

IMPROVEMENT OF ENGINEERING WEBSITE FOR CROSS-CULTURAL ACCESSIBILITY AND USABILITY

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Abstract. Websites that help manage and display the content which relates to various fields of engineering have become a significant assistant for industries of engineering. In many cases such websites are developed to address international audience and referred to as cross-cultural websites. The design of such websites is directly connected with improvement of the displayed content and user interface. It is recognized that the design process of cross-culturally usable and accessible websites does not involve just a translation of their content. In this paper methodology that allows improving the website content and design accessibility and usability for international users is introduced. For application case of the developed methodology, engineering website of the Scientific Laboratory of Biofuels initially developed for Latvian users, is analyzed and improved for Japanese users.

Keywords: cross-cultural, improvement of website, design methods, usability, accessibility.

Introduction

Development of various engineering research states and results publishing, laboratory or scientific group representation websites are often orientated for international audience. It is important to display the produced information in an accessible and usable form for various types of users. There can be different aims for creation of such websites, for example, to search for international research partners, attract funding, improve competitiveness of higher education, stimulate scientific experience exchange and announce seminars or conferences.

Websites that have abilities to function successfully in international fields are called cross-culturally accessible and usable websites. It is recognized that the design process of cross-cultural websites involves many design tasks [1]. The previously published researches [2] have already shown that if a website that is initially developed for users of certain culture is introduced to those who are from another culture, later without detailed improvement, usability and accessibility of this website can decrease. In the field of cross-cultural website development certain issues and design recommendations have been introduced by various authors.

The aim of this article is to bring forward design considerations and develop methodology for improvement of engineering website for cross-cultural accessibility and usability. To reach the aim, the following tasks are brought forward:

1. Summarize website groups and define engineering website.
2. Bring forward issues, which are important for design improvement.
3. Develop engineering website design improvement methodology.
4. Select culture and use methodology for improvement of the existing engineering website for the users from the selected culture.

Materials and methods

There are various matters which many commercial and non-commercial websites face, including the fact, that a part of websites are built without well defined design. Poor design can reduce usability and accessibility of the website content. According to Nielsen [3] about 90 % of commercial websites have poor usability. A poor website design is caused primarily by the lack of understanding of the target users [4], so as the culture to which the users belong.

Many terms related to the Internet including the definition of websites are ambiguous [5]. Researchers have tried to categorize websites from variety of perspectives. Two major streams of research on web classification and typology are based upon work in information science and marketing research [6]. For example, O'Neill and Lavoie [5] discussed three types of websites from technological perspectives, which include: public, private and provisional websites. At the same time there are other classifications available [6], such as classification in hierarchical way or classification

by different values created on the websites. The mentioned classifications are not a complete list. In this paper extraction from the classification that includes the sphere of activity as the criteria is chosen.

Engineering is widely taken as a disciplined application of scientific knowledge for the solution of practical problems. Various definitions confirm that engineering is accomplished through knowledge, mathematics, and practical experience applied to the design [7]. Engineering field website typically is of moderate richness in terms of the content. That means, these websites provide graphs and pictures, and some degree of interactivity such as basic search engines. The content of these pages may be updated on weekly or monthly basis. Typical examples of engineering websites include research laboratory websites, scientific conference websites, educational institution websites, article publication websites and others. It is seen that the list can be broad. However, common design aspects for cross-cultural engineering websites can be summarized based on evaluations of the website design.

Issue groups for design improvement of cross-cultural website

Aykin and Milewski [8] bring forward five common design issues and guideline groups that are important for design of cross-cultural information system user interfaces. From these groups, specific issues related to the improvement of engineering websites were selected and discussed.

