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SOFTWARE LOCALIZATION: ISSUES AND METHODS

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ABSTRACT

This paper examines the key issues in software product and interface localization, including the cost and the specific aspects of software that must be localized, and a methodology for analyzing and documenting software localization. Software localization is the process by which computer applications are analyzed and adapted to the requirements of different markets. The paper is based on a review of relevant literature, meetings with localization industry representatives, and an ongoing participant observation in a global telehealth company. Examples from the company illustrate the localization issues and their possible outcomes or solutions. Several research studies in the area of localization are identified in the conclusion of the paper.

1. INTRODUCTION

Software localization is the process by which computer applications are analyzed and adapted to the requirements of different markets. This analysis and adaptation may be done after the application has been successfully used or marketed in one country and the desire is to make necessary changes for a new market. While this produces software that is tailored to a specific market, the application is still not ready for easily adaptation to other markets (Johnston 1996). Increasingly localization is a concern from the beginning of application development, with the business strategy to introduce the application in multiple markets. In this second approach, the application is designed from the beginning to support international conventions, languages, formats and processing. This second approach makes localization easier and less costly (Miller, 1994; Washington Times, 2000), even though it requires a larger initial cost (Johnston 1996). In the localization process it is necessary to identify the parts of the application that are unique to a specific country or area (such as language and culture) as well as those that are based on the organization's needs in one locale. This localization process is necessary for software to be successfully marketed globally, for software that is used within an organization to be deployed internationally, and for websites aimed at the world market.

Localization may also be necessary within a country when there are distinct cultures within a country. Such localization enables *cultural/ethic marketing*, which is the adaptation of a product or its marketing to address the specific needs, desires, tastes and consciousness of particular cultural or ethnic groups (Foreign Exchange Translations, 2000). While the tendency in localization is to focus on differences between groups of

potential software users who are then viewed as quite homogeneous, it is also important to recognize that cultures are difficult to describe and measure and many individuals are multilingual and/or culturally heterogeneous. Developers of design rules for localization have to be careful to avoid stereotypical views that do not adequately represent the richness and variation in cultural meaning in any single group (Bourges-Waldegg and Scrivener, 1998). Increases in international travel for education, work and leisure, as well as transnational media and corporations are likely to create *transnationals*: individuals who are comfortable in multicultural and multilingual settings. Similarly, driving the deployment of global information systems is the need for common business processes and data within global organizations (Collins and Kirsch, 2000). Despite these trends, it is expected that there will be an enduring need to tailor aspects of software to the unique requirements of markets or organizational units.

Localization is particularly important in electronic commerce, since by 1999 43% of online users were non-English speakers and it is estimated that by 2005 that percentage will increase to 70% of the Web's 1 billion users worldwide. Foreign Exchange Translations (2000) reports that while most U.S. corporations have a web presence, less than 15% offer non-English content. Studies have shown that retail customers are up to as much as three times more likely to purchase products from web sites that use the customers' native languages (Washington Times, 2000). However, few U.S. sites serve foreign customers well, with 46% of orders placed by individuals from outside the U.S. unfilled because of process failures (Sawhney and Mandal, 2000).

The purpose of this paper is to identify the key issues in software product and interface localization, including the cost and the specific aspects of software that must be localized, as well as describing a methodology for analyzing and documenting software localization. The paper is based on a review of relevant literature, meetings with localization industry representatives, and an ongoing participant observation in a global telehealth company (GTC). Examples from this company will be used in the paper to illustrate the issues and their possible outcomes or solutions. Several research studies in the area of localization are identified in the conclusion of the paper.

2. KEY ISSUES IN SOFTWARE PRODUCT AND INTERFACE LOCALIZATION

2.1 Costs of Localization and Impact on Pricing

The initial and ongoing costs of localization are significant. eTranslate, a web-based service bureau, charges US$50 per page for European languages and US$60 per page for Asian languages for translation of content only. Microsoft currently spends more than $300 million per year on localization of their products into 46 languages. Berlitz Translation Services estimates a cost of between $50,000 and $100,000 or more to fully localize a software product for one additional language, while Microsoft estimates its costs at least $300,000 or more per product (Preston and Flohr, 1997). Forrester Research estimates that localization of a new web site adds between 10-60% of the original development costs of the site. In the case of the Internet, sites change, on average, twice a year (Yunker 2000), so there will also be significant, ongoing maintenance costs for localized web sites.

It is critical that the costs of localization be accounted for on a detailed level, since this cost accounting is needed for planning future efforts, and is of particular importance if the company sells localized products or localization services. If that is the company's business, then the cost information is necessary for accurate pricing of services for development and maintenance of the information products. In addition, the maintenance costs of the products and interfaces should be similarly collected at a detailed level in order to understand the special maintenance costs of a single application that has multiple, localized interfaces. High development and maintenance costs, and their importance to informing the pricing of information products, argue for a systematic approach to localization that includes cost measurement.

