed according to service oriented architectural component-based approach. It consists of multimedia content adaptation manager and adaptive content presentation panel. As a sub-architectural component multimedia content adaptation manager has three components: content synthesize, content synchronization and adaptation control.

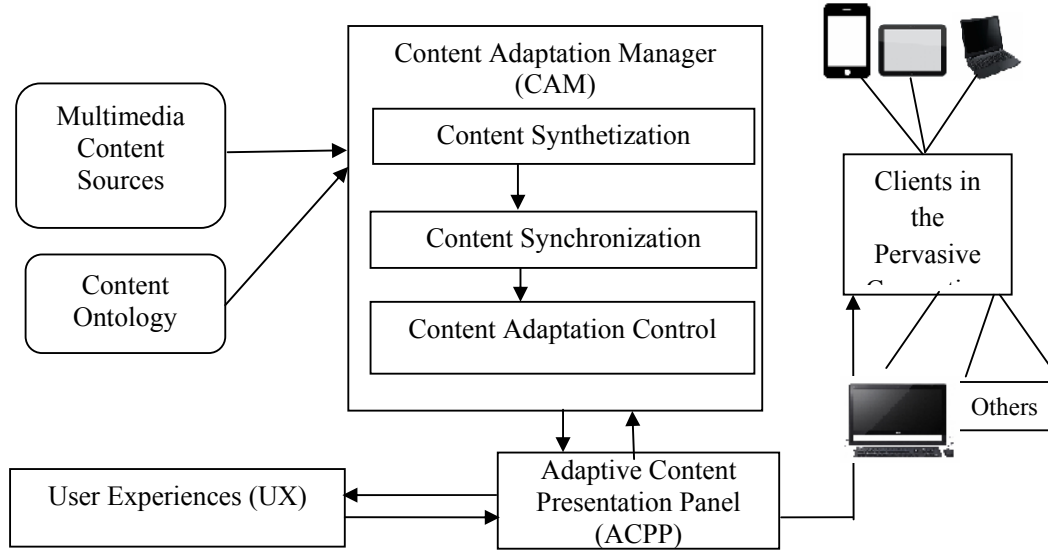


Figure 1: Adaptive Multimedia Content Repository Framework (AMCRF)

A. Multimedia Content Adaptation Manager

Multimedia content adaptation manager is composed of three sub-architectural components: content synthetization, synchronization and adaptation control. This component mainly acts as core engine of multimedia content adaptation to enhance multimedia content delivery. Each sub-component is described below.

i. Content Synthetization

To enhance multimedia repository service delivery in line with user preference, multimedia content should have to be analyzed and synthesized. Our main target is to provide a more efficient tool for multimedia content navigation. To synthesize multimedia content, we intended to use two components (levels) such as semantic content and multimedia relationship objects (for instance, key frames, video clips, shots, scene and audio). Therefore, transmission of the synthesized multimedia content stream usually requires much less bandwidth than the original content since redundant information in the background does not have to be transmitted. Key frames corresponding to highlight segments in a video sequence are organized in a hierarchical structure to facilitate efficient browsing. The structures in the hierarchy can be based on temporal semantic classification.

ii. Content Synchronization

Multimedia content synchronization is a process of coordinating multimedia content along three alignments: multimedia object's relationship, space and time. Automatically, it optimizes multimedia content matching. It addresses the convergence of networked and multimedia content combined with the increased use of continuous, time-based objects.

iii. Content Adaptation Control

This sub-component is intended to address client-based multimedia content adaptation to achieve user experience (see Figure 2). Most of the current studies state that there is a gap in addressing client-based content adaptation due to the complexity of multimedia objects' feature. Thus, it is targeted to attempt the adaptive multimedia content delivery. It is mainly focused on the interaction of user and multimedia content which are available on the client-side to adapt to user preferences and content accessibility needs.

a. Content Accessibility

To achieve user expectation in case of content access, multimedia content accessibility is an essential aspect of multimedia repository service delivery. So, to obtain seamless access of multimedia content via heterogeneous environment efficient allocation of contexts of content is significant. Thus,

to provide this perspective some features of content accessibility are attempted as follows.