5. Images, diagrams and icons.
 - 1.1. Maps. Maps that are published must always include actual information. It is considered as an insult, if a map is not drawn to scale or does not show the current legal borders [8].
 - 1.2. Image and text reading direction. The direction of how images, graphs and icons are read is important. Not all languages are read from left to right. The same direction in reading applies to displaying images in sequence [9].
6. Language rendering and translation.
 - 2.1. Language. Many countries can share the same language. Some countries are multilingual. Some countries have different dialects and writing scripts. The lack of a one-to-one relationship between countries, languages, and scripts means that designers must consider both language and country as potential determinants of design [8].
 - 2.2. Fonts. There is a need to consider character sets, spaces between symbols, words and lines. Selection of appropriate font families has to be taken into account. Font family loading priorities have to be defined using Cascade Style Sheets (CSS) [9].
 - 2.3. Writing direction. Main writing directions are from left to right, right to left and top to bottom [9].
 - 2.4. Translation support. There is a need to identify the content of strings in the code to be translated. This can be done by either including comments in the resource files or providing separate text files to the translators [8]. A clearly written text and translation glossaries should be provided, because translators will often have difficulty translating ambiguous terminology [10].
 - 2.5. Paper size. Paper sizes used in a certain country or region must be considered. The international standard ISO 216 regulates the paper sizes and is adopted in most of the countries [8]. When designing documents for publication in website, the page margin sizes should be considered.
 - 2.6. Abbreviations and acronyms. Should be included in the translator's glossary so that the meaning does not get lost during translation. All abbreviations and acronyms should be spelled out, beforehand translated, or left unchanged if they are universal [8].
 - 2.7. Spelling. The same language used in different countries can have different spelling rules. It is important that the users feel the language is theirs and not an imported version [8].
 - 2.8. Text expansion. When translating a text to other languages, the text can expand for 30 % to 200 %. Hoft [10] recommends that the layout should be designed to accommodate a 30 % text expansion rate. If the text is less than 10 characters long, the expansion rate can go as high as 200 % or 400 % [10].
 - 2.9. Sorting. Languages differ in the ways the characters are sorted [9]. The ISO standard ISO/IEC 14651:2007 provides universal default collation orders for multiple languages and can be used for designing lists and sorting texts in websites.
 - 2.10. Terminology. It is recommended to eliminate culture-specific metaphors, avoid jokes, humor, idioms which are understandable only by local users, gender-specific references and colloquial language. The translated version must retain the technical accuracy [8].
7. Formatting of objects.

- 3.1. Date and time. Date and time formats are sometimes associated with specific languages or locales. Even there is an international standard ISO 8601:2004 for international date and time formatting, many countries follow local date and time formatting [8].
- 3.2. Numeric formatting. There could be seen differences in use of thousands and decimal separator, the number of digits between separators and negative numbers [8].
- 3.3. Names and addresses. There are many formats and order sequences for display of an address.
- 3.4. Telephone numbers. The differences between telephone numbers can be seen in the total number of digits, separators, groupings of numbers, country codes and extensions [8].
- 3.5. Currency. Some countries have special symbols for currencies, such as \$, ¥, £ and €. The standard ISO 4217:2008 defines three-letter abbreviations for the representation of currencies and funds.
- 3.6. Monetary values. Most locales use their numeric formatting rules in terms of a decimal and thousands separator. The placement of the currency symbol also differs [8].
- 3.7. Sizes and measurements. Some countries use the imperial system for the measurements, whereas most countries use the metric system [8]. The sizes and measurements that may change include: typographic units, temperature measurements, paper and envelope sizes and clothing sizes.
8. General issues. Aykin and Milewski [8] also bring forward groups of issues and guidelines that relate to the design of non specific type of websites, this includes colour selection and improvement of the layout. Also other researches [11] show certain general issue groups and guidelines:
 - 4.1. Layout. For content layout, liquid layout is recommended [9].
 - 4.2. Navigation. Navigation menu should be placed according to the users reading direction. As a universal solution, top horizontal position is recommended [12].
 - 4.3. Character encoding system. It is recommended to use universal text encoding system, such as UTF-8 for support of various characters [12].
 - 4.4. Colour. Variations of blue colour are considered most safe for cross-cultural website design [13].
 - 4.5. Icons. The text should not be included in the design of icons [9]. Development of understandable icons is recommended. For example, for e-mail, the image of an envelope is recommended [14].
 - 4.6. META data. Inclusion of appropriate META keywords in the heading of the website can improve the website rating at search engines [12]. META keywords and description must be translated.

Methodology for improvement of website for cross-cultural usability and accessibility

Methodology for improvement of the existing website for cross-cultural usability and accessibility can be developed based on the available methods, known issues, practices and recommendations. This methodology is directly addressed to website user interface designers and content suppliers. Methodology can be displayed as a flowchart shown in Fig. 1, where each rectangle element represents a separate method or process and diamond represents the decision.

