ABUBEKER SEID ALI
A FRAMEWORK FOR LOCALIZATION OF OPEN SOURCE APPLICATIONS FOR INDIGENOUS ETHIOPIAN LANGUAGES: A CASE STUDY ON AMHARIC
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ADDIS ABABA SCIENCE AND TECHNOLOGY UNIVERSITY

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A MASTER'S THESIS

BY

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DEPARTMENT OF SOFTWARE ENGINEERING

COLLEGE OF ELECTRICAL AND MECHANICAL ENGINEERING

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A Thesis Submitted to the Department of Software Engineering for the Partial Fulfillment of the Requirements for the Degree of Master of Science in Software Engineering.

to

DEPARTMENT OF SOFTWARE ENGINEERING

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Declaration

I hereby declare that this thesis entitled **"A Framework for Localization of Open Source Applications for Indigenous Ethiopian Languages: A Case Study on Amharic"** was prepared by me, with the guidance of my advisor. The work contained herein is my own except where explicitly stated otherwise in the text, and that this work has not been submitted, in whole or in part, for any other degree or professional qualification.

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Witnessed by:

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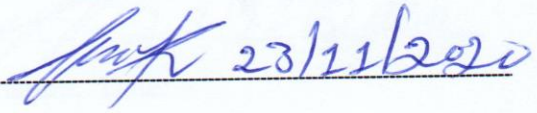
Dr. Kula Kekeba		23/11/2020

Approval Page

This is to certify that the thesis prepared by **Mr. Abubeker Seid Ali** entitled **"A Framework for Localization of Open Source Applications for Indigenous Ethiopian Languages: A Case Study on Amharic"** and submitted as a partial fulfillment for the award of the Degree of Master of Science in Software Engineering complies with the regulations of the University and meets the accepted standards with respect to originality and quality.

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Abstract

Open Source Software (OSS) provides a numerous advantage for developing country like Ethiopia. It gives privileges to use, copy, study, modify and distribute with free or negligible license fee. For multilingual and multicultural country, localization has a vital role to create and build local digital society. Localization of an OSS web application provides an opportunity to deliver information or services to a target local customers in their own language and cultures. This research focuses to study and develop appropriate framework for localization of an OSS web-based application (WBA) user interface into Amharic language. Low in cost, accessing source code and freedom to study/modify are the main reasons to choose and study OSS WBA. In addition, local Amharic speaker societies should not be mandatory to learn/know English language before accessing and using a WBA. Because most commonly the OSS projects are design and developed for English language speakers and their cultures. Language and cultural barriers have become the critical challenges to use an OSS WBA for local business in Ethiopia. This is especially true in rural areas, where native Amharic language speakers who cannot read or understand the English language. Localization is the process of adapting a web application to a particular local target language and culture. Localization framework is used to localize a WBA into a target local language; and in order to make localization easy. Although in the previous studies different localization frameworks are developed which are used for European and Asian languages and cultures. But those frameworks are not directly applicable for Amharic language, because a language and its local cultural issues are different from those countries. The literature analysis method is used to identify and analyze relevant localization issues, components and procedures of web application localization. In addition, literature analysis also used to explore and analyze the contents of a WBA user interface (UI) and the Amharic language content formats and cultural issues. The purpose of this research is to investigate and design a framework for localization of an OSS WBA into Amharic language with special focus on UI contents. It can help Amharic speakers to access and retrieve the web application resources using their own native language.

Keywords: WBA, Localization Framework, UI, Open Source Software.

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List of Abbreviations and Acronyms

AH	Anno Hegira /Hijra
AM	Anti Meridiem
CMS	Content Management System
DPS	Desktop Publishing Software
DT	Daytime
E.C	Ethiopian Calendar
EAT	East Africa Time
EULA	End User License Agreement
FOSS	Free and Open Source Software
G.C	Gregorian Calendar
GMT	Greenwich Mean Time
LISA	Localization Industry Standard Association
LSP	Localization Service Provider
NT	Nighttime
OSI	Open Source Initiative
OSS	Open Source Software
PM	Post Meridiem
QSAE	Quality and Standard Authority of Ethiopia
TOS	Term of Service
UC	Unicode Consortium
UI	User Interface
URL	Uniform Resource Locator
WBA	Website or Web Based Applications

CHAPTER ONE

1. INTRODUCTION

1.1 Background

The number of Internet users in African countries including Ethiopia has been growing rapidly as different government organizations and private businesses had started to develop and use their web-based applications as a means more interactive medium. Table 1.1 below shows that the number of Internet users in Ethiopia is increasing rapidly [2]. A number of government institutions as well as private industries and/or business companies are using their website and web-based applications (WBA) to communicate and deliver their services and products to their customers. However, due to lack of properly localized and customized web applications, a number of local users cannot read and use most of the online services [3]. Localization and customization of OSS web-based applications have a certain advantage over commercial software especially for multicultural and multilingual countries like Ethiopia [4] [5]. Most open source website applications are available for free or with negligible license fee along with source codes and resource files that can be easily customized and localized. Since most OSS web-based application has been predominantly designed and developed for English speaking countries, the challenges of language and cultural barriers have become a critical bottleneck for local business in Ethiopia. This is especially users, where native speakers of Amharic and other indigenous Ethiopian languages who cannot read and understand English language have been marginalized and ignored. In order to enable the majority of communities and local customers to use online services, WBAs should be localized into local indigenous languages and cultural preferences. These will have not only a positive impact on the user's attitude that can affect intention to use and trust online services but also may improve the usefulness and quality of a web application. WBA localization is the process of adapting or translating an application to a specific locale's language, culture, and legal requirements [1]. In many cases, localization will require modifications to the user-visible components of an application such as the user interface, images and documentation. Localization framework is used to localize a web application into a target local language; and to make localization easier.

The writing language fonts, characters and symbols, punctuation marks, Date and time, calendar, currency, address format, name and title, sort orders, abbreviations and capitalizations, etc. are the contents and content formats of a particular local language and cultural issues that are found in a website's user interface. However, existing web-based application contents including the OSS language content, contents layout and cultural formats are commonly designed and developed for European language like English and their cultures. As a result, local users are facing a critical problem in accessing and retrieving relevant information from local businesses and government web applications due to language barriers and cultural differences. Hence, there is required for localization of open source web application in Ethiopia into local languages and cultural preferences.

Currently, most of online information services and products from local websites are delivered using English, a foreign language that most of the indigenous communities cannot understand. In multilingual and multicultural African Countries like Ethiopia, where English is not a native language, there is a pressing need for localization of online interfaces and contents. In most parts of Ethiopia especially in rural areas, there are Amharic speakers who cannot read and understand English properly. Due to language barriers and cultural differences, accessing web contents in English language and western cultures have become a critical challenge for local users.

A number of earlier studies, researchers R. Cermak and Z. Smutny [6] and S. Qi, C. Ip, R. Leung and R. Law [7], had showed that to evaluate the effectiveness, usefulness and quality of a website, we need to consider the following dimensions: These are:

- Ease of use and easy to understand,
- Attractiveness and accessibility,
- Entertainment value, navigability and playfulness,
- User friendliness and responsiveness,
- User satisfaction and reliability,
- Security and functionality.

These dimensions have a major impact on the user's attitude that can affect the intention to use and trusts of the websites. These factors also furthermore reflect how customers can easily learn, understand and memorize to use a website.

The important concepts that are identified in the previous research studies shows that the most of website evaluation diminutions are directly related to the design of the website and its language contents, content formats and cultural values. Web application designer/developer should have been given an advance concern, during designing and localizing a website, about content formats including local user's language and cultures. The design and localization principle indicates that the proper use of local language fonts, symbols, number formats, punctuation marks, date and time, calendar, address format, name and title, sort orders, abbreviations, capitalization, color, multimedia, etc. increases a website usefulness, effectiveness and quality.

Furthermore, localization processes can increase the website usefulness, ease of use, ease to understand, accessibility, customer satisfactions, memorize and attractiveness. Localization of OSS offers numerous values for native society and a country, such as economical, can build IT infrastructure in local language, can creating and accessing digital resources in local language, provides opportunity to develop local language and cultures, increases the capacity of local software companies, facilitates to easily spreads and delivers e-services for rural area users, etc. The research attempts to design a framework to localize an OSS web based application user interface contents into Amharic language and cultural preference.

Table 1.1 Sample Africa Internet Usage, 2020 Population Stats and Facebook Subscribers [2]

AFRICA 2020 POPULATION AND INTERNET USERS STATISTICS						
Africa	**Population (2020 Est.)**	**Internet Users 31-Dec-2000**	**Internet Users 31-Dec-2019**	**Penetration (% Population)**	**Internet Growth % 2000-2020**	**Facebook Subscribers 31-Dec-2019**
Algeria	43,851,044	50,000	25,428,159	58.0%	50756%	19,000,000
Angola	32,866,272	30,000	7,078,067	21.5%	23,493%	2,244,000
Benin	12,123,200	15,000	3,801,758	31.4%	25,245%	920,000
Botswana	2,351,627	15,000	1,116,079	47.5%	6,455%	830,000
Burkina Faso	20,903,273	10,000	3,704.265	17.7%	36,942%	840,000
Burundi	11,890,784	3,000	1,154,568	9.7%	38,385%	450,000
Cabo Verde	555,987	8,000	352,120	63.3%	4,302%	240,000
Cameroon	26,545,863	20,000	6,128,422	23.1%	30,542%	2,700,000
Central African Rep.	4,829,767	1,500	655,466	13.6%	43,597%	122,000
Chad	16,425,864	1,000	1,027,932	6.3%	102,693%	328,000
Comoros	869,901	1,500	178,500	20.5%	11,800%	178,000
Congo	5,518,087	500	732,800	13.3%	146,460%	732,000
Congo Dem. Rep.	89,561,403	500	7,475,917	8.3%	1,495,083 %	3,117,000
Cote d'Ivoire	26,378,274	40,000	11,953,653	45.3%	29,784%	4,758,000
Djibouti	988,000	1,400	548,832	55.5%	39,102%	211,700
Egypt	102,334,402	450,000	49,231,493	48.1%	10,840%	42,400,00
Equatorial Guinea	1,402,985	500	356,891	25.4%	71,278%	100,000
Eritrea	3,546,421	5,000	293,343	8.3%	5,766%	21,000
Eswatini	1,160,164	10,000	665,245	57.3%	6,552%	255,000
Ethiopia	114,963,588	10,000	20,507,255	17.8%	204,972%	6,007,000
Gabon	2,225,734	15,000	1,307641	58.8%	8,617%	743,000
Gambia	2,416,668	4,000	442,050	18.3%	10,951%	370,100
Ghana	31,072,940	30,000	11,737,818	37.8%	39,026%	4,900,000

Table data from [2] in

1.2 Statement of the Problem

The main purpose of Web application is a communication channel between the organization and the target customers. However, since most of the web application in Ethiopia have been designed for English language speakers, the problem of language and cultural barriers has become a critical bottleneck. This is especially true in rural areas where native speakers of Amharic and other indigenous Ethiopian languages who cannot read and understand English language have been marginalized in a virtual environment. For web-based communication to be effective, the contents and content formats of a web application

must be clear and easy to understand by local customers. Web-based application of OSS is considered as a product with open source codes and resource files that can be easily adapted, customized and localized. As indicated earlier, they don't support local indigenous languages and cultures.

There are localization frameworks which are designed and developed for most of European and Asian languages. But most of the previous localization frameworks were focused on designing and apply to Europe countries language such as Spanish and French as well as Asian languages like Dari, Urdu, Thai, Vietnamese, Hindi, Marathi, Kannada and Arabic languages and cultural contents [4], [12] and [8]. Unfortunately, the localization frameworks that had been developed for European and Asian languages cannot directly applicable for Ethiopian Amharic language.

Obviously, the ability to access and retrieve web content should be independent of any language and culture. Local users and business customers should not be forced to learn English in order to use online information resources and services. One of the best strategies to resolve the problems of language barriers and cultural differences is localization. Accordingly, the aim of this research is to develop a general framework for localization of open source web-based applications focusing on user interface contents into the Amharic language to make them more culturally relevant for local communities in Ethiopia.

1.3 Research Questions

This research will attempt to investigate and address the following research questions:

RQ1: What are the major issues and challenges to localize the OSS WBA into Amharic language and culture?

RQ2: What are the main OSS web applications UI contents to localize into Amharic language and its cultural preferences?

RQ3: Which type of procedures and techniques are suitable to develop a framework for localization of OSS WBA user interface into Amharic language and culture?

1.4 Objectives

1.4.1 General Objective

The general objective of this study is to identify and analyze localization issues, challenges, contents of UI and adopt decision criteria in order to design an appropriate framework for localization and customization of an open source web-based applications UI contents into Amharic language.

1.4.2 Specific Objectives

The specific objectives of the proposed research are:

- To identify and analyze issues and challenges in OSS WBA localization.
- To identify relevant contents of user interface for OSS WBA localization.
- To explore and adopt appropriate decision criteria for OSS WBA localization applicable.
- To build a suitable framework for localization of OSS web applications into Amharic language.
- To evaluate the performance of the developed framework based on the feedback of selected users.

1.5 Significance of the Study

The development of an appropriate general framework to localize an OSS WBA user interface contents into Amharic language and cultural preferences would contribute to a better understanding to localize an open source WBA UI into Amharic language successfully. In addition, enabling local communities to access the web-based application in their own native language, provides an opportunity to develop IT infrastructure (creating digital society) in local languages, support to protect and development of local language and culture, could increases local native customers of an organization by using a localized organization's web application. Furthermore, the results of this study would improves the use of local language and culture in web application which helps to minimize fade out or mixing language (Anglicism) and cultures or traditions.

1.5.1 Application of Results

The beneficiaries from the result of this research study will be companies, organizations and institutions those have web applications to deliver information and services for local customers and software developing companies. Local native Amharic speaker website users will access information in their own local language. The benefits of a research study result are:

- ✓ Local users can learn and teach themselves in their own language to making life better.
- ✓ Improves the use of local language and culture in website application which helps to minimize fade out or mixing language (Anglicism) and cultures or traditions.
- ✓ Reduce the necessity to learn English language for employees/users.
- ✓ Increases the relationship between organizations and customers.
- ✓ Establish job opportunity for linguistic professionals.
- ✓ Increase customers trust and understanding when they get services in local language (For example Invoices or other documents in local language).
- ✓ Reduce dependence on proprietary software (web applications) and developing cost.
- ✓ Reduce the dependence on particular country language and culture to use and access of a website.

1.6 Scope and Limitation

Scope

OSS communities and organizations provide different types of software projects which are free or negligible for license fee and product own costs. Due to some reasons such as non-existent of organized translated term database (glossary terms) centrally in Ethiopia for the software localization purpose, localization needs a mixed type professionals and it requires further more time.

The scope of this research study is only focuses on to localize an open source web application user interface contents into Amharic language. Text to display, menu items, text on buttons, labels, check boxes and message are the common web application UI

contents. This study addresses such type of UI contents by identifying and separating from source file to localize into Amharic language contents and content formats.

Limitations

The general localization process/steps and procedures are complex, in accordance with the type and nature of a project. Mostly it needs multidisciplinary professionals and in addition it requires building the term database centrally. Due to that the stated reasons, this research study restricts to identify an open source web application localization issues and challenges, identify the contents of OSS web application user interface and adapt decision criteria for feasibility to localize an OSS web application. And finally localize the identified user interface contents into Amharic language.

Demonstration

To evaluate and examine the research result, select an appropriate OSS web-based application. Then localize and customize a selected OSS web application to show and demonstrate the final results of this research study.

CHAPTER TWO

2. LITERATURE REVIEW

2.1. Introduction

Generally, there are two particular motives to develop application software which are either Commercial or Free/Open Source Software (FOSS). Proprietary software is designed by organizations for the purpose of business profit with restricted license conditions. They exist only to use the software product, without source code which imply unable to modify, localize, improve and redistribute it. On the other side, FOSS is a type of software which is developed and improved by a group of volunteers from different software developer communities and those may work or lives at different locations (countries). FOSS software source codes are available freely and provide the right to use, access, modify, localize, improve and redistribute. The proprietary software sets restrictions on its use, copying and distribution.