Context filter: To improve multimedia content access context filter is necessary as a functional requirement to achieve user's accessibility needs (e.g., special content access

user, deaf user, blind user) and adaptation of user preferences in case of what adaptations are preferred under different circumstances.

Context Protection: Context protection is required to address content authority feature to achieve content privacy access.

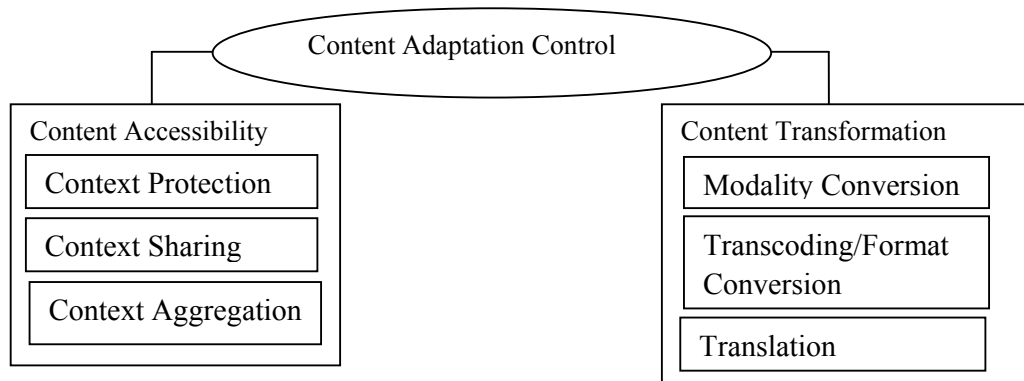


Figure 2: Multimedia Content Adaptation Techniques

Context Sharing: It is to enhance multimedia content in terms of user's content access expectation with other users across other platforms like social media networks (Twitter, Facebook, etc.) through context of multimedia content rather than sharing the whole content.

Context Aggregation: is used to provide content cross referencing in case of combining within randomly consecutive multimedia context of content through time space and with other multimedia content sources via URL. It is essential to enrich multimedia content cross referencing which is very common with text format document processing like word, pdf and others. Regarding multimedia content, for instance video content is composed of video scenes which are arranged consecutively according to time space, so it is possible to aggregate one part with other.

b. Content Transformation

Content conversion or transformation is used to define the process of transforming content (for instance audio to text, etc.) without changing the representation of the content (e.g., audio, video) rather than format conversion (gif to jpg, AAC to

MP3, etc.) to achieve user preferences, devices and network characteristics constraints.

Modality Conversion: also known as content transmoding transforms content from one modality to another. In our framework it is used to achieve pervasive access of multimedia content according to realized constraints such as user preferences, devices and network characteristics. It addresses content representation change (audio to text, etc.).

Transcoding/Format Conversion: Content format conversion is essential to convert content from one format to another (gif to jpg, AAC to MP3, etc.) to facilitate user's consumption of content using their preferred aspects by selecting the most suitable transcoding operation from multiple alternative options.

Translation: It is used to achieve user preference in terms of multimedia content to transform content from one to another language.

B. Adaptive Content Presentation Panel

Multimedia adaptive content presentation panel is a means to handle what and how to present (deliver) to the user according to user preferences and

accessibility needs. It deals with the taxonomy of multimedia content. Formally, it is used as terminal client application interface that assists the delivery of multimedia content repository in pervasive computing environment. Within this architectural component, resource description framework (RDF) is used in enriching multimedia item description based on semantic qualification method (for instance, metadata description).

Most of the current research indicates that client-based multimedia content adaptation is challenging due to the complexity of multimedia objects features. That is why we focused on this sub-component as a container panel to enhance multimedia content repository presentation scheme.