It can be seen that the methodology includes technological and organizational methods and their application sequence for the website improvement process. After accessing the source code and the files of the existing websites, two synchronous method execution sequences can be started, which include creation of the design wireframe and extraction of the content text and META data from the existing structures. Wireframe is a simplified mock-up of how the website will look, but devoid of colors, images and custom font styles. Wireframe allows discovering potential problems early in the design process and make decisions for improvement of the structures. The final method is publication of a prototype for the improved website.

Results and discussion

For application of the developed methodology, the website of the Scientific Laboratory of Biofuels located in Jelgava, Latvia was chosen. The website URL is <http://tf.ltu.lv/adzl>. It is available online in the Latvian language for local users, but there is a need to improve the website design for users from other countries. Improvement of this website for the selected culture users was made with the developed methodology. As the selected culture users, Japanese users were chosen. The Japanese users are separated from the Latvian ones by distance and have different characteristics and preferences than those who are from the European countries [15].

The analysis and improvement results of the website are summarized in Table 1. In the column “improvement recommendations” changes to the design are included. If these changes to the design are not needed, the acronym CNN is used. The column “No. of method” displays the numbers of methods that deal with certain issues. The numbers are taken from the developed flowchart displayed in Fig. 1.

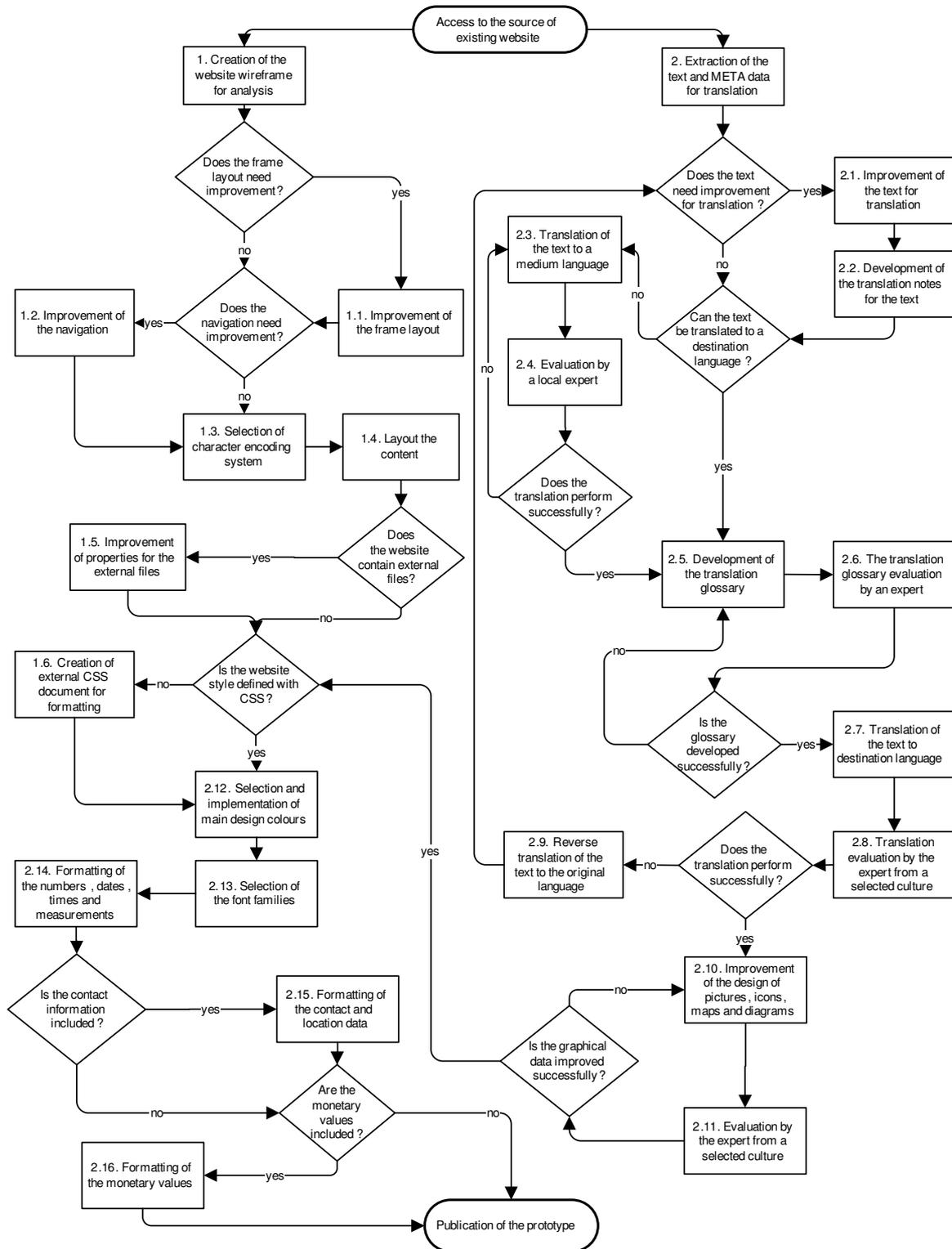


Fig. 1. Flowchart of the developed methodology

As seen in Table 1, there was a need to improve more than a half or precisely 15 issues from the total of 26 issues that are mentioned before the development of the methodology.

Table 1

Analysis and improvement results of the existing website

No. of methods	No. of issue	Existing website analysis (Latvian case)	Improvement recommendations (Japanese case)