2.2. Free and Open Source Software (FOSS)

The FOSS movement was started by sharing source code between software programmers to improve then back and submit for programmer communities to develop software through coordination in the late 1960 and early 1970 [1]. The idea of open source software (OSS) began at this time. Later, in early 1980, proprietary software was begun which is coming in conflict with freely sharing of source code [1]. This situation was the motive behind to start Free/Open Source Software projects. FOSS is a combination of two ideologies which are "Free Software" and "Open Source Software". Therefore the definition of FOSS derives from these two ideologies. According to W. Zuo, Daoying Qiu & Adriana Markaida definition, Open Source Software (OSS) is "anyone can have access to the source code of open source software, as the source code is open to public and licensed, within the scope of which, people can do anything with the source code including studying, modifying, and distributing" [11]. The researchers also define Free Software that additionally argues the definitions of other researchers, "Free software is more rigorous than that of open source software; Not all open source software can be considered as free software". The researchers indicated the real world situation that majority of open source software's are similar to the definition of free software. The source code of free software can be open to the public. But

definition of free software may not fulfill or satisfy the definition of open source software, since free software may possibly have some restriction and limitation to access the product [11].

Richard Stallman, a programmer at MIT Lab, started the GNU ("GNU's Not Unix") Project to develop a free operating system with free to use its source code at Massachusetts Institute of Technology (MIT) laboratory [9]. In FOSS evolution, there are two basic philosophies that advocate the free software movement and its development progress: Free Software Foundation (FSF) and Open Source Initiative (OSI).

2.2.1. Free Software - Free Software Foundation (FSF)

FSF is a non-profitable organization founded by Richard Stallman in 1985 to encourage computer user freedom and to defend the rights of all free software users [9]. He was the first person to initiate free software movement and established FSF foundation to support the free software movement. According to the FSF, free software is about granting users that the freedom to run, copy, distribute, study, change and improve the software. Free software is any software that provided the following freedoms [12]:

1. The freedom to run the program, for any purpose (freedom 0).
2. The freedom to study how the program works, and adapt it to your needs (freedom 1). *Access to the source code is a precondition for this.*
3. The freedom to redistribute copies so you can help your neighbor (freedom 2).
4. The freedom to improve the program, and release your improvements to the public, so that the whole community benefits (freedom 3). *Access to the source code is a precondition for this.*

2.2.2. Open Source Software - Open Source Initiative (OSI)

OSI was founded in 1997 by Bruce Perens with Eric S. Raymond. They developed an outline of open source code called “The Open Source Definition” (OSD) based on the Bruce Perens free software guidelines which deals on the software development. In open source definition commercial sales of software are allowed and also Copyleft is not mandatory. Copyleft means does not allow to add any restrictions to the license that anyone can redistribute the free software in original or modified form [9]. Free software without

Copyleft allows the user to add restrictions to new distributions of the software. The distribution terms of open source software must fulfill with the Open Source Definition by OSI, which is defined by the following criteria [10]:

1. Free redistribution without royalty requirements.
2. The program must include source code or there must be a well-publicized means of obtaining the source code.
3. The license must allow modifications and derived works.
4. Integrity of the author's source code.
5. The license must not discriminate against any person or group of persons.
6. No discrimination against fields of endeavor.
7. The rights attached to the program must apply to all to whom the program is redistributed.
8. The license must not be specific to a product.
9. The license must not place restrictions on other software that is distributed along with the licensed software.
10. The license must be technology-neutral.

In addition to the above OSS distribution terms the Open Source Initiative (OSI) also defines the basic idea towards the Open Source which is: “The basic idea behind open source is very simple: When programmers can read, redistribute, and modify the source code for a piece of software, the software evolves. People improve it, people adapt it, and people fix bugs” [10].

Advantages of FOSS over Commercial and Proprietary Software

Commercial software is a type of software which is developed by a business organizations and companies which intends for making profit. Commercial software companies release their products without the source code which is restricted to modify, improve and redistribute. The majority of all commercial software is also proprietary, but there is also a number of commercial open source software which is sold with license to end users [9].

Proprietary software is a type of software that is protected by copyright and contains limitation against use, modification, improvement and redistribution which are enforced

by its publisher, vendor or developer. It remains the property of the owner or developer that users and organizations can use with predefined conditions. Proprietary software source code is normally not available [13]. Proprietary software can be commercial software that vendors or software companies sold through licensed without access of source code. But it can be also sold with license fee which can provide the permission/right to use, copy, modify, improve and redistribute the product. The restrictions or conditions on proprietary software are expressed within the software's end-user license agreement (EULA), terms of service agreement (TOS) or other related use agreements [13].

Generally, depending on the type of software distribution license, level of accessing and modifying the source code to improve, modify and redistribute, software can be considered free, open source, proprietary or commercial software.

Open Source Software Advantages

There are three main advantages in the area of OSS development philosophy which are also providing a numerous benefits for developing countries [14, 5]**.** These are:

- Availability of source code
- Low in cost
- Human development

Availability of Source Code: Open source software permits programmers to have full visibility of the source code to study, modify and improve the software. Availability of source code of OSS provides the following benefits [14, 5]:

- *Customization*: - programmers can customize the software for particular needs.
- *Localization*: - local software developers can localize and adapt the software according to local language and culture.
- *Security*: - open source code software can be simple to examine or analyze and test each line of codes before use. It can also improve and add features including their security and quality.

Low in Cost: Open source code is free or low price to download, use and manipulate. In addition to this there are other benefits related to the cost which are [14, 5]:

- *Dependency*: - reduce dependency on proprietary software companies for supply, support, upgrade, maintenance and other services.
- *Free try before buy*: - before paying for complete license of full package source code to use, modify, you can install and check a free version of the software package.
- *Free support*: - open source software communities and developers are available throughout the world to support, advice and training documentation without paying money.
- *Reduce maintenance cost*: - local developers and programmers can study the source codes and communicate with the worldwide open source community and developers to fix bugs and errors and other software maintenance cost.
- *Reduce foreign currency*: - by adapting and customizing an open source software can able to reduce foreign currency that paying for development, licensing, consultancy and software support services. It can also provide a positive contribution for country economic development.

Human development: Software updates, bug fixes, and enhancements are available through a community of developers and customers behind the open source software who review and improve the code, making this model more user-focused. The degree of advantage is based on the activity of the community. The more active the community is, the better the software. The other benefits of working on OSS beside to locale human development (software developers and programmers) are [14, 5]:

- *Improve the capacity* of local software companies.
- *Improve skills and knowledge* of locale developers and programmers.
- *Increase collaboration* work between local programmers and local with worldwide programmers and developers.

The point listed below illustrates the reasons to choose FOSS and they are also disadvantages of proprietary software [4].

- Expensive to license and maintain.
- Dominated by the English language.
- Dependent on proprietary or closed standards.
- Has little or no local support.
- The high cost of the software leads to illegal copying of the software.
- The local software industry is not developed.
- Software cannot be localized or modified.

But almost all FOSS software are designed and developed for English language speakers and their countries cultures because most commonly developers group are organized the volunteers from locally or/and globally for FOSS projects. Web application localization is a key mechanism for translating and customizing an open source web based applications for a particular purpose and for specific local language and culture.

2.3. Web Application UI Contents

Web application is a collection of digital resources which can be accessible using Internet/intranet/extranet connection. Digital resources can be an organization's or a company's information, web contents, links or path, services and others. Oxford dictionary, defines the term website as "a place connected to the Internet, where a company or an organization, or an individual person, puts information". One of the core purposes of website is to exchange information or/and to communicate service providers and their customers. Communication is the main reason that service providers (companies and organizations) use their own website to communicate and deliver services to different local customers. In order to easily use and understand the products or services through web application (communication channel) it should be localized.

Web application have become more important for organizations, companies, individuals, and public or governmental institutions. Web applications are used as information and service channels which companies to provide their services and products for customers. Most web applications' UI contents, cultures and formats (language writing fonts and symbols, Date and time, calendar, currency, address format, name and title, etc.) are designed and developed in English language speaker countries. Information, products and services on web application are mostly delivered using the English language. Countries

like Ethiopia, were English language is not the official language in addition they have also different cultures. Web application user interface (UI) contents, format and cultures become a challenge or misunderstanding when to communicate with local customers (non-English language speaker countries) caused by the language and culture barriers. Researchers R. Cermak & Z. Smutny [6] shows that the effectiveness and quality of websites are consisting of the following dimensions: usefulness, ease of use, entertainment value and complementary relationship [6]. The other researchers S. Qi, C. Ip, R. Leung & R. Law in [7] reviewed and studied different research papers to show and identify characteristics or aspects of website evaluation. They discovered and categorized into three main points. These are website usefulness, website service quality and website physical accessibility [7].

Web application usefulness represents user attractiveness, playfulness and functionality which are referring to how websites are easy to use and also it has an impact on the individual attitude which affects users' intention to use and trust the websites. Website UI content navigability, ease of use, layout and design, playfulness, functionality and accessibility are the main factors to influence the web application usability. These factors furthermore reflect how customers can easily learn to use a web application, understood, controlled and skilled.

Website service quality is the one diminution to evaluate the websites. Researchers recognized some attributes to assess website service quality. Web-marketing strategies and website reliability are the main two factors. In addition to this website customization, responsiveness, consumer satisfaction, reliability and security are contributes to service quality [7].

The points above show that most of websites evaluation diminutions are directly related to the web application UI content design. The web application designer / developer should be given an advance concern during design and localization of WBA user interface contents which specifies about content formats including customers' native language and cultures. The design and localization principle indicates that to design web application UI content strongly advice to include attractiveness, content organization, language and cultural consideration (proper use of fonts, Date and time, calendar, address format, Name and title,

color, multimedia, etc.). Consequently, from the above research articles, to enhance the effectiveness and quality of web applications should be designed or localized with including the following dimensions which are easy to understand, accessible, usefulness, ease of use, entertainment values (attractiveness, satisfaction), responsiveness, reliability, security and complementary relationship.

2.4. Web-based Application Localization

In order to easily use and understand the products or services, organization's website UI (communication channel) contents should be localized. Web application localization is simply the process of adapting and translating contents into the target local societies. Localization has a number of definitions according to different researchers/ professionals, organizations working on localization. Localization Industry Standards Association (LISA) defines localization as "Localization involves taking a product and making it linguistically and culturally appropriate to the target locale (country/region and language) where it will be used and sold". Researchers D. Cyr and R. Lew in [15] defined as "localization refers to content adaptation to accommodate various cultures and cultural preferences it includes language translation and adjusting content to capture the meaning of the message, as well as consideration of various web design features" [15]. The other definition of localization from P. Sandrini: "Localization is the process of adapting a product to a new locale" [16].

As described on the above, companies and organizations provide their information and services for different customers using the web application. Web application is a collection of pages' content, links, information, services and others. Users or customers use web application to search out and access information, products and services from the providers. However, customers may not understand or misunderstand if the language and contents of the web application UI are not localized. In addition to this, studies shows that website users are not interested or decrease the intent to use the web applications which are not localized to their local language and culture.

Usually websites design specifications and designed for English language countries. Its contents, language and culture are influenced by those English speaking countries. In order

to use these website applications in the countries whose language and cultures are different from English speaking countries it needs and apply web application localization.

Web application localization is the process of adapting, translating and customizing a web application for a specific purpose and for specific local language and culture. This includes language translation and adjusting website user interface contents to easily understand the meaning of the message, as well as consideration of web layout, sort order, Date and time, calendar, address format, name and title, number and currency formats, etc.

2.4.1. Web Application UI Contents

Web-based application is composed of different digital resources and contents. These digital resources and user interface contents are the main parts of web application localization. In localization process, one of a basic task is identify what kind of UI content has to be localized. The previous studies are explored contents and formats which are required for web application localization since they are highly sensitive to local culture. The following are some of the UI contents and formats in the web application which are required to consider when localizing [17, 18]:

- ✓ **Language:** Language is the core means that customers get information from a website.
- ✓ **Layout:** Proper design of layout and menu items which are provided for web application visitors to easily understand, accessing information, and efficient communication between a website.
- ✓ **Common contents:** Characters, texts, special characters, images and icons.
- ✓ **Different Formats:** The important elements that represent in diverse ways from different countries. The following are examples which are representing different formats in according to the culture of a local country. These are:
    - ➢ Date and time formats, Numeric and currency formats
    - ➢ Weights and measures
    - ➢ Telephone numbers and address formats
    - ➢ Names and titles
    - ➢ Social-security, national identification, and passport numbers
    - ➢ Sort order formats
    - ➢ Capitalization and punctuation formats

- Local-specific issues such as culturally acceptable or political sensitivity [18].

There are some more aspects involved to localize user interface (UI) contents which are identified and listed by S. Gross [19]. The researcher suggests that commonly user interfaces have to fulfill the following requirements:

- Communication has to be done in the country's native language.
- Country-specific writing symbols (e.g. punctuation) have to be supported. Native display of date, currency, weight scales, numbers and addresses have to be supported. Those attributes are defined in locales.
- Consider how the work environment of the specific country looks and supports people's natural work habits.
- Keep the communication polite and friendly.

2.4.2. Benefits of Web Application Localization

Currently, people who want to use web application must first be familiar with the English language to better understand and to find out what the required information. In a country with low skills in English language, or users who are not learned before faced a challenge to identify and access information easily in the web application. Hence, in order to avoid challenges in language and cultural barrier to access information it should be localized into local language and culture. Localization has the following benefits [4]. These are:

- ✓ Reduces the amount of training for employees to use a WBA system.
- ✓ Make easy to introduce WBA into the local societies.
- ✓ Companies increase the market strategy in different languages.
- ✓ Give an opportunity to employees to work in a local language and manage data in local language.
- ✓ Increase the opportunity and capacity of local software development companies.
- ✓ Provide a job opportunity to linguistic professionals for translation.
- ✓ Communication between customers and companies in the local native language are easy and increase trust.
- ✓ Increase the local customers of the companies.
- ✓ Allows societies to communicate through e-mail in their own language.

2.5. Related Work

Website applications are one of the products offered by the open source software developer society with full authorization to adapt and localize. Website localization principle constitutes of translation, internationalization and globalization. Translation is one the main part of localization. Localization typically refers to the translation and adaptation of software or web product contents and their related documents into a target language [20]. Internationalization, in the localization concept, is the process of ensuring that the software or web product can handle multiple languages and cultural issues in order to making a product easy to localize into different languages [19]. Globalization in the localization context refers to the processes necessary to prepare software products, feature and code design, for international market which can be applicable to many different local languages [20]. Therefore, localization can be the process of translating and adapting an internationalized software product for particular local language and culture.

2.5.1. Localization Steps and Procedures

Localization involves taking a software product and adapting it linguistically and culturally appropriate to the target locale. It is the process of implementing different tasks, methods and procedures which are executing in the pre-localization, on localization and post-localization phases. Those tasks, methods and procedures are important that significantly improve the localize product to making-up excellent usable for the target country. Previous studies and companies/organizations working on software localization explored basic steps/phases or procedures that are required to localize website or software product. For instance, M. Bhatia, et.al [20] reviews the papers which are focused on software localization work proposed nine (9) phases to localize the project. These are, project setup, translator training, terminology definition, user interface translation, test of user interface translation, documentation translation, review of documentation translation, finalization of documentation translation and lessons learned. They are furthermore concluded with the substantial localization process steps, which are: analysis, assessment, creation and maintenance, translation, adaptation, media localization, testing, quality assurance and project delivery [20]. On the other hand S. Gross proposed three major steps to successfully software localization [19]:-

1. Translating all relevant text strings of the user interface and if required the printed documentation can also be translated.
2. Adjusting graphics, colors, menus, text direction to display text correctly and look familiar to users of those cultures.
3. Defining a locale that makes sure that all country specific formats are displayed correctly.

ARGOS multilingual localization company recommends the basic five (5) steps to localize a website or software product [21] which are:-

1. Obtain file types and examine specific related issues.
2. Selection of project tools.
3. Project plan identifying the procedures and defining the roles of each project member.
4. Translation and proofreading.
5. Export to the target format and functionality tests.

Moreover, ARGOS identifies and suggests in some phases that the procedures are need more emphasis according to the type and complexity of localization project.

In addition to the above earlier studies which designed and developed steps and procedures to localize an open source product. There are also a number of studies particularly focused on the localization framework for open source software. Most of them mainly to localize User Interface (UI) contents into a targeted local language and culture. On the other studies has developed the localization framework to identify localization issues, components, elements, local content formats and localization criteria or guidelines. In addition to these explored culturally sensitive features when localize a web application. The subsection below states about related works focuses on open source software localization frameworks.