4. Implementation and Experimental Results

An adaptive multimedia content repository system is developed based on user experiences. In this section, we present different tools and technological development environments that are used to develop the prototype. In addition, concept of ontology

construction and screen shots are presented to show the outputs and the user interface of the system. Finally, we have evaluated our design framework based on the experimental method using multimedia digital resource collections of UNECA.

a. Ontology Creation

In distributed computing, the concept of ontology is the working model of entities and interactions in some domain of knowledge applications. We have created audio-visual conference domain ontology to show how concept formulation is done through ontology based concept synthesis.

b. Prototype

A prototype is developed to show the validity of the proposed adaptive multimedia content repository framework. User interface facilitates a user to access and process multimedia repository according to adaptive content scheme as shown in Figures 3.



User intends to filter a specific context according to its needs from the coordinated content.



User is accessing the specific context

Figure 3: Contextually Coordinated Multimedia Content Access

c. Evaluation

Once the prototype is developed, it is evaluated to show the validity of the framework in addressing adaptive multimedia content repository service delivery. Thus, it has been tested on different network characteristics (for instance, wireless connection), devices and other circumstances. User

reviews are collected to evaluate the prototype by UNECA multimedia Institutional Repository staff. The results shown in Table 1 have been obtained. The aim is to check if the prototype's functionality is correct or not. If its functionality is not correct, the prototype needs some improvement.

Table 1: Evaluation Result

No.	Functionality	No. of times functionality is tested	No. of times correctly functioned	Percentage
1.	R1	11	9	81.8
2.	R2	25	21	84
3.	R3	23	19	82.6
4.	R4	18	14	77.8
5.	R5	19	13	68.4
6.	R6	24	20	83.3
7.	R7	16	15	93.8
8.	R8	27	20	74.1
9.	R9	22	19	86.4
<i>Total</i>		<i>185</i>	<i>150</i>	<i>81.1</i>

It has been checked 185 times by 35 UNECA multimedia Institutional Repository staff under different situations in different times. The evaluation criteria are provided to evaluators in the form of questionnaire which they used to evaluate the effectiveness of the prototype. It has been performed based on the percentage of user satisfaction in terms of user preferences and content accessibility requirements which are stated as follows.

R1 (Variability): Multimedia content is contextually variable and clear in addressing content adaptation to realize user preferences and accessibility need.

R2 (Understandability): Multimedia content is understandable and usable.

R3 (Cohesiveness): Multimedia content is contextually connected with the semantic content to enrich utility need.

R4 (Discoverability): Content discovery is clear, findable and related to the actual content.

R5 (Accessibility): The multimedia content feature or approachability of being at hand when needed is addressed well in terms of content access.

R6 (Utility): Content usefulness is used to provide user satisfaction in case of access need.

R7 (Scalability): Multimedia content is scalable in terms of pervasive content access.

R8 (Recoverability): Content recovery is clear, reusable and related to the actual content.

R9 (Serviceability): Multimedia content is contextually useful for functional requirements regarding content accessibility need.

In some functionalities, like “R7”, the evaluators’ evaluation of the prototype is efficient in addressing this functionality. In other functionalities, for example “R5”, the prototype is not that good in approachability when needed according to preference and content accessibility need.

Out of 185 attempts to determine the functionality of the prototype, it has correctly satisfied the evaluator’s preference and content accessibility need in 150 of them which makes it 81.1% accurate. The functionality that has been incorrect is about 35 out of the 185 attempts.

5. Conclusion

In this paper, we proposed an adaptive multimedia content repository framework based on component oriented service architectural approach for the improvement of multimedia repository content to address user experiences requirement in pervasive computing. As a service architectural model, it is composed of multimedia content adaptation manager and adaptive content presentation panel. Multimedia content adaptation manager is initiated as content adaptation engine in optimizing effective multimedia service provision. It has three sub-components: content synthetization, content synchronization, and adaptation control.

To evaluate our modeling scheme, we developed a prototype. It has been evaluated using different

evaluation criteria and it has been found to be 81.1% accurate.

This research work discovers different contexts of multimedia content that can be further adapted as well as some components that should be implemented and integrated for better accessibility of content. Accordingly, dynamic content customization of multimedia content services delivery in line with the aspect of content security features and quality of services optimization techniques are future works.