At GTC, initial development of the portal was done without adequate cost accounting, and while localization needs were considered from the beginning, a technical review found the initial portal to be non-scalable and

not easily adaptable. When the decision was made to redesign the portal for the new technology environment (which was concurrent with a change in technology leadership in the company), no data existed on the initial portal development to estimate time and cost for the redesign. This lack of information has reinforced the need to collect such information, and the new technology management has instituted development procedures to collect metrics on all development activities. In some ways this initial mistake was serendipitous, since the impact was relatively low (little basis for planning the portal redesign effort), and now managers and developers are committed to measuring the costs of the main software product (now in development for several medical practices). This software product will have to be localized extensively to the needs of the individual practices as well as locales, and it is critical to the company to have solid information on costs in order to price the product appropriately.

2.1 Localization Industry

It is possible to outsource some or all of the localization development and maintenance. The decision about whether or not to outsource, or what parts to outsource are based on the traditional tradeoff issues relevant to any make-or-buy decision. The advantages of in-house localization are that the organization builds expertise, can exercise tight control on process and quality, and the localization results may not be easily reproduced by competitors. However, as discussed earlier, in-house localization has significant costs, and the expertise required may not be available in all cases. (There may be more help available in the future. There is a graduate degree in software localization offered at the University of Limerick in Ireland. Pym (1999) argues that localization should be required in the curriculum of all degrees that prepare translators.) The advantages of outsourcing localization are speed of delivery and cost, but outsourcing localization means that no in-house expertise will be built, the organization will be dependent to at least some extent on the company providing the development, and there is little competitive advantage to be maintained.

Sources of information about localization and outsourcing vendors include:

www.lisa.org	Localisation Industry Standards Association
www.multilingual.com	Multilingual Computing
www.localization-institute.org	Localization Institute

In 1999 localization accounted for 32% of the $11 billion world market for translation services (Washington Times, 2000). While translation software and careful preparation of source text minimizes translation costs, there is still a need for human intervention to handle words, especially technical terms, for which there is no word in some languages, as well as to deal with differences in meaning from direct translations and cultural differences.

The services offered by the localization industry are quite varied. Some offer traditional translation services, human, human-enhanced, and automatic; some have translation management systems to stores and maintain translations; some are aimed at specific industries (Simms, 2000). Automatic translation is especially effective when the source text has been written in an international style, sometimes called “controlled language”. For example, Harkus (2000) lists specific writing practices: simple and clear copy (e.g., limit the number of nouns that qualify a noun) that avoids humor and analogies that don’t translate to other cultures, and formatting rules (e.g., do not uses dashes or slashes as punctuation marks) that facilitate translation.

GTC reviewed the range of services from the localization industry, and decided to purchase an automatic translation-enabled email and discussion room functions for the portal. The localization of the portal and the main software product is being done in-house, to leverage the market research that has been done to select countries in which to operate and to build in-house expertise in this area. GTC maintains offices in each country of operation, and these local office individuals support system development and testing. Partners with real estate on the portal are responsible for their own localization, but GTC acts as an advisor to the partners when they have no experience with localization.

2.3 Localization of Specific Aspects of Applications

Software localization is based on market research on each country as well as on input from usability testing in the target country. Testing global software in-country leverages developers' knowledge of the locale, and such well-defined tasks with little interdependence are easily distributed (Carmel, 1999). Many of the aspects of the country knowledge are obvious and immutable characteristics, such as language; other aspects are subtler and subject to cultural shifts, such as the meaning of colors. The technology infrastructure of a country presents a particular design challenge, since that infrastructure will change and may be controlled by individual governments or companies. Therefore the local technology-driven parts of a design will have be revisited on a regular basis. This means that the reuse possibilities and maintenance demands of the localized software solutions will differ by type and country. Finally, structural differences within organizations create a need for either localization or a change to common business processes and data. Collins and Kirsch (1999) found that structural boundaries arise from differences in business processes, data quality, and business priorities. Even when a decision is made to make a change to a truly global solution, it is common to have a technological core system with localized interfaces.

In this section of the paper, the country-specific aspects that might need localization are discussed in greater detail**.** This section is an expanded version of the guide prepared for developers at GTC.

2.3.1 Language and Content

Translation of content from one language to another can be partially supported by translation software, but in most cases human intervention is needed because direct translation may change the meaning of the content. A classic example of this problem is from the popular Milk Processor Board commercial that uses the tag line 'Got Milk?' If translated directly into Spanish, the tag line would come out as 'Are You Lactating?' In order to market to Latino mothers the ad's tag line was changed to 'And You, Have You Given Them Enough Milk Today?', and the images shown are of mothers cooking flan and other milk-rich Latin foods in a family kitchen (Wartzman, 1999).