2.5.2. Localization Framework

Lielet Getachew has developed methodology to localize an open source software content management system (CMS) into Ethiopian Amharic language [22]. The author used Joomla (an open source web development tool) to enable nonprofessional and professional user can be web localize easily. For Amharic text entry adopt virtual keyboard.

Rufael Tadesse and Fekade Getahun have proposed a methodology which is similar, with Lielet Getachew [22], in approach and the same web CMS tool used to localize open source software contents into Ethiopian local language [23]. However, the authors are enhancing the capability to localize the contents into three (3) Ethiopian languages (Amharic, Oromigna and Tigrigna). Authors are also designed and embedded a virtual keyboard for Amharic language.

Zemene Adgo has developed a system on customization of open source software content management in Ethiopian language. The study focused on specifically for the government document management system to improve the Ethiopian government document management using web application in Amharic languages [24]. Zemene used OpenCMS tool to translate English language into Amharic language.

Researchers in easily [8] reviewed the previous related works and proposed a model for localization of the web application in Indian languages from English language to Indian and from one Indian language to anther Indian languages. The main reason to develop this localization framework is most existing frameworks are designed to localize the Roman language script. The model classifies the text contents into static text and dynamic text for translation. The proposed framework contain to prepare separate translation language resource files with its abbreviation as file name for every language to identify the target language resources easily [8].

R. Cermak and Z. Smutny also proposed a holistic framework for cultural localization of websites to improve utilization [6]. This framework developed by reviewing literatures more than eighty (80) studies, and then author's select fourteen (14) studies. After that identify more than one hundred fifty (150) culturally sensitive website features for different countries. The researchers examined and confirm that culturally sensitive website features can influence the design, content or functionality of that website and to define website element or content element on a website. It is useful for web experts during in cultural localization of websites.

Table 2.1 Summary of related works on localization framework.

No.	Author Name	Research Title	Proposed Solution	Gaps
1	Lielet Getachew	Localization of Open Source Content Management Software into Amharic Language	Methodology to localize an OSS content management system (CMS) into Ethiopian Amharic language.	Not covered some formats & cultures such as Geez numbering, currency, calendar, Date & time, name and title
2	Rufael Tadesse and Fekade Getahun	Localization of Open Source Web Content Management System	A methodology similar to Lielet G. for 3 Ethiopic languages (Amharic, Oromigna & Tigrigna).	Similar to the above
3	Zemene Adgo	Open Source Content Management Software Customization for the Ethiopian Government	Developed a system on customization of OSS content management in Ethiopian language. Study focused on government document management system for Amharic language.	Focus on translation of government document and develop gov't document management system
4	J. B. Karande, M. L. Dhore & S. R. Shinde	Framework for Web Application Internationalization and Localization Supporting Indian Languages	Proposed localization framework for web application from English to Indian and from one Indian to other Indian languages.	Only for Indian languages content formats and cultural preferences
5	R. Cermak and Z. Smutny	A Framework for Cultural Localization of Websites and for Improving their Commercial Utilization	Proposed a holistic framework for cultural localization of websites to improve utilization.	Focus on cultural issues

2.5.3. Summary

Website application is one of FOSS open source product to adapt and localize. The localization process is simply making a software product linguistically and culturally suitable to a target local society. Practically implement different tasks, methods and procedures in pre-localization, localization and post-localization phases to improve effectiveness, quality and usability of localized product. In earlier studies number of localization framework has developed to support and making localization easy. In previous related works, most of them particularly designed and applicable for English language speakers and culture. Others developed for the Latin language script, European, Asian, Indian and Arabic language and cultural content format. Ethiopian local researchers (Lielet Getachew, Rufael Tadesse and Fekade Getahun) are focused on designed methodology to localize an open source software content management system (CMS) into Ethiopian Amharic, Oromigna, Tigrigna languages. Two of them were used Joomla (an open source web development tool) and developed virtual keyboard that users can able to localize

without difficulty. But in these studies there are gaps that are not covered which are found in Ethiopian contents, formats and cultures such as Geez numbering format, currency, calendar, Date and time, name and title, etc.

However, Ethiopia is the collection of multilingual and multicultural country in addition Ethiopia has their own Amharic language script, Geez numbering format, currency, calendar, Date and time, name and title (For example **አቶ፣ ወ/ሮ=ወይዘሮ፣ ወ/ት=ወይዘሪት**). Moreover, there are also national holidays which are celebrated only according to Ethiopian calendar such as New-year, and the other holidays similarly need to be refer the European calendar (e.g. Mayday), Arabian Hegira calendar (for Muslim society to celebrate Eid ul-Fitr and Eid ul-Adha). Ethiopian Amharic language writing rules also have nine (9) punctuation marks. Table 2.1 illustrate the Ethiopian punctuation marks and its English equivalent punctuations [25]. Punctuations in the third row (፧, ※ and ፨**)** on the table are nowadays most commonly not applicable or used in Ethiopian literatures.

Table 2.2 Ethiopian punctuation marks and their English language equivalence [25]

Ethiopian Punctuation	**English Equivalent**	**Ethiopian Punctuation**	**English Equivalent**	**Ethiopian Punctuation**	**English Equivalent**
፡	Space	።	Full stop/Period	፣	Comma
፤	Comma	፤	Semicolon	፦	Preface Colon
፥	Question mark	※	Section mark	፨	Paragraph Separator

CHAPTER THREE

3. OVERVIEW OF AMHARIC

3.1 Analysis of Amharic Language Contents, Formats and Cultural Issues

3.1.1 Introduction

Ethiopia is a collection of multi-nations, multilingual, multicultural and traditions country found in East Africa, in Ethiopia over eighty (80) languages are spoken. Amharic language is one that has the greatest number of speakers in all over Ethiopia country and an official language of federal government. Ethiopian societies are connected each other and within worldwide through different type of relationships which are economic, political, technological, linguistically, geographical and other interconnecting mechanisms. Governmental or non-governmental organizations, business institutions/societies, industries and companies are nowadays using website or web based applications (WBA) to communicate and deliver their service, products and information to local and foreign customers. Website and web based applications are typically designed and developed in English language and its content and content formats are usually influenced by the culture of English language speakers. On the other hand, most local customers cannot fully understand the English language or furthermore, may not learn English language before. The language barriers and cultural difference can the cause of many problems. Some of the problems are: locale native customers may not understand or misunderstand the information found in web based applications (WBA), it can be problematic to navigate, hard or difficult to find out or searching information or resources what the customers want and reduce the interest to use websites. But the websites or WBAs major aim is communication medium, particularly between organization and customers remotely.

Moreover, researchers indicated that attractiveness, ease of use, reliable, understandable or simple to navigate, flexible, customizable, user satisfactions and accessibility are some of the main factors which are used to evaluate the usefulness and quality of websites. To achieve and fulfill these features for local native customer's websites or WBAs should be localized to a target local language and cultural preference.

Nowadays website is a primary means of communication channel and a way to deliver an organization's service/product for local and worldwide customers. To address all the desired customers that have different native languages and cultures the organizations should be done website localization. Website localization is simply adapting, translating and customizing website contents and content format in to a specific target locale customer's language and cultural preferences. Language writing fonts/symbols, Unicode representation, numeric format, punctuation marks, name and titles, date and time, currency, sort orders and calendar are some of the examples which are we should be consider during localization. As mentioned on the above commonly websites and WBAs are designed and developed in accordance with European or Western language and cultures. But then again Amharic language speaker society cultures, traditions and the language contents and content formats are completely different from Western or Europeans cultures, language contents and content formats.

For developing counties including Ethiopia must use Information Technology (IT) to work and communicate with the outside world (developed countries). Furthermore, in order to facilitate the growth and development of a country, it should build and support local IT infrastructure. Software system design and developing is the most important or central part of IT infrastructure. Open Source Software (OSS) is low in cost (save foreign currency, insignificant cost for purchasing and licensing software), gives an opportunity to local human development, increase and enhances an opportunity for local software industry and other advantages. Moreover, OSS provides a privilege to access the source code and freedom to use, copy, study, modify and improve the software package for local business use. In general, these features can be making localization of OSS into Amharic language is ease and reduces the required efforts. The reasons choosing OSS are its benefit, freedom and privilege which are stated previously and convenient to achieve the research objectives. The second and fundamental reason is the cost of proprietary software for developing countries is prohibitive. Apart from these huge numbers of Ethiopian society cannot get information in locally understandable languages what they want. It has numerous negative impacts on the growth and development of Ethiopia.

3.1.2 Literature Analysis of Amharic Language

Under this subsection covers only the selected Amharic language contents, content formats and cultural issues which are completely relevant to the research objective. What it means the contents, content formats and cultural issues of Amharic language are very broad and not all are relevant to discuss. Contents, content formats and cultural issues are explored, identified and examined from our experience, related books, research literatures, government standards, policies and procedures, published or unpublished (W3C, Unicode Consortium) website documents.

Most fundamental web application localization issues in Amharic language and local cultural context preferences are the following [26, 27, 19]:

Language Script: - Amharic language script contains a set alphabet letter, number digits, punctuation marks and other special character and symbols which are uniquely used to write texts, messages or documents in Amharic language.

Character Encoding: - Ethiopic Unicode character representation is used for all Amharic language script characters. Ethiopic Unicode characters are encoded in the table range of 1200–137F from the Unicode standard, version 12.1 published by Unicode Consortium [27]. These all character encoding are also used for other languages in Ethiopia for example Geez and Tigrigna. The localization issue related to Amharic Unicode characters encoding is the use of multi-byte representation for the single character font. Multi-byte representation can require to increase and improve the storage size and internet speed to download [19].

Number Format: - Amharic literatures have used two types of number format. In old literatures and books (before digital technology or Desktop Publishing Software (DPS)) mostly used Ethiopic digits known as Geez numbers [25]. But nowadays in modern digital or printed Amharic documents usually uses a Western number system; however we have also found documents that are using the Ethiopic number format. In addition the Quality and Standard Authority of Ethiopian (QSAE) published the localization standard for Amharic language. The ES 3450:2008 publicizes to use a number format similar to the US English number format. Moreover, the second option of the Amharic language number format we are using is Ethiopic digits which are published by UC. Unicode standard,

version 12.1 is the latest version of encoding all characters and numerical digits of Ethiopic Amharic language. The table 3.1 shows a sample of Ethiopic number formats and its equivalent Western number format.

Table 3.1 Sample Ethiopic number formats and its equivalent Western number format [26].

Ethiopic Digits	አልዐ	፩	፪	፫	፬	፭	፮	፯	፰	፱	፲	፲፩	፲፪
Western Number	0	1	2	3	4	5	6	7	8	9	10	11	12
Ethiopic Digits	፲	፳	፴	፵	፶	፷	፸	፹	፺	፻	፻፶	፪፻	፲፻
Western Number	10	20	30	40	50	60	70	80	90	100	150	200	1000

Currency: - Ethiopia has an own monetary system. The Ethiopian local currency name is called Birr (**ብር**) which is also commonly used for a paper note. And the metallic coins cents is known as Santim (**ሳንቲም**) in locally. ETB is a symbol or unit for local currency of Birr [26].

Calendar: - Ethiopians use their own calendar system which is ancient and it has unique features from the other Gregorian Calendars (G.C.) and Islamic calendar Hegira/Hijra (AH) [28]. Ethiopic calendar (E.C) differs from Gregorian [28, 29] in that it has13 months from these 12 months are 30 days and 13th month called Puagman (**ጳጉሜን**) has 5 days or 6 days in leap year, seven/eight (7/8) years behind the G.C. year and Ethiopic New-year starts on Meskerem (**መስከረም ፩**) or September 11 (or 12 for leap year) in G.C. The table 3.2 below shows Ethiopic calendar month names, number of days per month and start dating in Gregorian [26, 29]. Table 3.3 also shows Ethiopian calendar differs with the Gregorian calendar in number of dates and years [30, 31]. Both table values have a vital role to calculate dates and years during localization.

In every Ethiopian (personal, governmental or non-governmental organization, religious institution, educational, companies, etc.) work activities requires calendar timeline to plan, manage, modify and perform the duties or business concerns what want to do. Moreover, national holiday, Christian and Muslims holidays celebration and fasting days/months calculation are requires to implement the calendar timeline [28]. Ethiopian calendar's covers the holidays which are celebrates only according to Ethiopian calendar such as

Ethiopian New-year (**እንቁጣጣሽ**),Epiphany (**ጥምቀት**), Ethiopian Christmas (**ገና**), national holydays and for Muslims society to celebrate Ramadan fasting month, Eid ul-Fitr (**ኢድ አል-ፈጥር**) and Eid ul-Adha (**ኢድ አል-አረፋ**) the calendar needs to refer Islamic calendar Anno Hegira(AH). On the other hand it holds holidays which require to refer the Gregorian calendar for example Mayday.

Table 3.2 Ethiopian calendar Amharic month name & English name, No. of days & start date in G.C [26, 29].

Month No.	Amharic Month Name (Eng. Pronunciation/ Name in G.C)	No. of Days	Starts Date in G. C. (Leap Year)
01	**መስከረም** (Meskerem /September)	30	September 11(12)
02	**ጥቅምት** (Tikimt /October)	30	October 11 (12)
03	**ኅዳር** (Hidar /November)	30	November 10 (11)
04	**ታኅሣስ** (Tahsas /December)	30	December 10 (11)
05	**ጥር** (Tir /January)	30	January 9 (10)
06	**የካቲት** (Yekatit /February)	30	February 8 (9)
07	**መጋቢት** (Megabit /March)	30	March 10
08	**ሚያዚያ** (Miazia /April)	30	April 9
09	**ግንቦት** (Ginbot /May)	30	May 9
10	**ሰኔ** (Sene /June)	30	June 9
11	**ሐምሌ** (Hamle /July)	30	July 8
12	**ነሐሴ** (Nehase /August)	30	August 7
13	**ጳጉሜን** (Puagman / -)	5/6	September 6

Table 3.3 Ethiopian calendar differs with Gregorian in number of dates and years [30, 31].

Dates Between in Gregorian / In Leap Year	Dates Between in Ethiopian Calendar / In Leap Year	Date Gap /In Leap Year	Year Difference
September 11/12– October 31	**መስከረም** 1–**ጥቅምት** 21/20	10/11	7
November 1 – December 31	**ከጥቅምት** 22/21–**ታኅሣስ** 22/21	9/10	7
January 1 – January 31	**ከታኅሣስ** 23/22–**ጥር** 23/22	8/9	8
February1 – February 28/29	**ከጥር** 24/23– **የካቲት** 21/21	7/8	8
March 1 – March 31	**ከየካቲት** 22– **መጋቢት** 22	9	8
April 1 – May 31	**ከመጋቢት** 23 – **ግንቦት** 23	8	8
June 1 – July 31	**ከግንቦት** 24 – **ሐምሌ** 24	7	8
August 1– August 31	**ከሐምሌ** 25 – **ነሐሴ** 25	6	8
September 1– September 10/11	**ከነሐሴ** 26 – **ጳጉሜ** 5/6	5	8

In Ethiopian calendar each year has a name with four-year cycles. The year names are named by the name of four evangelists those are Matthew (**ዘመነ ማቴዎስ**), Mark (**ዘመነ ማርቆስ**), Luke (**ዘመነ ሉቃስ**) and John (**ዘመነ ዮሐንስ**) [26, 30]. Each year in E.C also have four seasons similar to the G.C but locally named as **መጸው** (spring), **በጋ** (summer), **ፀደይ**

(autumn) and **ክረምት** (winter). The table 3.4 below shows the starting and ending days of Ethiopian four seasons per year [30].

Table 3.4 Starting and ending days of Ethiopian four season in a year [30].

Dates in Ethiopian Calendar	Dates in Gregorian Calendar	Season Name
መስከረም 26 - **ታኅሣስ** 25	October 7 – January 3	**መጸው** (Spring)
ከታኅሣስ 26 - **መጋቢት** 25	January 4 - April 3	**በጋ** (Summer)
ከመጋቢት 26 - **ሰኔ** 25	April 4 – July 2	**ፀደይ** (Autumn)
ከሰኔ 26 - **መስከረም** 25	July 3 – October 6	**ክረምት** (Winter)

Date and Time: - The other basic localization issue of Amharic language content formats is the date and time formats and the terms used for each day's. According to Ethiopian calendar all seven days of the week have different name from the European and Islamic calendars. Table 3.5 below shows the week day name in Amharic (English pronunciation), shortest name and day name in Gregorian [26].