1.1	4.1	Fixed layout.	Liquid layout [9].
1.1, 1.2, 1.4, 2.10,	2.8	Word count on the main page: 533. Occupied space: 1 A4 size page.	Word count on the main page: 1403. Occupied space: 1,5 A4 size pages.
1.2	4.2	Left vertical.	Top horizontal [11].
1.3	4.3	UTF-8	UTF-8 [14]. CNN.
1.4, 2.7	2.9	No sorting in the text.	CNN.
1.5	2.5	Sizes defined in ISO 216.	Sizes defined in JIS P 0138-61 [16].
1.6	2.2	CSS is used.	CSS remain. CNN.
2, 2.3, 2.7	4.6	META data are available.	META data must be translated [11].
2.1, 2.2, 2.5,	2.4	Translation notes needed. Need for a translation to a medium language.	Development of translation notes and the text translation to English.
2.1, 2.8	2.7	Not the same language family.	CNN.
2.2, 2.3, 2.5, 2.7	2.10	Culture-specific metaphors are not used. Field terminology is used.	Field terminology inclusion in glossary and translation.
2.3, 2.7, 2.14	3.1	DD MM YYYY and 24 hour time is used. Defined in ISO 8601:2004.	Need to be formatted: YYYY MM DD or 2011年10月7日, 24h [8].
2.3, 2.7	2.1	Latvian variant of Latin alphabet.	Scripts: kanji, katakana, hiragana [11].
2.3, 2.7	2.3	Left to right.	Top to bottom, left to right [11]. CNN.
2.1, 2.5	2.6	Encountered in the text.	Inclusion in the translation glossary.
2.10	1.1	Not available.	CNN.
2.10	1.2	Left to right.	Left to right, top to bottom [11]. CNN.
2.10	4.5	Icons are not available.	CNN.
2.12	4.4	Green.	Blue [13].
2.13	2.2	Case sensitive. Arial, Helvetica and sans-serif.	Case insensitive. MS PGothic, Hiragino, Osaka [11].
2.14	3.2	Arabic numerals with decimal comma or point. Minus sign before negative numbers.	Arabic numerals with decimal point [8]. Minus sign before negative numbers.
2.14	3.7	Metric system used. Temperature: Celsius. Specific typographic units not included.	Since 1924, metric system is used [17]. Temperature: Celsius [8]. For typographic units CNN.
2.15	3.3	Sequence: name, e-mail, phone number, city, street, building number. No index and no country name included.	The address must be written in order from largest unit to smallest. Sequence: country, index, city, street, building number, name [18].
2.15	3.4	Full notation used, +371-00000000.	CNN.
2.16	3.5	Not used.	CNN.
2.16	3.6	Not used.	CNN.