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A Predictive Model to Determine Mobile Banking Customers: The Case of United Bank

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Abstract

In Ethiopia Mobile banking (M-banking) has been offered by various financial institutions, including private and public banks. However, M-banking in Ethiopia is not widely used and accepted as in other African countries. Accordingly, the study of M-banking in Ethiopia focuses on factors affecting adoption of E-banking in Ethiopia. Different factors are mentioned and discussed with different researchers. This paper aims to build a model to predict potential M-banking customers in the case of United Bank, identify significant attributes based on the bank's historical data using data mining techniques with various classification algorithms such as BayesNet, Naïve Bayes, IBK, KStar, PART, J48, and RandomForest and to recommend appropriate actions to be taken to promote Mobile Banking in Ethiopia. These algorithms are selected based on literature review and discussion with experts. Data are collected from two disparate databases on M-banking to identify registered customers and core banking to identify non registered customers and different transactions provided by the bank. The Mobile transaction attribute is used for the domain knowledge or class label. Stratified random sampling was used to collect unregistered and registered but not use the service from 109 branches of the bank since this sampling technique is more precise and represents the data. A total of 3000 customers are identified with 14 attributes. A total of 7870 instances or datasets was prepared and fed into the WEKA tool for experimentation. The experiment was done in two phases, the first with 10 fold cross validation and the second one with 75/25 percentage. Model evaluation was done by accuracy rate and ROC. According to the comparison made on the classification algorithms, seven algorithms are selected to build the model. Among those algorithms, PART from Rule is the best and has value of 79.75% accuracy and ROC Area 0.837. Account to account is a significant attribute. This is followed by loan repayment and telegraphic transfer. Then a prototype is developed. Based on the prediction model, the bank can easily identify customers that are potential users of mobile banking services.

Keywords: Mobile Banking; Electronic Banking; Data Mining; Classification; Model; Prototype

1. Introduction

Recently banks have developed innovative products and offered a wider range of services in an effort to increase customer satisfaction and efficiency. Therefore, banking services are being presented through electronic delivery channels. Electronic-banking offers banking services via various electronic channels. Electronic banking is becoming the main tool for bank services without needing the physical presence of customers. E-Banking is a means of

banking service where funds are transferred through electronic devices between financial institutions and individuals instead of cash exchange, checks, or other negotiable instruments E-banking, also known as electronic funds transfer, uses electronic media to transfer funds directly from one account to another. The term E-banking often refers to online banking or Internet banking which is the use of the Internet as a remote delivery channel for banking services. With the help of the Internet, bank services are available anywhere, customers all over the world can access

bank services 24 hours a day, seven days a week. E-banking can be also defined as a diversity of platforms such as Internet banking, TV-based banking, mobile phone banking, and PC (personal computer) banking whereby customers access these services using an intelligent electronic device, like PC, ATM (automated teller machine), and POS (point of sale) [11]. The most important channels are: the Internet, wireless connection systems, ATM (Automated Teller Machine), telephone, etc. [2].

When we see the history of E-Banking, it started in the use of ATMs. Finland is the first country in the world to use E-Banking [4].

Among various E-banking channels, due to its convenience, familiarity among the society, and easy to use, mobile banking is a powerful channel to deliver banking services to billions of people.

Mobile banking also means performing banking activities which primarily consist of opening and maintaining mobile/regular accounts and accepting deposits. Furthermore, it includes performing fund transfer or cash-in and cash-out services using mobile devices [12].

Mobile banking is classified into two. The first is transformational mobile banking, which is the provision of banking services using a mobile phone to reach the population that do not have a bank account instead use a phone as an account. The second is additive Mobile banking, in which the mobile phone is simply an additional channel that is used to provide banking services to those who have bank accounts [13].

According to [7] through mobile banking a customer can operate his/her account from office or home. The need for going to the bank in person for every single banking activity is reduced. It eliminates the need to wait long queues for the reason of bill payment, most, if not all, services that are usually accessible from the local bank can be found in a single handset, sharp growth in credit card or debit card usage can be credited to Mobile banking. A customer can shop globally without any need for

moving paper currency. In M-banking, banks are available 24 hours a day and 7 days a week and are just a finger click away.