Table 3.5 Week day names in Amharic (English pronunciation), short name and day name in G.C.

Day No.	Day Name in Amharic (English Pronunciation)	Shortest Name	Day Name in Gregorian
1	**ሰኞ** (Segno)	**ሰ**	Monday
2	**ማክሰኞ** (Maksegno)	**ማ**	Tuesday
3	**ረቡዕ** (Rebue)	**ረ**	Wednesday
4	**ሐሙስ** (Hamus)	**ሐ**	Thursday
5	**ዓርብ** (Arb)	**ዓ**	Friday
6	**ቅዳሜ** (Kidame)	**ቅ**	Saturday
7	**እሑድ** (Ehud)	**እ**	Sunday

The localization standard for Amharic language that published by the Ethiopian standard agency stated about the date and time representation format. The date representation format can be written in one of the two formats [26], which are:

Basic format: YYYYMMDD Example: 20120416

Extended format: YYYY-MM-DD Example: 2012-04-16

Note: YYYY refers to calendar year, MM is the month numbers within a calendar year and DD represents the ordinal number of a day within a month. But the standard notifies that when the month is written in letters (alphabet) the month come first and use forward slash (/) as a separator such as month name YYYY or month name DD YYYY [26]. All date formats should be written using reference characters E.C. or **ዓ.ም**. (in Amharic) after date

values. Note that **ዓ.ም**. means for shorthand of "Amete-Mhiret" (**ዓመተ ምህረት**). The following is an example of date values with an appropriate reference characters in Amharic Ethiopian and Gregorian calendars. These are:

ሚያዚያ/1979 **ዓ.ም**. (In Amharic) = April/1979 E.C (English) = April/1986 G.C (In G.C.)

መስከረም 01 2012 **ዓ.ም**. = (In Amharic / Ethiopian New Year) = September 12 2019 G.C

On the other hand each day in Ethiopia has 24 hours, 12 hours of daytime (**ቀን**) and 12 hours of nighttime (**ሌሊት**) in local practice. A new day starts during the daytime of sun rising at 12:00 o'clock local time (after 5:59:59 PM or at 6:00:00 AM) early morning and the daytime ends when the sun goes down or after the sunset (6:00 PM). And the nighttime of a day is starting after sunset12:00 o'clock local time (after 6:00 PM) and the nighttime ends before sunrise (at 6:00:00 AM); at this time a day is completed and starts counting the next day. In Ethiopia, the daytime and nighttime is conventionally used to divide a day. But in local practices one day have parts. Table 3.6 below show the most commonly practiced daytime and nighttime parts in local society and its English equivalent meaning of a day [26, 32]. Note that DT denotes to Daytime, NT is Nighttime, EAT refers to East Africa Time zone, which is GMT+3 in Universal Time system and greater than (>) represents to after. In the table below additionally trying to show the date changes in G.C at the midnight time of Ethiopian local time. The date locally **ማክሰኞ፣ ታኅሳስ** 7/2012 **ዓ.ም** (or Tuesday, 17-Dec-19 in G.C) is used as example day.

Table 3.6 Local societies most practiced daytime and nighttime parts and its English equivalent meaning of a day [26, 32].

Local Time Range ታኅሳስ 7/2012 ዓ.ም	**EAT (GMT+3) Time Range (17-Dec-19 G.C)**	**Local Terms used for Parts of a Day**	**English Equivalent Meaning**
>12:00 –3:00 (DT)	>6:00 AM–9:00 AM	**ጧት**	Early morning
>3:00 –6:00 (DT)	>9:00 AM–12:00 AM	**ረፋድ**	Morning
>6:00 –7:00 (DT)	>12:00 PM–1:00 PM	**እኩለ ቀን**	Midday
>7:00 –10:00 (DT)	>1:00 PM–4:00 PM	**ከሰዓት**	Afternoon
>10:00 –12:00 (DT)	>4:00 PM–6:00 PM	**ወደማታ**	Dusk/Early twilight
>12:00 –6:00 (NT)	>6:00 PM–12:00 PM	**ምሽት**	Evening
Day Not Changes in E.C ታኅሳስ 7/2012 ዓ.ም		***Day Changes to Weds, 18-Dec-19 in G.C***	
>6:00 –7:00 (NT)	>12:00 AM–1:00 AM	**እኩለ ሌሊት**	Midnight
>7:00 –10:00 (NT)	>1:00 AM–4:00 AM	**ሌሊት / ውድቅት**	Dark night
>10:00 –12:00 (NT)	>4:00 AM–6:00 AM	**ንጋት**	Early Dawn

Name and Title: - In Amharic language and local culture there are a number of names and titles are available which are used differently from English language speaker (Western and European) countries. Names and titles found in Amharic language can come from or used in different places and conditions/situations to show the position, status and honor of a person. Some of the sources of names and titles can be from local religious (Churches and Mosques) institution, social traditional practices, government organizations, academic institution and from the previous royal family administration system or around the king palaces. The following table 3.7 shows some selected sample of the names and titles that uses and practice in local Amharic language speaker society [32, 33, 34].

Table 3.7 Sample of the names and titles that uses and practice in Amharic language [32, 33, 34].

Amharic Names and Titles	Sources/Practice In	English Equivalent	Description
አቶ	Social & Gov't	Mr. (Mister)	Used for a man in official position.
ወ/ሮ=ወይዘሮ	Social & Gov't	Mrs.	Used for married woman.
ወ/ት=ወይዘሪት	Social & Gov't	Ms. (Miss)	Used for unmarried woman.
መምሬ	Religious	Priest	Higher teaching staff in Churches.
ሸህ	Religious	Priest	Studies in higher Islamic knowledge.
አለቃ	Religious	Chief Priest.	Chief/general in religious knowledge.
ሊቀ መኳስ	Social	Minstrel	Traditional singer using "Mesenko"
ጋሽ	Social	Sir	Politely called a man with respect.
ደጅ አዝማች	Imperial Military	Lt. General	Keeper/Commander of the door.
ሊቀ መምበር	Gov't & Social	Chairman	In charge of a committee/gov't office.
ሀኪም	Professional	Physician	Specialist in general medicine.
ሻ. አለቃ	Modern Military	Captain	An army officer in military.

On the other hand, in order to write the full name of a person or in Amharic language we follow the following structure or formats of the person's name. Full Name = [Given Name] [Father Name] [Grandfather Name] {Optional}. Given name is the name of his/her own name. In most common official naming of a person usually use only up to [Grand Father Name]. But the levels of a full name of a person can be more than grandfather name.

Both a male and a female name are uses the same naming formats. In Amharic language person's name is not called by using surname or father's name like Western's or European's person name formats. If a person has title(s) name, the person naming can be called by using a title name first then a given name and/or father name.

Punctuations Marks: **-** Ethiopic Amharic language writing rules have several numbers of punctuation marks. In the Ethiopic character encoding document which is published by Unicode consortium encodes twelve (12) punctuation marks. On the other hand, from the "Ethiopic Layout Task Force, part of the W3C" published document and in the "**የአማርኛ መዝገበ ቃላት**" book prepared by the Ethiopian linguistic research center found an additional number of punctuation marks. Punctuation marks which are published in these two documents are not used/applicable entirely on current day especially in digital documents. But almost all of Amharic language punctuation marks are found and used in old/classic period (before DPS comes to Ethiopia) books and handwriting or printed documents of Ethiopian literatures [25]. Table 3.8 illustrates some selected Ethiopian punctuation marks and its English equivalent punctuations [25, 33, 27].

Table 3.8 Ethiopian punctuation marks and their English language equivalence [25, 33, 27].

Amharic Punctuation	English Equivalent	Amharic Punctuation	English Equivalent
፡ (ሁለት ነጥብ)	Space	። (አራት ነጥብ)	Full Stop
፣ (ነጣላ ሰረዝ)	Comma	፤ (ድርብ ሰረዝ)	Semicolon
፥ (ንዑስ/ነጣላ ሰረዝ)	Comma	፦ (አስረጅ ሰረዝ)	Preface Colon
- (ሰረዝ)	Hyphen	፧ (ሦስት ነጥብ)	Question Mark
※ (ክፍል መለያ)	Section Mark	፨ (እልባት አንቀፅ)	Paragraph Separator
…. (ነጠብጣብ)	Ellipsis (3 dots)	« » (ድርብ ጥቅስ)	Double Quotation Mark
Ö (ማጥበቂያ ምልክት)	Gemination Mark	‹ › (ነጠላ ጥቅስ)	Single Quotation Mark
/ (ህዝባር/ማሳጠሪያ)	Forward Slash	. (ነጥብ/ማሳጠሪያ)	Dot
Note: ※ ፨ ፧ and Ö these punctuations are not used in most current digital documents.			

Abbreviations and Capitalization: **-** Amharic language uses the punctuation marks to write in a short form of the long named organizations/institutions or titles of the professions or others which has multi-words or phrases. The two punctuation marks used to abbreviate words or phrases in Amharic language are forward slash (/) and dot (.) [25]. Forward slash (/) is commonly used to abbreviate a single word by using the first and last letter(s) of the word. Dot (.) abbreviate marker is usually used for multi-word by using the first letter of each word. Capitalizations of letter(s) or alphabet(s) in Amharic words are not used for Amharic language because it does not have upper and lower case letter writing system. The following are examples of abbreviation in Amharic language. These are:

Example: *Single Word Abbreviations*

Amharic Word	**Abbreviation**
ዶክተር	⇨ **ዶ/ር**
ሆስፒታል	⇨ **ሆ/ል**
ጽህፈት ቤት	⇨ **ጽ/ቤት**
ትምህርት ቤት	⇨ **ት/ቤት**

Example: *Multi-Word Abbreviations*

Amharic Multi-Words	**Abbreviation**
የተባበሩት መንግስት ድርጅት	⇨ **የተ.መ.ድ.**
አፍሪካ ሕብረት	⇨ **አ.ሕ.**
አዲስ አበባ ሳይንስና ቴክኖሎጅ ዩኒቨርስቲ	⇨ **አ.አ.ሳ.ቴ.ዩ.**

Sort Orders: - Sorting orders of Amharic language words are using Ethiopic alphabets and all other Unicode characters which are developed and published by UC. The sort order of Amharic words are based on the orders of Ethiopic Unicode standard character sets found in the range of 1200–137F. The Ethiopic alphabet characters are encodes in syllables characters which contain root letter (vowels) and each letter has six or seven phonetic variants (consonants). The first letter is used as a basis for sorting. The consonants are the next sort order we used based on their sequence of the first letters.

Based on the Unicode character set value the sequence of Amharic words including non-alphabetic and numeric characters are coming after the alphabetic characters. The Microsoft style guide prepared to localize the Microsoft products into Amharic language states that the sort order of Amharic language can be affected by the following conditions. When Amharic language words contain the non-Ethiopic characters such as the Arabic numerals and hyphens the sort orders in the lists are affected [35]. Table 3.9 Sample of Ethiopic Unicode character encoding values used to sort Amharic words [27]. The sort order first uses horizontally and then proceeds with vertically. Note: R= Reserved.

Table 3.9 Sample of Ethiopic Unicode character encoding values used to sort Amharic words [27].

	0	1	2	3	4	5	6	7	8	9	A	B	C	D	E	F
120	ሀ	ሁ	ሂ	ሃ	ሄ	ህ	ሆ	ሇ	ለ	ሉ	ሊ	ላ	ሌ	ል	ሎ	ሏ
121	ሐ	ሑ	ሒ	ሓ	ሔ	ሕ	ሖ	ሗ	መ	ሙ	ሚ	ማ	ሜ	ም	ሞ	ሟ
⋮		⋮					⋮				⋮					⋮
133	ጸ	ጹ	ጺ	ጻ	ጼ	ጽ	ጾ	ጿ	ፀ	ፁ	ፂ	ፃ	ፄ	ፅ	ፆ	ፇ
⋮		⋮					⋮									⋮
135	ፐ	ፑ	ፒ	ፓ	ፔ	ፕ	ፗ	ፚ	፝	፞	፟	R	R	፠	።	፨
136	፧	፡	።	፣	፤	፥	፦	፧	፨	፩	፪	፫	፬	፭	፮	፯
137	፰	፱	፲	፳	፴	፵	፶	፷	፸	፹	፺	፻	፼	R	R	R

Address Format: - Commonly a country government design and develops an address format which is used to detect and identify the detail information about where the person lives or works. And it is also used to identify information about company's phone number, email/website, postal address and where it is found. In Ethiopia, there is no standard or formal address formats throughout the country. The address format uses in one organization may not similar to the other organization found in the same city or region. And also it may not have similar formats in the persons identification card (ID) given by different Kebele (**ቀበሌ**) in one city or region. In Ethiopia most commonly address format being used in personal ID card given by Kebele (**ቀበሌ**) contains the following information. These are:

Address Format: Person ID Card.

1. Title: [Region Name, City Name, Kebele (**ቀበሌ**) Name or Number]

ID Number: _____

2. Personal Information

First Name: _____ Father's Name: _____ G. Father's Name: __ _____ Sex: __

Mother's Full Name: _____

Date of Birth: _____ Place of Birth: _____

Region/Nation (Optional): _____ Nationality: _____

Kebele/locality (**ቀበሌ**): _____ House Number: _____

Phone Number: _____ Mobile: _____

Job/Occupations: _____

3. Person's In Case of Emergency

Full Name: _____

Kebele/locality (**ቀበሌ**): _____ House Number: _____

Phone Number: _____ Mobile: _____

4. Issued Date: _____ Authorized Name and Signature: _____

Address Format: for Company's Busyness Card.

The following information is common in most of company address formats or business cards.

Person Full Name: _____

Company Name: _____ Position Title: _____

City: _____ Sub City: _____ Kebele: _____ House Number: _____

Phone Number: _____ Mobile: _____

P.O. Box: _____

Email: _____

Website: _____

Notes: In general in Ethiopia the address format is organized with the following information starting from the large area that a country (Ethiopia) is divided called region, then proceed to small/specific area which are City/Town, Sub City, Woreda/district (**ወረዳ**), Kebele/locality (**ቀበሌ**) and finally house number. The address format also includes Nationality, fixed home/office phone numbers, mobile number, postal address, email and website address. But in order to exchange mail with individuals we commonly used an organization P.O. Box number. On the other hand, there is no culture to use a street number address in all local address formats.

The format of fixed line phone number used in Ethiopia is [Country Code][Area Code][Phone Numbers] with totally twelve (12) digits. Three (3) digits used for Country Code, three (3) digits also used for Area Code and six (6) digits used for Phone Numbers. A Country Code is +251 uses during an international call for fixed line and mobile numbers. The following are some examples of fixed line and mobile numbers in Ethiopia.

Fixed Line: +251 11 5511211 Black Lion Hospital, Addis Ababa, without country code: 011 5511211.

Mobile: +251 911 22 54 64 Tebita Ambulance, without country code: 0911 22 54 64

Examples of Area Code: 011= Addis Ababa. 058 = Bahir Dar. 034 = Mekele. 046 = Hawassa. 025 = Dire Dawa.

Page layout: - The requirement of Amharic language documents and literatures in accordance with paper/page size and layouts. Localization issues related with paper or page layout are page margins, paragraph formats, justification, page numbering, titles and subtitles, the emphases of words or phrases, etc. are some of selected to show.

Paragraph format in Amharic language documents is starting the first line with indents (spaces) than the other paragraph lines. Justify paragraph format is used in most of Amharic documents, books and literatures to alien texts into both left and right margins of the page. The page numbering format of the document commonly uses similar to the Western document page numbering standard formats. The task force of "Ethiopic Layout Requirements" states that "page layout, formatting and section numbering in Ethiopic practices does not demonstrate a marked difference from Western conventions" [25].

The main title and subtitle format used in a document and in its subsection of Amharic language is changing the title text size and makes it to center alignment [25]. The use of text underlining and text color changing are not suggested to Amharic language document titles [25]. Moreover, in Amharic language document emphases words and phrases are commonly identified by changing color and underlining.

Calendar Based Events: - the following are some examples of Ethiopian calendar (E.C) based or related issues and events in Ethiopian:

- Holidays
- Fasting periods
- Government Budget year and its section
- Government Activities
- Ethiopian education and training institution training schedules

CHAPTER FOUR

4. RESEARCH METHODOLOGY

4.1 Research Design

First identifying and analyzing benefits, issues, components and procedures of web application localization from experienced countries published documents, related literatures, proceeding papers and documents from software localization companies. In addition to these, the study make an attempt to explore out and analyze the contents and content formats of Amharic language and cultures from related literatures, books, local government language localization standards and research papers.