Conclusions

1. From the developed methodology, it can be seen that translation of the contents is just a part of the whole website improvement processes. However, an appropriate method application sequence for translation is very important. There is a need to not just search for an appropriate expert to perform translation, but improve the source text with generalization of concepts, explain abbreviations and even consider using a medium language for translation. In the mentioned case, there was a need to translate a text to English and only then translation to the Japanese language could be performed. This can be explained by the lack of Japanese language experts in Latvia.
2. The developed methodology has been successfully applied on the improvement process of the selected website. The prototype was built. However, there is a need to evaluate prototypes with

- more users from Japan which is planned in near future. It means that an evaluation of the methodology is still in progress and it is early to provide certain statements about efficiency of the developed methodology and application for cases with other selected cultures.
3. As the cross-cultural website development is a relatively new field of research, there is a possibility that new issues can be identified and added to the overall classifications. So, it is recommended to perform the general examination and the issues clarification of a selected culture that can address an improvement process. There is also a seen synthesis of culture, tradition, globalization and technology, for example, Japan has accepted the metric system and global website development practices, such as an information display for the direction from left to right.
 4. It can be noticed that the developed methodology involves the execution of methods that can have overall increasing costs, such as for recruiting translators and experts from the selected culture. In the development process of this methodology the costs were considered as a secondary factor, with main attention paid to the improvement of the quality of the development process.

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References

1. Shaoyi H. Interplay of Language and Culture in Global E-commerce: A Comparison of Five Companies' Multilingual Website. Proceedings of "19th Annual International Conference on Computer Documentation, Vol. 1", October 21-24, 2001, Santa Fe, USA, pp. 83-88.
2. Rau P.R., Gao Q., Liang S.M. Good Computing Systems for Everyone – How on Earth? Cultural Aspects. *Journal of Behaviour & Information Technology*, vol. 27, 2008, pp. 287-292.
3. Web Usage Paradox: [online] [13.02.2011]. Available at: <http://useit.com/alertbox/980809.html>
4. Radosevich L. Fixing Web-site Usability. *InfoWorld*, vol. 19(50), 1997, pp. 81-82.
5. Web Characterization Using Sampling Methods. [online] [23.02.2011]. Available at: <http://www.w3.org/1998/11/05/WC-workshop/Presentations/oneill/index.htm>
6. Pan B., Fesenmaier D.R. A Typology of Tourism Related Web Sites: Its Theoretical Background and Implications. *Journal of Information Technology and Tourism*, vol. 3, 2000, pp. 155-166.
7. Mendes E., Mosley N., Counsell S. The Need for Web Engineering: An Introduction. In *Web Engineering*. New York: Springer Berlin Heidelberg, 2006, pp. 1-27.
8. Aykin N., Milewski A. Practical Issues and Guidelines for International Information Display. In *Usability and Internationalization of IT*. New Jersey: Lawrence Erlbaum, 2005, pp. 21-50.
9. Marcus A., Rau P.R. International and Intercultural User Interfaces. In *The Universal Access Handbook*. Boca Raton: CRC Press, 2009, pp. 156-166.
10. Hoft N.L. *International Technical Communication: How to Export Information about High Technology*. Toronto: John Wiley & Sons, 1995. 400 p.
11. Vitols G., Arhipova I., Hirata Y. Evaluation of Cross-Cultural Web Information System Design Guidelines. Proceedings of the 13th International Conference on Enterprise Information Systems - Volume 5: Human-Computer Interaction. SciTePress (In Press).
12. How to Design Websites That Appeal Across Cultural Divides. [online] [11.03.2011]. Available at: <http://tutorialblog.org/how-to-design-websites-across-cultural-divides/>
13. Tips and Thoughts on Cross-Cultural Global Web Design. [online] [15.02.2011]. Available at: <http://speckyboy.com/2010/06/30/tips-and-thoughts-on-cross-cultural-global-web-design/>
14. Choong Y. Cross-cultural Issues in Human-Computer Interaction. In *International Encyclopedia of Ergonomics and Human Factors*, vol. 1 part 5. London: Taylor & Francis, 2001, pp. 644-647.
15. Okazaki S. Does Culture Matter?: Identifying Cross-national Dimensions in Japanese Multinationals' Product-based Websites. *Electronic Markets*, vol. 14(1), 2004, pp. 58-69.
16. Paper sizes in Japan. [online] [17.02.2011]. Available at: <http://sizes.com/materls/paperJapan.htm>
17. Japanese units of measurement: Wikipedia. [online] [12.03.2011]. Available at: http://en.wikipedia.org/wiki/Japanese_units_of_measurement
18. Address (geography): Wikipedia. [online] [19.01.2011]. Available at: [http://en.wikipedia.org/wiki/Address_\(geography\)](http://en.wikipedia.org/wiki/Address_(geography))