For the banks, the main advantage of the mobile phone lies in its capabilities to reach everywhere. Its influence is transforming the economics of service delivery, especially by reducing the costs of financial transactions worldwide. In addition, it has the potential to significantly increase people's access to finance. In South Africa, the Democratic Republic of Congo, Zambia and Kenya, for instance, mobile banking is taking services to remote areas where conventional banks have been physically absent. People can now open accounts, check their balances, pay their bills, and transfer money [1].

Despite its expansion around the globe, specifically in Africa, the services provided by Ethiopian banks are not attractive and the penetration is not fast as in neighboring countries.

Since 2009 United Bank started M-banking services such as SMS and telephone banking, but the service was not successful due to user unfriendly and complex commands in the case of SMS banking. Since July 2013, due to the innovation of new mobile banking technologies like USSD (Unstructured Supplementary Services Data), the bank replaced its previous version with the new one. The innovation of new technologies came with additional features of SMS notification for each transaction, fund transfer, Forex rate and min statement inquiry.

However, we observed some problems with the services provided by the bank. M-banking is the main service having more registered customers following ATM users. Despite the number of registered customers, the service is accessed by few. Thus, this research tries to explore and predict potential customers of M-banking based on data mining techniques and various classification algorithms with the bank's historical data [4].

2. Related Work

When we see related works on the challenges of E-banking, different researchers mentioned challenges

in the adoption of E-Banking in Ethiopia. These are chances of risk, lack of trained and efficient staff in e-banking, lack of appropriate legal and regulatory framework, absence of financial networks that link different banks, low level Internet penetration and poorly established telecommunication infrastructure, high cost of Internet, and security issues. In addition, lack of customer awareness regarding the service is another challenge in order to provide the service [3].

The work in [8] investigated E-Banking customers using data mining techniques and under clustering they used K-means algorithm. The objective of was to find valuable customers and their usage behaviors in order to add new products or services to meet customers' needs. According to the findings, daily E-banking concurrent access increased between 12.00 - 17.59 PM that impact the system to serve all resulting with slow response.

Data collected from September and October 1999 in University of Michigan's Survey of consumers also found that age and education have an effect on the use of electronic banking products [6]. The study of 1,000 US households evaluated attitudes toward electronic banking. The paper concludes that positive attitudes to e-banking services matter more than demographic factors in determining whether such services are used.

The work in [9] investigated the extent of the adoption and usage of M-banking services among banking customers in Nigeria and the associated problems. The finding shows that M-banking was more established than Internet banking and ATM services, but ATM services have a wider reach.

Research on the effect of e-banking service on deposit mobilization was conducted by Hailu Biza [10]. The paper concluded that mobile credit and card credit transactions have a great impact on deposit mobilization.

There have been a number of valuable studies in the area of mobile banking over the years. Almost all focused on finding the challenges of adoption of E-banking in Ethiopia. No one investigated or predicted potential M-banking customers so far. The existing

research in Ethiopia included mobile banking in electronic banking challenges and barriers [3, 5, 10]. To the best of our knowledge, there is no study conducted with regards to potential M-banking customers in Ethiopia. This study, therefore, aims at predicting potential M-banking customers in order to increase usage of M-banking services and to create an understanding of this new technology in the banking sector as well as the society.

3. The Proposed Solution

According to the work in [7], there are no security and dysfunctional issues mentioned by commercial banks in Ethiopia. In this paper we tried to predict potential M-banking customers of the bank based on historical transaction with the help of data mining techniques and classification algorithms. Then a prototype is developed. The overall objective of this study is to design a model to predict M-banking potential customers, identify the core attributes of transactions using data mining techniques and identify the best model. To do this 7870 instances and 14 attributes including the target class were input into WEKA tool. After using InfoGain Attribute EvalAttributes we found 7 Account to account, 8 Loan-repayment, 6 Telegraphic-transfer, 12 Inhouse-checke Deposit, 11 CPO, 3 Cheque-Withdrawal, 10 Inward-Clearance, 5 Fund transfer-Incoming, 13 Other Bank-RTGS, 4 Fund transfer-outgoing, 1 outgoing-RTGS, 2 Cash-Withdrawal, and Time-Deposit.