A literature analysis method is applied in order to identifying, evaluating and interpreting the existed relevant research and journal papers, conference proceedings, books, published documents from localization experienced companies and country. Literature analysis also applied to identify and examine Amharic language contents, content formats and cultural content preferences of local society.

Then research conducts descriptive analysis on the particular selected research papers, literatures and documents which are relevant to research objectives and to answer the research questions. And also applied this method on the literatures which are significantly applicable in the countries that English language is not a native language.

Finally the research attempted to develop a localization framework, to localize an OSS web application UI into Amharic language, from existing experience, knowledge and from the identified Amharic language and its local cultural localization issues.

4.2 Data Gathering Methods

Data gathering methods: - the research data collect from secondary sources of data. The required data are collecting using the following method.

- Literature analysis

Literature analysis method is applied to collect the secondary sources of data. Studies and reviews related research work papers and journal articles which are significantly applicable in different countries that the English language is not a native language. Governmental and

Non-governmental organization published standards, documents and related books were furthermore used as the secondary source of data. The following are some of secondary sources of data types which are used:

- Existing related literatures, books, documents and standards.
- Government and non-government published Amharic language standards.
- Localization Service Provider (LSP) organizations published documents.
- Related research papers, review articles, other countries research projects and Books.

The reasons to choose a literature analysis method are

- ✓ The core data sources of this study are the existing literatures and related works
- ✓ The research objectives are centered on identifying and analyzing the existing related literatures which are significantly applicable in different countries.
- ✓ To identify and examine issues and techniques of web application localization from previous studies and literatures of localization experienced organization.
- ✓ For searching and identifying benchmark to develop a framework for localization of an OSS WBA user interface into Amharic language.

Searching techniques are used in order to recognize and ensure that the collected data from previous literatures are appropriate and relevant. These are:

Browsing literatures using the combination of the keywords from research problems and objectives which are determine as potentially relevant for this study. In addition, by using reference of the previous related literatures. The following are the main keywords we are used to identify the relevant literatures during searching and collecting data:

- ✓ Software localization framework
- ✓ Website localization framework
- ✓ Open source software localization and customization
- ✓ Website application localization issues and challenges
- ✓ Amharic language grammar + content formats

Searching relevant literatures by using the search function of journal website for e.g. searching function found at Google scholar.

4.3 Data Analysis

The selection criteria to analyze and examine the collected literatures and documents are must be pertinence and relevance to the particular research questions and objectives. And also the literatures and documents were significantly applicable in the countries that English language is not a native language.

Descriptive analysis method is applied on the selected extensive and relevant literatures and documents which are collected in the data gathering method to obtain a theoretical foundation for the research study. Finally the research attempted to develop a localization framework from previous existing experience and knowledge, and from the identified Amharic language and local its cultural localization issues.

4.3.1 Literature Analysis of Web Application Localization Issues and Challenges

Introduction

Website is an internet connected place of digital resources of an organization, company or an individual with specific address (domain name) designed and developed usually to communicate with their customers. Organizations or companies use website application for a particular application or task such as to deliver services, products and information to their customers. Website digital resources are a collection of documents, files, texts, user interaction (menus, dialog box, input/output fields, etc.) commands, images, multimedia files (audio and video), webpage links and others which can be accessed by uniform resource locator (URL) address. In general, websites should be designed and developed according to the target customer's language, culture, language content and content formats. All customers of an organization or company may not speak the same language and have not similar culture. Contents and content formats of two different languages cannot be the same. As stated above, OSS products are designed and developed by group of volunteer programmers live or work at different locations. Generally OSS websites are designed and developed for English language (Western) countries culture and language content formats. In order to use OSS website applications for Amharic language speaker societies whose

language and cultures are completely different from English language and their culture, we should put a team effort on website localization.

Website localization is the process of adapting, translating and customizing a website for a specific purpose into a particular target locale language and culture. Ii includes language translation and adjusting website user interface contents to make the information/message meaning is an easy to read and understand. Furthermore localization process should be concern the target local language contents and content formats such as: web layout ("look-and-feel"), name and title, numeric format, punctuation marks, currency formats , sort order, capitalization and abbreviation, Date and time, Calendar, address format and other. In section 4.6 Amharic language contents and formats will see more detail about Amharic language contents and content formats.

4.3.2 Why Localize Web Application?

In real world common practice, formal education methods (teaching, training and learning) are used to change and improve the society's knowledge, skills and attitude through the educational institutions. Most peoples in developing countries could not have an opportunity or not gained good enough access of educational and training institutions; that are used to acquire and improve the skills of English language that to make the local societies excellent in reading, writing, speaking, listening and understanding. On the other hand, nowadays peoples can be able to learn and train themselves to develop their own knowledge and skills what they want. Building a country ICT and internet infrastructure provides a vital role to develop and growth the skills and knowledge of the societies and also facilitates the development of country in different aspects. There are different types of websites are available throughout the world which are designed and developed to provide or deliver information, services or/and products for intended target customers. E-learning, e-market, communication with volunteers group and others are some of the examples website primary purposes or functions. Organizations can provide services to customers using a website and then customers can get diverse service, also can learn and train from these organizations, or themselves or/and each other's.

Research shows that the ability to reading and understanding of English language is still the big problem in Ethiopia [36]. There is a huge amount of Amharic speaker societies in

different part of Ethiopia that cannot able to read English totally, or some others can be try to read but not understand/misunderstand what it mean or furthermore not learned totally English language before. Currently, people who want to use website must commonly first be familiar with the English language for better understanding and to find out what the required information. Amharic speaker societies that have problems to read and understand English language can be difficult or challenged to find, identify and access services, products or information easily in the website developed in English. Hence, in order to avoid challenges in language and cultural barrier to access information in website is localizing websites into a target local language and culture. The previous studies identified the importance of website localization in different point of views. The following paragraphs show the importance and benefits of website localization from previous studies [37, 3, 4].

Consumers may choose a service provider based on the languages they offer and they are ready to pay more for a service [37]. In addition to these, Mari Taanonen listed the following benefits of localization from service provider's and customer's perspective by reviewing the previous studies.

Table 4.1 Benefits of localization from Mari Taanonen 2014 thesis [37].

Service Provider's Perspective	**Customer's Perspective**
Global reach	Reduced cognitive effort
Societal goals	Ease of use
Goodwill and bonding	Increased interactivity
Competitive advantage	Consumer Preferences
Increased sales and revenue	Purchase intention
Increased interactivity	Increased trust
Impact on purchase intention	Satisfaction
Increased user trust	
Increased user satisfaction	

A. Souphavanh and T. Karoonboonyanan identifies the benefits of localization. Researchers studied with Asia-Pacific Development Information Program (APDIP) that aims to promote the development and application of new ICTs for poverty alleviation and sustainable human development in the Asia-Pacific region. The following are the benefits of web application localization identified by those researchers [4]:

- Reduce the amount of training necessary for employees to use a web based application system.
- Make easy to introduce web based applications into the local societies.
- Companies increase the market strategy in different languages.
- Give an opportunity to employees to work entirely in the local language and manage data in official local language.
- Increase the opportunity and capacity of local software development companies.
- Provide a job opportunity to linguistic professionals for translation.
- Communication between customers and companies in the local native language are easy and increase trust.
- Increase the customers of local companies.
- Allow societies to communicate in their native language.
- Increase the availability of digital (web) information in local language [3].

Furthermore, web localization can be able to:

- Improve efficiency of communication with target customers.
- Company or organizational markets can grow into new target local customers.
- Introduce an opportunity of building language independent ICT in a country.
- Help to solve the problems and challenges that come from language and culture difference.
- The local native user's to teach and learn themselves in their own language.
- Provide an opportunity to develop local language.
- Build trust, confidence and interest to uses the websites.
- Adjust and make it the local user's life with current global conditions.

4.3.3 Web Application Localization Issues

A central base idea for a successful localization project is identifying and examines all possible localization issues related to the target local language, cultures and conventions. There are numerous fundamental localization issues we should concern and analyze throughout the website localization processes. Localization issues starts and come into arise from the pre-localization stage, during-localization process and post-localization stage. Some of the most basic and essential issues that which are found in pre localization

are interconnected with the feasibility analysis of website application product is applicable to the local market. Under this situation, what the most important action is examine the application product in attempting the following questions. All the available product features are applicable to the target local market? How much efforts will require for the number of features that we should have to add, expand or/and enhance? The number of features should have removed before localization?

In addition to inquiring a project features is appropriate and more pertinent to target native local language, cultural context and conventions. The following are principal localization issues that should be carefully explored and analyze before starting and performing localization process [3, 19, 38, 16]:-

- ***Size of Project:*** Project size is the main decisive factor to estimate the required localization efforts, cost or budgets, team member size (nature and number of professionals composition), period of time (schedule) and other additional relevant require resources such as term database or glossary terms, working environment or office with equipment, HW and SW tools. According to the total cost needed and the expecting time spent to complete or finished localization processes with the capability of local organizations to fund the money. Then, if the localized project able to provide an indispensable benefit for local organization. The localized project should be able to increase business profitability, enhance market competitiveness, support in market growth and improve or develop organizational performance. Or other types of organizational related benefits which are in accordance with the nature and type of local organization. Based on the appropriateness of a project localization cost and its time required to complete and project applicability, project size cannot be an issue or a main reason to terminate localization process. If the situations and conditions that previously stated will not be able to validly and achievable in practice. We can say that the project is not feasible localize.
- ***A Way of Design:*** if the source (original) version OSS project was designed and developed in the method of internationalization. Localization process will not be complicated and the required effort is easier than a project which was designed and

developed without internationalization approach. Because internationalization design process makes an OSS web application most likely free from the effect of specific countries or nation language content format and cultural context features. In addition, it makes the application language elements and cultural resources are separate from the source code and stores in different place. Therefore, the process of identifying localizable resources and adding or enhancing features and elements is simple and efficient. It can also useful in minimizing the chance of happening content translation problem during the localization process.

- ***Coding Style:*** source version of application project should be open to access, modify and as much as possible organized in compile format. In addition, web application program source codes typically hold components of user interface (UI) contents which should have been localized or translated. Some of the UI contents that can be found inside an application source code are string or massages, label string, menus, dialogue boxes, texts, date and time, currency and others [19]. So, the application program coding style is one of the key localization issues because it can be determines the amount of efforts required to identify and extracting strings or contents to be localized, to modify/adapt the source code and to add/remove or enhance the functionality features of an application. And also it should not be hard coded and complicated which means source code should not be deliberately less clear and difficult to understand [38]. The hard coded application has an impact on the level of effort required to realize the program and then to reprogram the source code to eliminate hard coding by a local programmer, in order to simplify subsequent localization processes and to make the program suitable for cultural content adaptation.
- ***Life Time:*** the project localization process lifetime is the one that should be considered in pre-localization stage. The amount of time requires to come into finalize localization process and the additional time and its rate required to update the website application for new string/message and content values are happening [3]. The amount of cost related to localization lifetime and the number of updating frequencies must be acceptable and appropriate.

- ***Market Size:*** the amounts of demand available in the target local organization customers and the possibility for growth in market size are issues that should consider before localization. Localized website should have a good impact on the target local market to increasing the number of customers. In addition to the amount of desired available local market size, number of other existing local competitor organization and their competitiveness is also taken into consideration before localize the application [3].
- ***Other Issues:*** in general localization of website application should have considered and eliminates texts, messages, images, colors and way of expressions that are against to the target locale society's cultural preference, religious practice and political situations [16]. So before localize of web applications we need check it free from culturally, religiously and politically violate to the local norm or conventions,

In addition to pre-localization issues mentioned on the above, there are several important issues that we should consider during the localization process of website UI contents. Most commonly website can contain static or/and dynamic information which needs to be adapted and localized into a target local language and cultural preferences. The previous studies and organizations working on multilingual software localization shows various issues we should be carefully analyzed and examined to translate and localize websites are the following [21, 39, 16]:

Analyze and Plan: - carefully examine and design the layout and structure of what the anticipated localized website looks like before translation starts [21]. What problems might happen and resolve it. How web contents layout suitable to localize.

Hard Coding: - the original source code can be complicated or confuse to understand programming development methods. It can be hard to add/remove features and functionality, mixed texts with source codes which contain technically difficult to extract texts or messages that should be translate, allocated size of strings or texts to display may not adequate for translated local language strings or texts to displaying on screen, [39] etc. Local programmer should analyze and examine the original source codes and then rewrite the hard coded section(s).

Word Length: - the available assigned screen size to display the source language word or text length may not be sufficient for displaying the translated local language word or text length. Most usually, the translated Amharic language word length can be greater than from English word length. The allocated display space size can be unfit for displaying translated texts those have extended text/message size than the source. Some of the website UI contents which should be translated are messages, menus, I/O or form labels, dialog box and others UI content string.

Text on Images: - source files can contain graphics and images with texts on top of them. Sometimes it is difficult to extract texts on image and graphics to localize [39]. In order to localize texts on the image and graphics we should first extract or separate texts from the images. If it is not possible to isolate texts from the image we should redesign the images and graphics without texts.

Cultural and Local Language Specific Contents: - local language and cultural specific content formats are the core issues during localization. It concerns about local society language and cultural practice and conventions such as punctuation marks, sort order, abbreviations, currency formats, Dates and time formats, calendar, number formats, name and title, a way to express something, etc. [16, 39].

Ambiguity Terms: - translation of the source file language messages and texts to make glossary terms and preparing localized resource file is a basic part of website application localization. The issues under making of the glossary terms are trying to find out and eliminate terms and statements that have unclear meaning and ambiguous [39]. And also avoid terms that can be contradicted or against with religious, political and cultural tradition practice, values and norms of local society.

Local Specific Issues: - A local government procedures, standards, polices and business laws are the other common local specific localization issues we need to consider during the localization process [16]. But these types of issues are may not be incorporates all of them in a selected web based application project. If a selected project contains all these issues from foreign country and they are different from the target local government procedures, standards, policies and business laws. We should calculate the cost and efforts required to

customize and adapt those specific issues. After identifying and analyzing the costs and efforts required we can make a decision to proceed or terminate the localization process.

Finally, there are issues we need to consider in post localization process stage. Usually website application contents can be contains dynamic information or organizational information that could be necessary to change/update and upload in frequent time manner. The important issues we need to consider during the post localization stage are update and validation test [16, 40].

Update: - website contents and its information can display on the browser screen with time scale and dynamic. The contents or information displaying period of time can be limited and it should be necessary to change and update with the new required content or information [16]. On the other hand the prepared glossary terms and others language related contents may not contain for new entry words, texts, images, etc. Website localizer should identifying the new entry terms or contents to translate and updating the existed glossary terms and other contents.

Thus, the first thing to assess after the translation is whether the localized web application functions in exactly the same way as the source application. All the hyperlinks must work properly, locale-specific formats must have been adapted like currency, dates, addresses, etc. A special problem with interactive websites can be Web forms, where many locale-specific formats will be used, which may cause text length and encoding problems.

Test: - the localized website application should be checked and tested to verify the functionality and to check the goals what we planned to achieve are attained or not. In addition to website functionality test, localized website layout, content appearance and local language words, terms and other symbols are displayed and visible correctly [16, 40].

Localization Challenges in Amharic Language

There localization challenges which are related with Amharic language content formats that identified in the previous literatures. The following are some of the issues and challenges when localize the application into Amharic language [25] [35]:

- ✓ Translated texts/word length are unfit with the available space to display.

- ✓ Sort orders: when western numbers and other non-Ethiopic Unicode characters are available in the lists, the sort orders can be affected.
- ✓ Special symbols: foreign symbols such as currency ($, €), copyright (©, ®), @, % (percent symbols are commonly used for local term of 'Bemotogna' (በመቶ), etc.
- ✓ Technical words: translated and adapted technical words and terms into Amharic language as they are used in English words. For example explore, file, account, ALT, ESC, BACKSPACE, etc.
- ✓ Acronyms: usually abbreviation words are adapted without changed or translated. For example CD, DVD, RAM, etc.