Seven algorithms were used for experimentation namely, BayesNet, NaiveBayes, IBK, KStar, PART, J48, and RandomForest. Accuracy, ROC and Confusion matrices were used to choose the best model. Finally, to help the bank to predict customer potential, a prototype is developed. The prototype has a database connection that helps to maintain attributes and rules revealed from the best model.

In general, the bank can use the prototype to predict mobile banking customers and take appropriate measures regarding M-banking service provision.

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To achieve the main and specific objectives of this paper, the significant transaction attributes or parameters collected from the bank are used to build the predictive models based on data mining technique and different classification algorithms. We achieved an accuracy rate of 79.75%. The research questions and the findings are the following.

a. What type of transaction is most important to predict Mobile banking potential customers?

‘Account to Account’ transaction is the most important to predict customer potential. Loan repayment and telegraphic transfer transactions come next. These three are the main transactions that can be accessed by mobile channels. Customers also want to know their loan status, monthly repayment amount, loan repayment date, outstanding loan, and transferring money from one account to another. To perform the above mentioned activities, Mobile banking services are more suitable.

b. Which data mining algorithms can best classify customers based on the transaction data?

Based on the comparison made on classification algorithms, seven algorithms are selected to build the model. Among those algorithms, PART from rule classifier is the best and has accuracy of 79.75% and ROC Area of 0.837 followed by RandomForest with accuracy of 79.63% and ROC Area of 0.84, then J48 with accuracy of 79.61% and ROC 0.818. We are unable to compare the result with similar works done by other researchers, since there are no researches done on potential customers using historical data with data mining techniques. The result shows that rule and decision tree classifiers predict customer potentiality better than other classification algorithms in terms of accuracy and ROC area.

c. How can a best predictive model be designed to predict potential e-banking customers?

Predicting customer potentiality is applied based on data collected and data mining techniques. In addition to this, a prototype is developed to predict

customer potentiality. Based on this prediction model, The organization can easily identify potential customers. It helps to identify target customers in order to set quotas for each branch based on those identified significant attributes rather than newly opened accounts to build strategic follow up techniques to follow the status of service activities. For example, Account to account transfer, loan repayment, and telegraphic transfers are the most significant attributes to identify potential customers so that they can identify such customers from the core banking database and check whether all those potential customers are registered and use services actively or not and should take appropriate measures in order to address them.

Figures 1 to 3 show screenshots of the developed prototype.

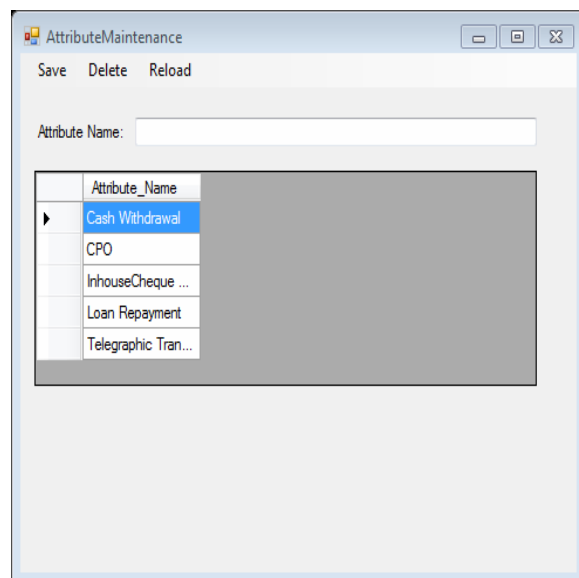


Figure 1: Attribute Maintenance Interface

This interface is used to maintain, modify, and remove new and existing attributes, since attributes may increase in number or changes in type.