4.4 Identifying the Decision Criteria to Localize a Web Application

Before starting to localize a project first analyze and examine the required efforts and its cost to localize. Based on this analysis result we can make a decision wither the selected OSS web application project is feasible or not for local business use. Identify and adopt the decision criteria to know the feasibility of the selected web application localization is the third objective of the research study. From earlier literature analysis results, standards to localize Amharic language, and from identified and analyzed Amharic language contents, content formats and cultural preferences. The research study develops and adapts the recommended points of decision criteria before starting the localization processes.

To start using and realizing each points of aspects in the decision criteria first we need have to identify and prepare a decision reference checklist document. A reference document should be contains the following important points about a desired localized web application in order to understand the entire required efforts and costs, then makes a decision that localization can be feasible or not feasible:

- ➢ Identify and clearly define the purposes and a number of benefits from a localized application.
- ➢ Identify and express clearly the required number of functional requirements (features) of a localized application in local business use.
- ➢ Defines what values are needed to add in local business after localized application.
- ➢ Identify or estimate an organization maximum finance capability for the required localization work budget and profitability from the identified available market size.

The criteria points that are states below helps to understand and estimate the required efforts, cost/budget, time schedule and human resources then finally make a decision. The proposed decision criteria points to localize a selected desired web application are adapted from "Factors to be Considered while Deciding to Localize Software" in [3]. Table 4.2 shows the proposed decision criteria points to localize a desired web application which is adapted from [3]. The proposed decision criteria points which are essential to examines before starting to localize are the following:

- Features and functionality
- Design and development
- Market volume
- Text and related issues: Text size, Texts on graphics and difficult to extract texts
- Available of glossary terms
- Total cost: is the amount of license cost (if any) and localization cost.

Table 4.2 Proposed decision criteria points which are essential to examine before localize an OSS WBA, adapted from [3].

Proposed Decision Criteria Points Before Localize		**Factors to be Considered… to Localize from [3].**
Criteria Points	**Propose Points to Decision**	
Features and Functionality	More than 50% of required functionality requirements should be available.	Nature and Scope of the Software Product
Design and Development	An application developed with internationalization method is recommended	Size of the Target Market and Audience
Market Volume	Realize degree of acceptance	Market Acceptance
Text Size and Related Issues:- identify number of	✓ Words to be translated ✓ Unedited texts on graphics ✓ Difficult to extract texts	Competitor Behavior
Total Cost= License Cost (if)+ Localization Cost	Estimated cost should be less than the available budget.	Length of the Product Life Cycle and Anticipated Update Frequencies
The Available of Glossary Terms	It minimize cost and time required to finish	National or International Legislation
Adapted	New Added	From [3]

Features and Functionality

Number of features available in a web application that are appropriates and functionally applicable for local business numbers of functional requirements. If a web application

contains the features which are inapplicable to the local business use it should be removed out first. On the other hand, if the feature(s) which require for local business are not available it should be first adding the necessary feature(s) before localizing it.

Design and Development

Before starting to localize a web application first analyze and examine the design and development issues. The degree of hard coding in the application must not be more complex and required more efforts that are time consuming to reorganize it. Coding style should not be complicated to understand, redesign and to add/remove features or modules. A recommended and preferable design and developments of a web application to localize should be in the way of internationalization mechanism, because it reduces the required efforts and time to localize.

Market Volume

The availability of the desired target market size and the magnitude of acceptance in the local customers are must be realized before localizing. Moreover, the localized product should be also analyzed and examined the benefits and significant for the target local users.

Total Cost

The other basic factor need to consider before localized an application is analyze and estimate the required total amount of cost, which includes the license fee (if necessary) and overall localization cost. The total cost of localization relies on the variable factors in accordance with a type of project. Such as: project size and scope, the amount and its size of feature(s) essential to add and/or redesign, number of messages (words) to be translated and its cost per word, the magnitude and its price for graphics/image editing and how the professionals are paid (per hour, per workload or monthly/weekly salary), the length of product localization life time and others (team experiences, the available of resources for example previously translated terms/glossary).

Text Size and Related Issues

Text has an important role to affect and complex the localization process in order to achieve an effective and efficient localization result. Text can be a single word, set of strings or phrases which are needed to extract and translated into a target local language and cultural

preferences. Some of the text related issues that are needed to consider, inspect and examines carefully are the following. These are:

Text Size: - the number of special characters/symbols, words, message strings which should be extracted and put into localized resources to be translated. The amount of texts to be translated are determines the efforts and translation cost.

Text on Graphics: - text on the image(s) and icon(s) are can be difficult to extract and translate them are the fundamental issues of localization process that are essential to inspect and examine. If the text on graphics can be able to extract we need to consider and realize the amount of available space is sufficient to appropriately display the translated local text. But if the available spaces insufficient to display translated text and unable to extract the text on graphics, it should be required to redesign or replace with new appropriate images or icons. It needs additional extra efforts and costs which increase the localization budgets and schedule time to complete.

Difficult to Extract Text: - the other basic issue relates to text are texts or words or any special characters/symbols which are can be difficult to identify and extract to be translated or localized. Some of the examples of text that are difficult to extract are error messages which are might not be display when an event or situation is occurred, texts or words that can be put inside the programming tag and the others are symbols/characters or strings which are can be used to represent a country currency, organizational business trademarks, others local convention symbols, etc.

New Text: - the probability of happening and emerging a word that is not available exactly or similar local word or term to translate. If a term has not found similar local term, it requires creating new term or expressed with more than one locale words. In addition to these, how the term(s) or texts can be violates to the local cultures, traditions, conventions, government policies, rule of law, standards, etc. these type of issues are also should be consider to analyzes and examines the required efforts and costs before starting localize an application.

Based on the above mentioned main decision criteria points analysis result we can estimate the required cost and its efforts. From the estimated result and a capacity of organization

budget, we can make a decision it can be possible to localize or not a selected web application. The table 4.3 below indicates the general points of decision criteria to make a decision before localize an OSS WBA.

Table 4.3 General points of decision criteria to make a decision before localize an OSS WBA.

Decision Criteria		**Yes**	**No**	**Remark**
No. of features or functional requirement	Less than 50%			
	More than 50%			
Application design and developed with	Hard Coding			
	Internationalization			
	Easy to Redesign			
License cost	Required			
Unable to edit texts on graphics are	Less than 50%			
	More than 50%			
Available of glossary terms	Less than 50%			
	More than 50%			
Total No. of Yes and No				
Put ✓ on the option of Yes or No columns to identify an OSS web application.				

NOTE: 1. *Total number of Yes is more than total number of No = Localization can be feasible.*

2. *The available localization budget should be more than the estimated localization cost.*

4.5 A Framework for Localization of WBA into Amharic Language

4.5.1 Web Application Localization Work Flows

The activities required to localize a web application are almost similar to other software localization. But there is conditions we need to realize in web application localization, the information can be dynamic and it needs to be updating the term database or glossary terms and the other update required localizable resources. In addition to this it is essential to identify and predict the update frequency and its required length of time in post localization stages.

The following are the well-known main activities which are used to localize a web application. These are:

- Identify and define clearly the required purposes, benefit and number of features from a desired localized application.
- Search and select an OSS web application.

- Analyze and examine a selected application to check and decide localization feasibility.
- Identify and separate localizable resources from the source code.
- Customize or adapt an application design, including adding a required feature(s) and remove out feature(s) which is unnecessary for local business use.
- Translate the identified messages and prepare term database (glossary) and localize the other localizable resources.
- Localization functionality checking in order to test all required features are available, properly customized and their functionality. The localization functionality test also used to check a local language contents format are applied correctly, translated terms are properly displayed, and layout and cultural issues are appropriately used.
- Updating the term database (glossary) and other localizable resources if necessary.
- Make the Approval tests to check and make approves of all functional requirements are successfully achieved, the required objectives are accomplished, all information contents are displayed appropriately, and also used to check the error messages are properly localized.
- Implementing a web application to starting use if the approval test is successfully completed.

The proposed localization process workflow to localize an OSS web application user interface contents into Amharic language are illustrated in the diagram below. A figure 4.1 below shows the proposed workflow of OSS web application localization process.

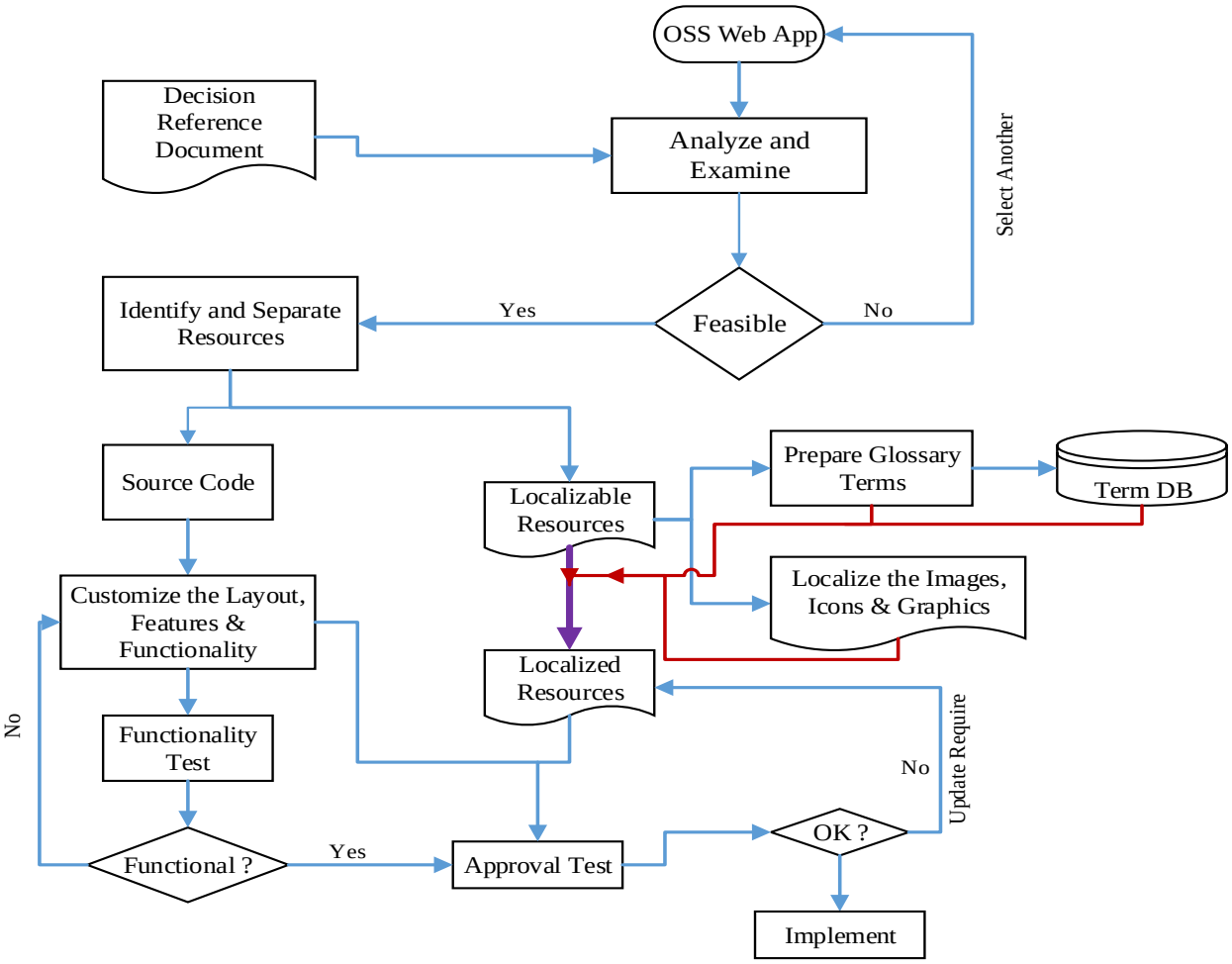


Figure 4.1 Proposed localization process workflow to localize an OSS web application UI content into Amharic language.

4.5.2 Components of Localization Framework

The components found in the proposed localization framework to localize an OSS web application UI are the following:

Guideline Document: - first identify and analyze the desired local organization business web application objectives and requirements. After that, prepare the reference document that used to provide information to the localization team in order to have common understand. Also helps to be able to make a decision during the localization processes.

OSS Web Application: - select and download an appropriate OSS web application for local business use based on the identified objectives and requirements.

Localization Team: - organize localization team, according to the type and nature of the application.

Analysis and Examine: - after selecting an application, analyze and examine to understand and make decisions for feasibility. Under this we can also identify and estimate the required total cost and efforts.

Separation: - in order to localize, customize and translate an application, we need first identify and separate localizable resources from the source code.

Localize: - localize can include recoding the source code to customize an application features and functionality. And on the other hand translate terms to make term glossary and customize, edit and adopt the graphics, images, icons and other localizable resource.

Test: - an application feature functionality test and approval test are applied to check localized components work properly, to identify and eliminate errors and to identify if changes or updates are needed. And also it is used to make sure that wither a desired localized application is achieved.

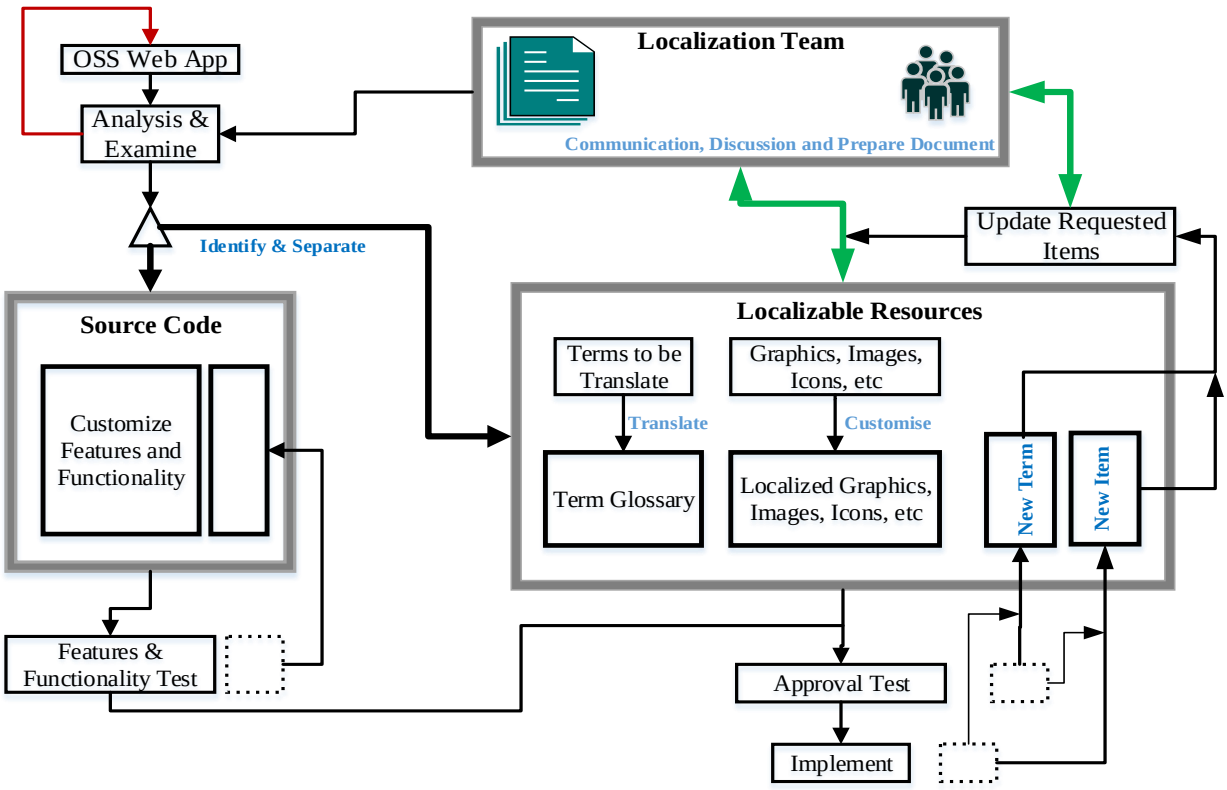


Figure 4.2 Proposed localization model to localize an OSS web application.

Update: - it includes add/remove out features, functionality change, translate terms for new or changes required terms and other update required application components.

Implement: - finally all required objectives, application features and functionality are successfully achieved, we can implementing an application for local business use. The figure 4.2 above shows proposed localization model to localize OSS web application.

4.5.3 Web Application Localization Team Composition Structures

Localization is a process of making an application suitable and appropriate to a native local user's language and cultural preferences. The processes and activities found in the application localization are required to make a team with the members of mixd proffesionals. The proposed recommended professionals in a team to localize an application. However a team size or the number of team members and a type of profession and the required number is decided based on the nature of a project. A project scope, size, how an internationalization development technque is applied, avialble budget, a period of time required to be completed, and the level of contents complication are some of the issues that have an important role to determinants a team size and member of profession type. The following are most commonly required localization team members composition:

- Localization project manager or coordinator
- Programmer(s)
- Language professional (s)
- Graphics editor

CHAPTER FIVE

5. RESULTS AND DISCUSSION

5.1 Results

From literature analysis gathered data on previous studies, we identify the basic web application localization issues and challenges. Some of the issues we need to consider before starting localizing web-based application that are identified during literature analysis are:

Project size: - it is core issue we should have analyzed before start localization activities. It determines total cost, required efforts, team size and compositions, time required and other additional required resources.

Design issue: - localizable source web-based application design and development approach is the other key issue we need to consider before localize a web application. In order to simplify localization processes and to minimize the overall required efforts, cost and time the localizable application should be designed and developed in internationalization design approach.

Coding style: - the source project source coding style or a way of development is a main issue in the localization process. Hard coding style required more effort and time consuming to understand, realize and then making to recoding/reprogramming the source code.

Project life time: - the amount of required localization process life time is an issue in localization. Because the web-application can create a new messages or text or document which should be localized, in addition the required amount of rate to update web-application. Finally, we need to estimate total time schedule that localization come in to finalize.

Market size: - in the literature analysis the other finding localization issue is market size. Before starting to localize the web application project first we need estimate the amount of demands available in the local market.

One limitation of this study is the lack of analysis of much more literatures that to finding out each and every issue of web-based application localization. But the other issues required considering during web application localization are eliminating texts, messages, colors, images, a way of expressions, etc. which are against to the local society cultures, procedures, religious practice and politics.

The objective of this study is to adopt decision criteria for feasibility of localization web application project. The other findings from literature analysis to identify and adopt the decision criteria are specified below. To estimate and understand the required efforts, total cost, total time, human resources and other required resources we proposed decision criteria to localize a selected web application. These are:

Web application features functionality: - these indicate the number of features available on source project and the required features and their functionalities of the desired web application.

Design and development: - design and coding style should not be complex and required more efforts to localize, add/remove features and functionality.

Total cost: - the overall efforts and cost required to localize a web application should be compromised with the available budget and their features functionality.

Text size and related issues: - the number of texts/words to be translated into local language determines the required efforts and localization cost. Translation cost should be examined and acceptable price for local business use. The other text related issues which can increase the required efforts and localization costs are:

- ✓ Text on graphics and image which are require editing the image and graphics.
- ✓ Text that is difficult or hard to extract.
- ✓ The frequency of creating new text/word in web application and needs translates.

Research result discusses below organize from an application which is used for testing. An application used for testing is applicable for an individual or family budget planning. On the other hand, it is focused on user interface contents which are texts on menus, labels, buttons and simple word(s) or phrases.

A research recommended procedures for localizing a web application into Amharic language speaker society are mainly: first analyze and examine an application, then extract and separate localizable resources. In the thired step customize and localize an application after these test and update. Finaly, implement an application for local business use. The paragraphs below indecate that the results from the application localization test result related with previously mentioned steps.

Just simply shows and observe the application without preparing guideline documents to analyze and examine an application before localization procedures begin. Preparing guideline document is advantageous to identify and estimates the required total cost, effort, time and then to make a decision for either localize an application is feasible or not.

In the extract and separate resources, identifies source codes, translatable terms, and other localizable resources such as images (logo, screenshot pictures). Then copy all files from source file folder to a new localized folder and move to localhost.

From customize and localize stage, translating and preparing Amharic language words using dictionary terms to make similar meaning and then save in the localized resource folder “AmFamilyBudgetPlanner”. After localized and translated the identified resources, test by writing the address of an web application in the browser’s address bar then enter. Figure 5.4, 5.5 and 5.6 below are shows sample screenshots after localization of an application homepage, inputting income and expense respectively. However, at this stage localization more needs to prepare team or group to achieve well better and desirable results. But during testing the research no localization group is organized to translate and localize the application homepage. In localization process, Notepad ++ 7.8.2 text editor application is used for translating and creating Amharic language terms. WAMPSERVER 2.5 also used for creating and testing a web application project written in PHP web language.

Translate terms into Amharic language then test the application. After that, if any errors or other issues which are required update, then edit and translate using text editor application. During translation and preparing local terms uses dictionary terms inside source code. No new files are created for the glossary terms or for term database in the processes of testing a “Family Budget Planner” application.

To make an application approval tests it needs previously prepared checklist document which is associated with the initial guideline documents. Approval test is useful to check and approves all required functional requirements are successfully achieved, objectives are accomplished, all information contents are displayed appropriately, and also used to check the error messages are properly localized. According to the required functionalities there is no identified problem during testing an application.

Useful points learned and understand from localization of application during testing are the preconditions that we should be get and recognize before localization an application. These are:

- Produce well organized guideline or checklist document(s) from clearly identified purposes and numbers of required features/functionalities from a desired application.
- Search and select an OSS web application by making multiple appropriate search key words for researching more again.
- Analyze and examine a selected application carefully to check and decide localization can be feasible or not.

5.2 Test and Evaluation

This section attempts to test a proposed framework to localize a web application user interface into Amharic language. A proposed solution test and evaluation only focuses on a single word or term UI contents such as menu items, button labels, check boxes, date and time values and other single term contents.

In the first stage identify the required application objectives, features and its functionality then prepare the reference guideline documents. At this stage simply goto searching an application which is applicable for personal level. Managing personal resource is an initial idea of a required application objective to search. Which means there is no created and organized guideline and checklist documents that to show the identified objectives, features and functionalities.

The second step is search and identifies a required open source web application to download and localize. Just for testing purposes download an application of “Family

Budget Planner". An application source files are found from www.sourceforge.net freely. The Family Budget Planner is used to assist to plan a personal or family budget.

After download application resources, analyze and examine in order to evaluate, add and remove features and functionalities in accordance with locally required. In addition to these, to estimate a required total localization cost including the required human resources, period of time to complete and other tools or resources. In this testing process there is nothing to add or remove features or functionalities simply attempt to localize the resources into Amharic language.

The pictures below are sample screenshot of an application and from the resource file before localize.

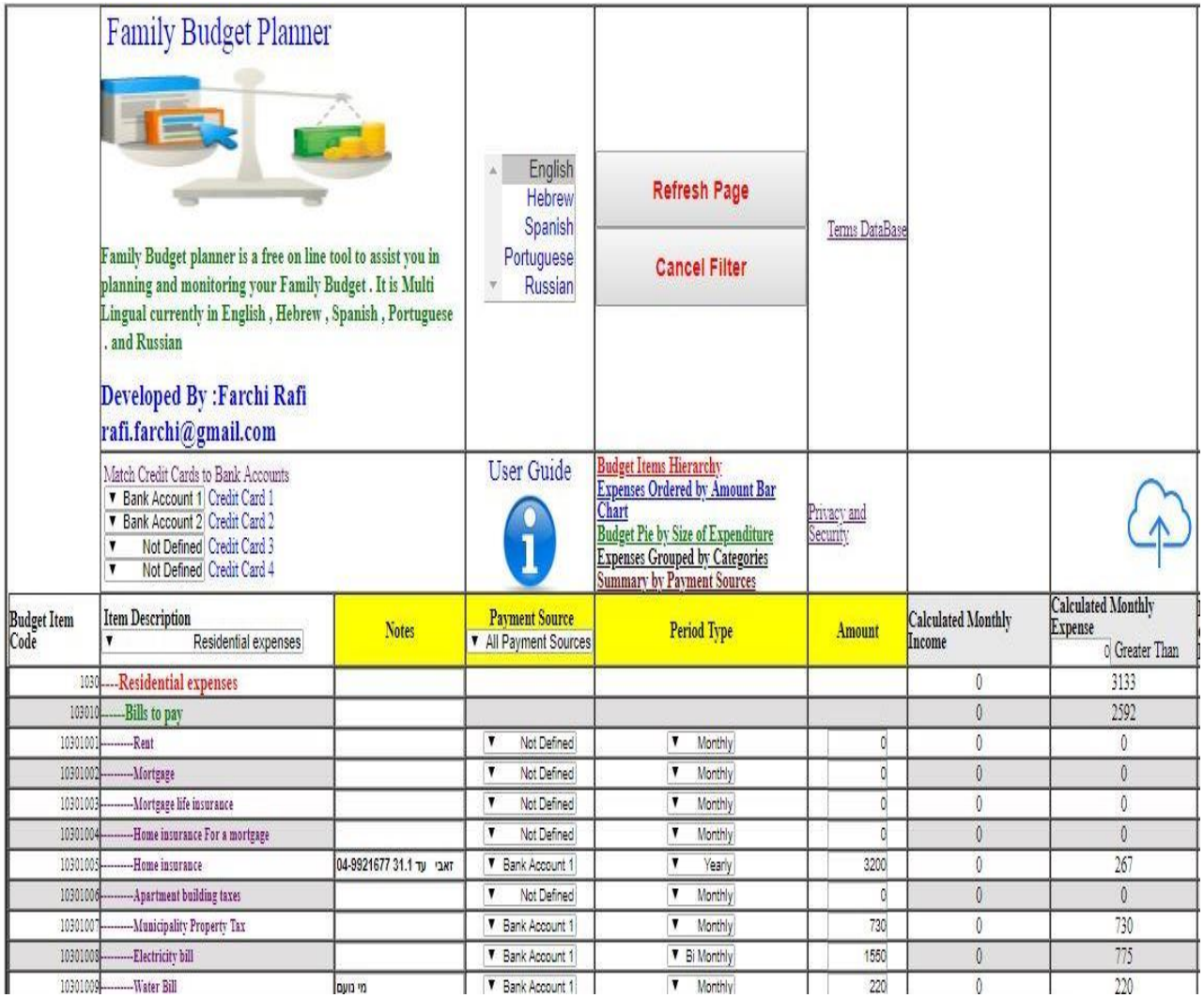


Figure 5.1 Screenshot from Family Budget Planner application homepage.

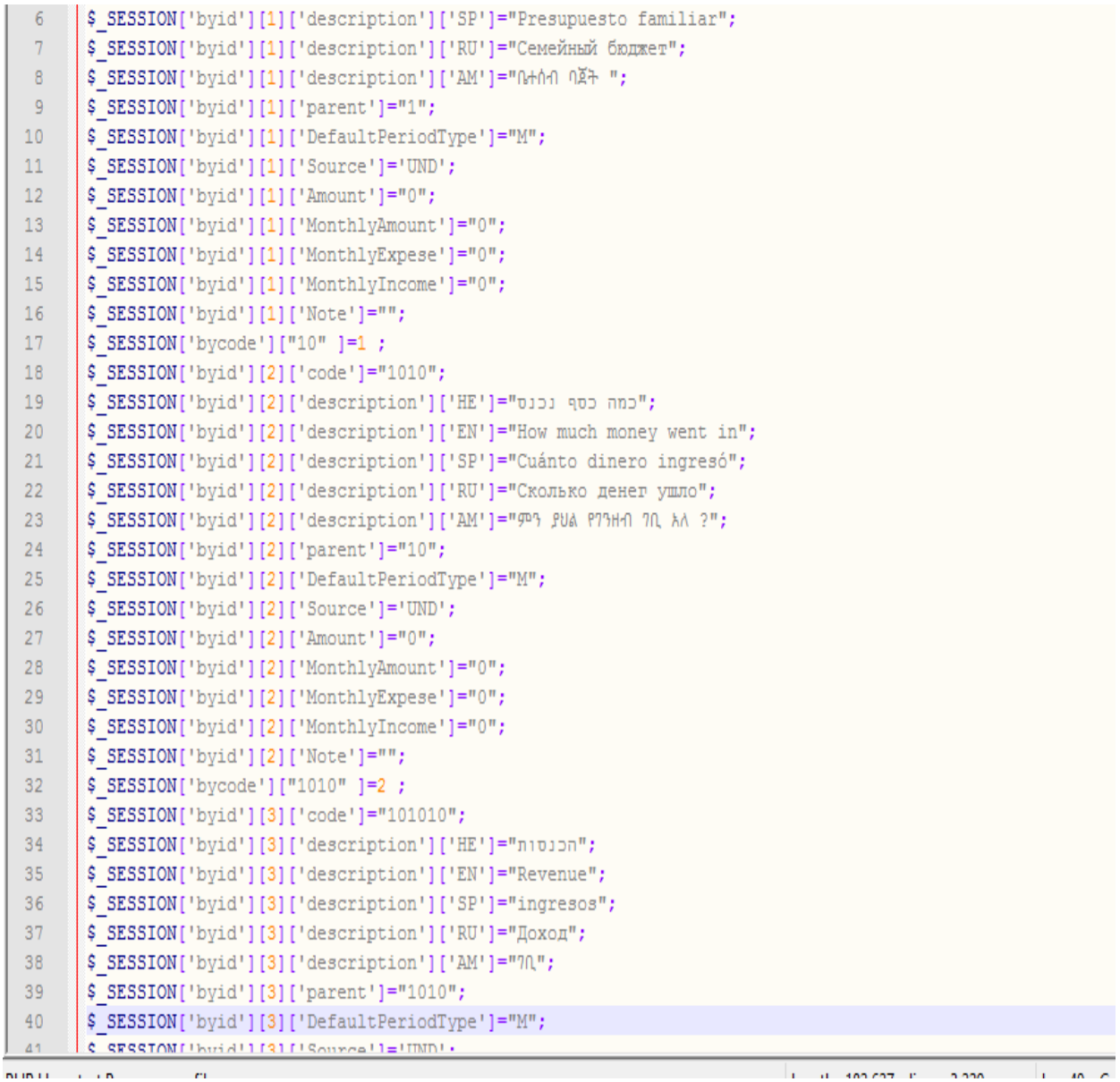
The images below show sample identified and separated localizable resources (images and graphics) from the resource file of a “Family Budget Planner” project. Figure 5.2 illustrates an application logo and user help icon.

Logo

Help Icon

Figure 5.2 Family Budget Planner application logo and user help icon from resource file.

From the proposed localization process workflow, translate the identified WBA UI contents into Amharic language is the one from the basic task of localization. The figure below is a sample screenshot of translating UI contents (labels text, dropdown, button’s text) using Notepad ++ 7.8.2 text editor. Figure 5.3 Sample picture during translation using Notepad++ text editor.



```
$_SESSION['byid'][1]['description']['SP']="Presupuesto familiar";
$_SESSION['byid'][1]['description']['RU']="Семейный бюджет";
$_SESSION['byid'][1]['description']['AM']="ቤተሰብ ባጀት ";
$_SESSION['byid'][1]['parent']="1";
$_SESSION['byid'][1]['DefaultPeriodType']="M";
$_SESSION['byid'][1]['Source']='UND';
$_SESSION['byid'][1]['Amount']="0";
$_SESSION['byid'][1]['MonthlyAmount']="0";
$_SESSION['byid'][1]['MonthlyExpese']="0";
$_SESSION['byid'][1]['MonthlyIncome']="0";
$_SESSION['byid'][1]['Note']="";
$_SESSION['bycode']["10" ]=1 ;
$_SESSION['byid'][2]['code']="1010";
$_SESSION['byid'][2]['description']['HE']="כמה כסף נכנס";
$_SESSION['byid'][2]['description']['EN']="How much money went in";
$_SESSION['byid'][2]['description']['SP']="Cuánto dinero ingresó";
$_SESSION['byid'][2]['description']['RU']="Сколько денег ушло";
$_SESSION['byid'][2]['description']['AM']="ምን ያህል የገንዘብ ገቢ አለ ?";
$_SESSION['byid'][2]['parent']="10";
$_SESSION['byid'][2]['DefaultPeriodType']="M";
$_SESSION['byid'][2]['Source']='UND';
$_SESSION['byid'][2]['Amount']="0";
$_SESSION['byid'][2]['MonthlyAmount']="0";
$_SESSION['byid'][2]['MonthlyExpese']="0";
$_SESSION['byid'][2]['MonthlyIncome']="0";
$_SESSION['byid'][2]['Note']="";
$_SESSION['bycode']["1010" ]=2 ;
$_SESSION['byid'][3]['code']="101010";
$_SESSION['byid'][3]['description']['HE']="הכנסות";
$_SESSION['byid'][3]['description']['EN']="Revenue";
$_SESSION['byid'][3]['description']['SP']="ingresos";
$_SESSION['byid'][3]['description']['RU']="Доход";
$_SESSION['byid'][3]['description']['AM']="ገቢ";
$_SESSION['byid'][3]['parent']="1010";
$_SESSION['byid'][3]['DefaultPeriodType']="M";
```

Figure 5.3 Sample picture during translation using Notepad++ text editor.