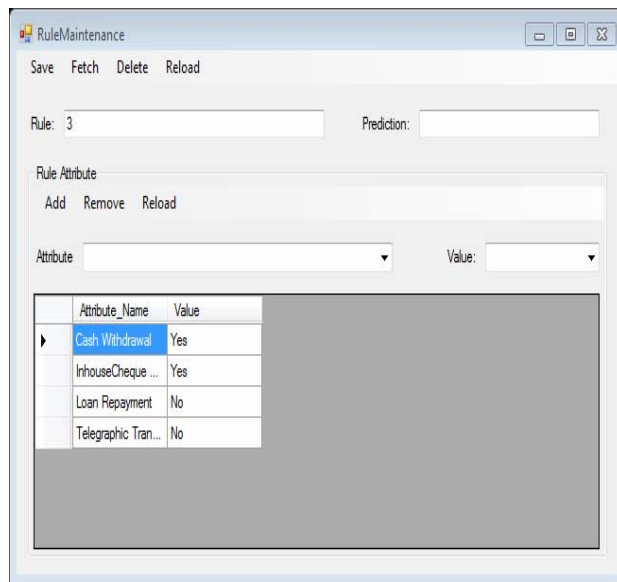


Figure 2: Rule Maintenance Interface

The interface shown in Figure 2 is used to maintain each rule in the database. A new rule can be maintained and the existing ones can be modified and deleted using this interface.

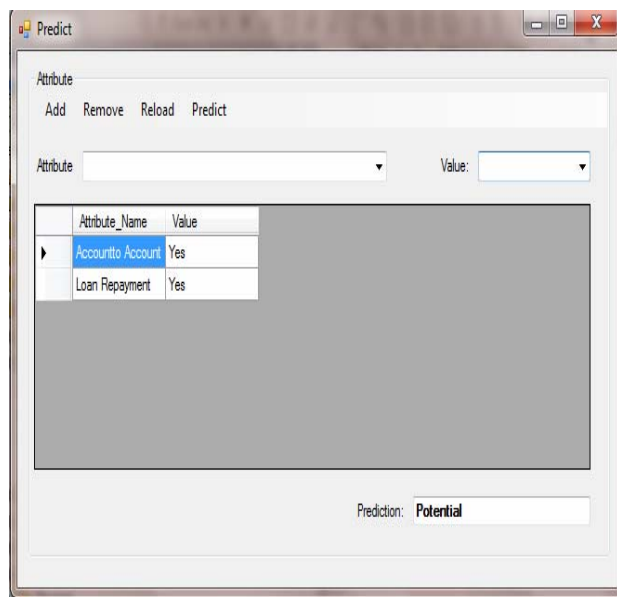


Figure 3: Rule Prediction Interface

Rule prediction will be done by selecting attributes with the corresponding value in the Gridview then click the Predict main menu, then the system automatically displays a Customer Potentiality on the prediction text box as shown in Figure 3.

5. Conclusion and Recommendations

In this paper, we tried to see unseen or predict potential M-banking customers of the bank based on historical transaction with the help of data mining techniques and classification model. In addition to this, a prototype is developed.

7870 instances and 14 attributes including class label are input to WEKA tool. The algorithms used for experimentation were BayesNet, NaiveBayes, IBK, KStar, PART, J48, and RandomForest. The attributes are selected based on expert decision and branch transaction observation. Accuracy, ROC and Confusion matrices were used to select the best model. PART was selected as the best model with accuracy of 79.75% and 0.837 ROC.

Based on the result, account to account has significant contribution to predict customer potentiality. Moreover, loan repayment and telegraphic have significant impact for the service following account to account.

Finally, in order to achieve the bank's objective of customer retention, the bank should work with potential customers. To help the bank to predict potential customers, a prototype is developed. This prototype has a database connection that helps to maintain attributes and rules.

In general the bank can use this prototype to predict potential customers and take appropriate measures regarding M-banking service provision.

We recommend the following:

- Employees of the bank have to understand the benefits of the M-banking product and work more on awareness creation.
- Employess of the bank should identify potential customers based on the developed interfaces, then address each customer to promote the services and to make customers more aware of M-banking services.
- Bank Association, NBE and all financial institutions should work together for awareness creation of the society regarding M-banking services.

- The bank should make capable internal staffs by enforcing them to use the services in order to make a good support to customers.
- To make research based on personal information data, the bank should incorporate appropriate information on the application forms since current registration techniques lack personal detailed information.
- The bank should identify the most used channels and services accessed by customers to plan accordingly.

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