The next stage is translating and preparing Amharic language words using dictionary terms to make similar meaning save in the localized resource folder “AmFamilyBudgetPlanner”. Once all resources are localized and translated move to a localhost www folder. Run and test by typing http://localhost/AmFamilyBudgetPlanner/index.php in the address bar. The pictures below are sample screenshot of an application after localization procedures.

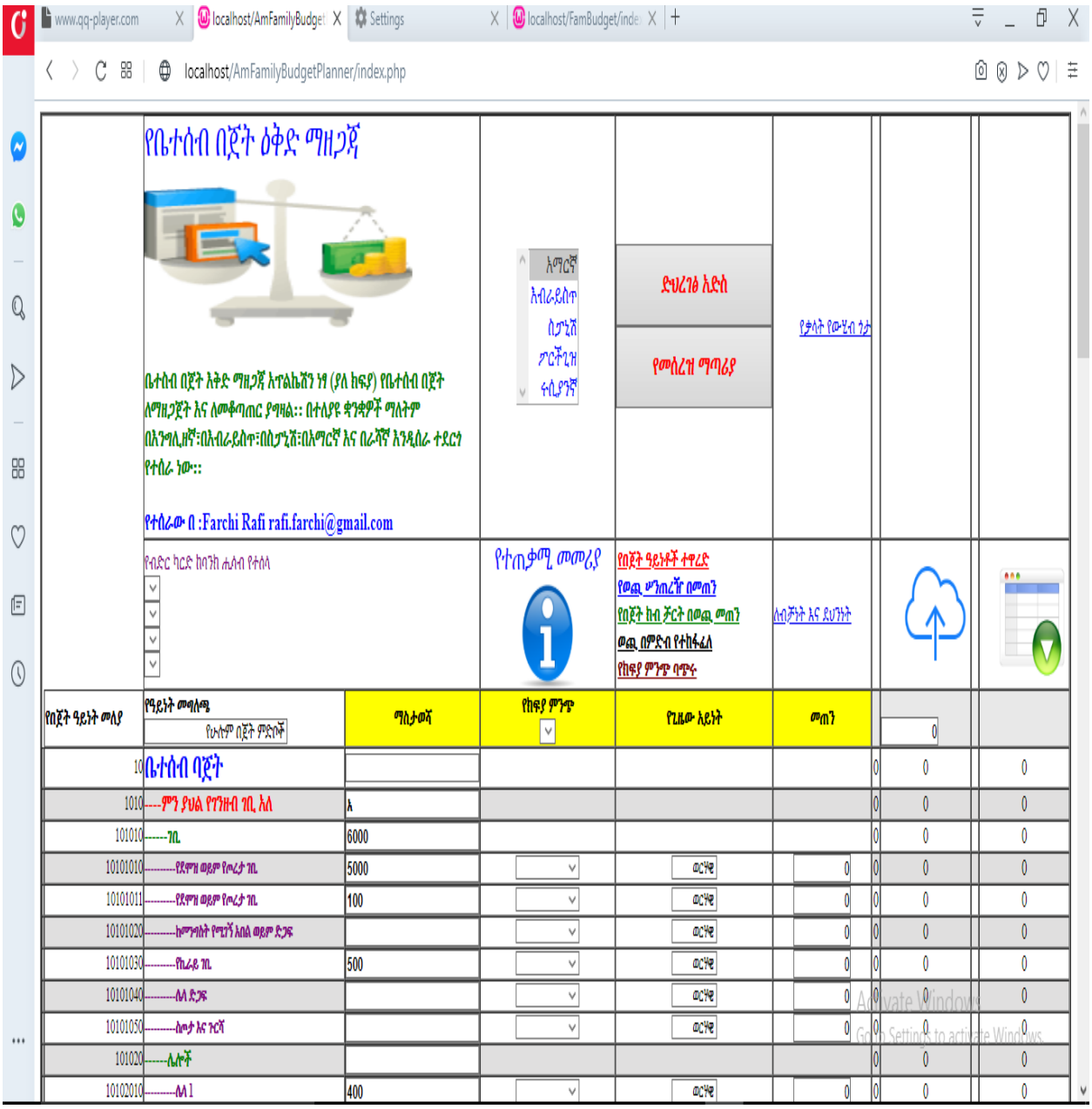


Figure 5.4 Sample screenshot after translate and localize the application home page.

The picture below shows an application family income registration or input screen after localization procedures are done. Figure 5.5 below illustrates sample screenshot after translate and localize an application family income registration input screen page.

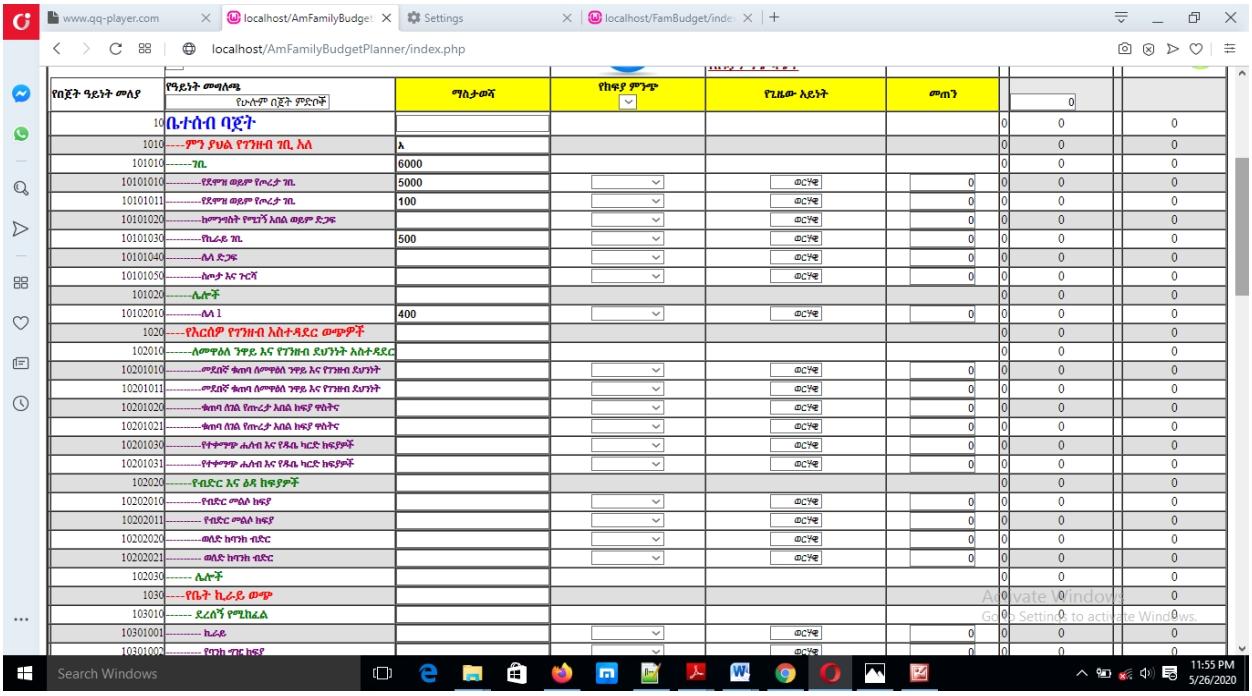


Figure 5.5 Sample screenshot after localize an app family income registration/input screen.

The picture below illustrates a sample screenshot after translate and localize an application family expense registration input screen page.

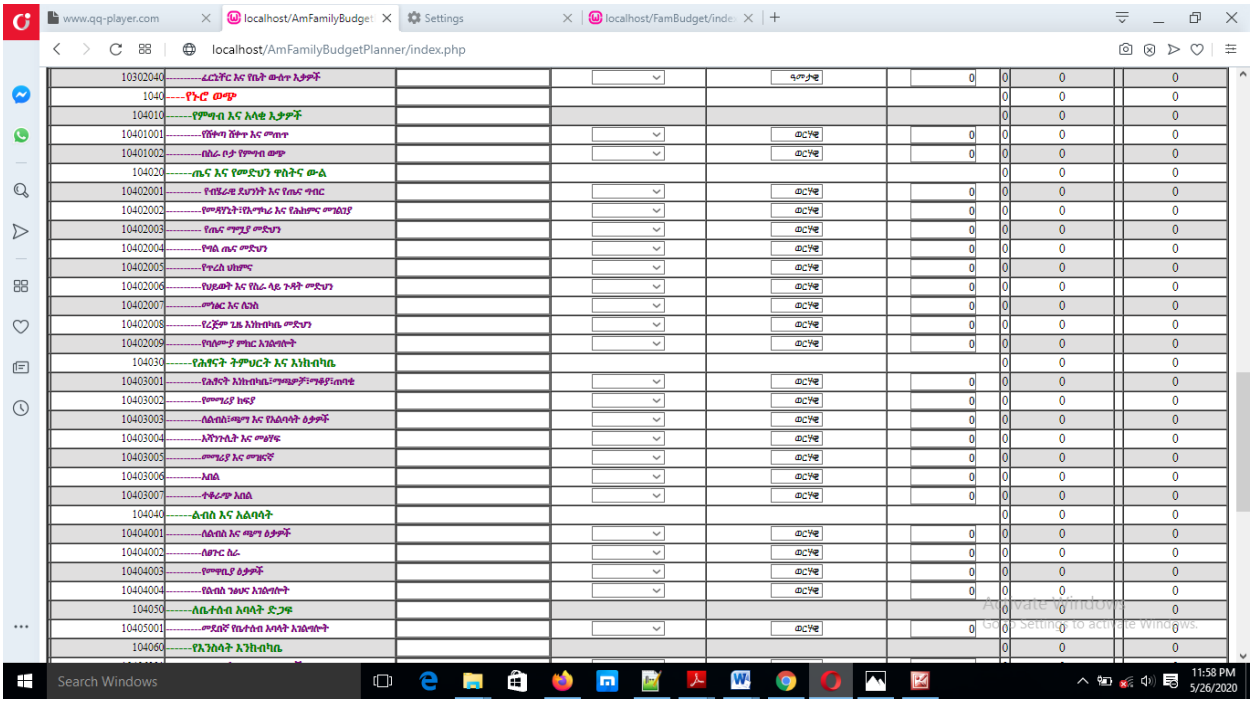


Figure 5.6 Sample screenshot after localize an application family expense input screen page.

5.3 Compare with Previous Related Works

In earlier related works, most of the developed frameworks are particularly applicable for the European, Asian, Indian and Arabic language contents and cultural formats. In accordance with localization steps and procedures, M. Bhatia, et.al proposed nine (9) phases to localize the project. And they are furthermore concluded with the following substantial localization process steps. Which are: analysis, assessment, creation and maintenance, translation, adaptation, media localization, testing, quality assurance and project delivery. In addition to these S. Gross also proposed three major steps to successfully software localization.

On the other hand, the Ethiopian local researchers (Lielet G., and Rufael T. and Fekade G.) are focused on designed methodology to localize an open source software content management system (CMS) into Ethiopian Amharic, Oromigna, Tigrigna languages. Both studies were used an open source web development tool (Joomla) and developed virtual keyboard that users can able to localize. But in these studies not covered the following Amharic language contents and cultural issues. These are Geez numbering format, currency, calendar, Date and time, name and title.

The results identified in this study which are differ from the previous studies are the following. These are: -

- Attempt to address all issues and challenges during localization of OSS WBA user interface contents into Amharic language content and cultural context preferences.
- Proposed the decision criteria points which are used to making a feasibility decision before starting to localize an application.
- The proposed OSS WBA localization process workflow and localization model differs from the previous related works which are stated on above. Which means, the study result recommends, before starting localization activities first we need to prepare reference checklist document to analyze and examine a selected OSS web application to make a decision either feasible or not.

CHAPTER SIX

6. CONCLUSIONS AND RECOMMENDATIONS

OSS organizations or institutions or individual developers provide free and open source applications freely. This provides a numerous benefits for developing country like Ethiopia. Website application is one of the OSS product with source codes and resource files to adapt, customize and localize. But OSS websites mostly designed and developed for English language speaker countries and cultures.

A typical use of a website is communication to access/delivers information and services. The writing language characters and symbols, punctuation marks, Date and time, calendar, currency, name and title, sort orders, etc. are some of the common contents and content formats of a particular local language and cultural issues which are found in a website's UI. Websites content, layout and cultural formats are most commonly designed and developed in English language and cultures. Language and cultural differences are challenges or problems to use websites for native local users.

In addition, use and access internet in English language has an impact on the native users, local language and culture which can blend with foreign language and culture. Language and cultural practices are simply defining and shows an identity of a local society. To use a technology including access and using internet or website should be language independent.

To gain benefits from OSS we have to localize into a target local language and cultural preference to use an open source web applications for local business. A research developed a framework for localization of an open source web based application's UI contents into Amharic language and cultural preferences.

The research study designed appropriate framework to localize an open source web application into Amharic language and cultural preferences. The proposed framework covers four central concerns. Which are: localization issues and challenges, decision criteria to localize, identify UI contents and finally localize the identified contents.

The research attempted to identify and analyzed essential localization issues and challenges to localize an application into Amharic language and cultural preferences. However the issues and challenges of localization are huge and complicates in accordance with the type and nature of an application.

Making sure an application is applicable to local use, recognizing the required efforts, costs, human resources and the time taken to complete are some of issues before localize an application. In addition to these, identify and analyzes a project size, coding and design style, application life time, market size and knowing that an application is appropriate and relevant to target native local language, cultural context issues and conventions.

On the other hand, there are challenges when localizes an application such as to realize hard coding, long text size to display, to edit texts on the image and a local language and cultural specific contents. Plus to these identifying local specific issues, which are government procedures, standards, polices and business laws are other common localization issues we need to consider during localization process.

Localization decision criteria's are required to understand and estimate the required efforts, cost/budget, the time schedule and human resources then finally to making a decision. The following are essential points to be included in decision criteria to localize a selected desired web application:

The number of features are available that appropriate and functional according to a number of functional requirements for local use. An application design should not hard coded style, complicated to understand, require more efforts and time consuming to reorganize and localize. A preferable design and development is in the way of internationalization mechanism to reduce the required efforts and time taken. In addition, other factors that need to realize are the available market size, a magnitude of acceptance, total cost required, the available budget and examine the benefits and significant of an application for a target local users. We can estimate a required effort and total cost by analyzing the decision criteria points to make a decision.

Translate and adapting user interface contents are fundamental and central parts of an application localization process. Text to display, menu items, button text, labels, check

boxes, messages, help document, etc. are the common contents of the UI which should identify and separates to localize. Amharic language contents and content formats are practically different from English language contents and content formats. Local cultural issues such as abbreviation, sort order, name and title, date and time, calendar, etc. are also the main concerns in localization tasks.

Finally, after identified and analyzed UI contents localize according to a target local language and cultural preferences. Translate terms, customize and adapt the identified UI contents and layout including application features or functionality are the main activities to completion of the localization processes.

Future Works

Ethiopia is a collection of multi-nations, multilingual, multicultural and traditions country. In Ethiopia over eighty (80) languages are spoken. Ethiopian societies are connected each other and within worldwide through economic, political, technological, linguistically, geographical and other interconnecting mechanisms. Governmental or non-governmental organizations, business institutions and companies are using website to communicate and deliver their service for multilingual and multicultural local customers.

In Ethiopia, all local societies should be able to access and uses information and services which delivers through a website in their own native language. In order to create and build digital society and digital economy, everyone should get services and information in own language and cultures. So localization has an important role to achieve and build digital society; on the other side it plays a major role to develop a country. Localization will be better when administrate and manage in a central national level organization and preparing multilingual term glossary database. In future works, research recommends to study and develop the localization framework for Ethiopian multilingual and cultural societies to translate and localize multi-languages concurrently or at the same time. Build a central language translator server for local multi-language glossary terms and for translation services. Local language and culture localization standards, polices and strategies should be studied and developed in national level of responsible organizations.

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