The translation ratio of words and sentences is not 1:1. Since the space required for a body of text can be dramatically different between languages (e.g., when English text is translated to French, the increase is between 15 and 20%, when it is translated into Hindi, the increase may be 80%), interface design must account for these differing space requirements. Individual words used in menus and on tabs can be especially problematic for design: for example, the 'Preferences' selection common on Windows interfaces translates to 'Bildschirmeinstellungen' in German. Therefore menus, boxes, logos or other graphics with words imbedded must be self-sizing, or there will be additional costs in redesigning those elements for each localized interface.

Some terms, especially technology terms, may not exist in some languages. Often the original word is used, but sometimes a new word is coined based on a phonetical translation. The commercial translation services create and maintain dictionaries of these specialized terms to reduce redundant translation effort and to increase the coverage of automatic translation software.

Punctuation marks also vary between languages. For example, interrogatory sentences in English end with a question mark (?), in Greek they end with a mark that looks like an English semicolon (;). Content also needs to be examined to see if it is legal in a country. For example, comparative advertising (brand a is better than brand b) is legal in the U.S., but not in other countries, such as Germany. In many European countries, the collection of personal data may be subject to local country laws about data privacy.

Content may be culturally loaded, in that the idea being expressed may only work in some cultures. For example, meetings in Japan are a public ritual of consensus, since all brainstorming has been done and all conflict has been worked out in discussions after work, often conducted in a social setting. So translating the word for meeting might be easy, but the meaning will definitely be different (Nakakoji 1994). In some industries, like travel, there are travel-specific differences between nationalities that require a company like Lastminute to tailor descriptions of accommodations (e.g., the meaning of a three star hotel) (Spiegler 2000).

Asia presents some of the greatest challenges to localization. 1.3 billion people speak CJK (Chinese, Japanese and Korean), and in Japan alone more than 17 million are online. These ideographic (as opposed to character-oriented languages like English) languages convey meaning through symbols, and the number of symbols is large. Text may include a mix of writing systems: Japanese and Korean commonly use some Chinese characters, as well as limited Roman (English) characters (Yunker, 2000).

There are two main technology issues for language. First, the words seen while using a computer come from an assortment of systems, although users tend to see the interaction holistically. The main system being used may have all text translated, but that user may also see messages (especially error messages) from the operating system, browser, and/or companion systems (like data base management systems). Developers may not be in total control of a user's workstation, but developers need to realize that users may be confused about the source of a problem when calling for support. Second, many languages require a two byte character set because of the large number of characters in the language. For example, many Asian languages use more than 50,000 characters. Unicode (www.unicode.org), based on ISO 10646, enables the current input, display and output of all known human languages without data corruption. However, Unicode is not currently supported by all systems. Developers can expect to deal with a difficult and changing environment for character sets for some time.

You may decide to support only a few languages initially, especially for Internet interfaces. For example, seven languages (English, Japanese, German, French, Spanish, Portuguese, and Swedish) account for 90% of online users (as of 1999). Another approach may be to minimize some of the language and other issues identified in this document by creating unique content for each target market, or by making the content a subset of the content for the original site. Some character sets (e.g., Arabic, Chinese, Hebrew) may require special fonts for proper display. Current versions of browsers like Netscape and Internet Explorer support viewing most languages, but the fonts must be installed. In order to input Asian characters, an input method editor (IME) is needed that will enable users with a standard keyboard to enter Asian characters (Yunker, 2000).

2.3.2 Currency

Currency issues for any transaction that is done in more than one country include displaying the appropriate local currency, indicating the applicable local taxation on the transaction, including any tariff or other duties that may be incurred, calculation and timing of the currency conversion, and determining how and when the accounting for that transaction will take place. While there is currently an effort underway to develop international standards for accounting, the most recent proposal was not well received by the U.S. accounting standards board. Until such an international standard is created and accepted, each company will have to determine how accounting is to be done when the transaction involves parties in different countries.

2.3.3 Time and Date Formatting

Conventions for the formats of dates and time vary by location. For example, if you read 02/03/04, do you think that is indicating February 3, 2004; March 2, 2004, or March 4, 2002? The international Gregorian calendar standard is YYYY-MM-DD, and so the internal, system representation of dates should probably follow that standard. Local presentation of the date on an interface may use the local format, or need to be converted into another calendar, such as Hijri (Middle Eastern), Japanese, Korean, or Thai.

The international standard notation for time is hh:mm:ss. To eliminate time zone difference problems, Universal Time (formerly Greenwich mean time) is indicated by hh:mm:ssZ. Local times can be shown as a deviation (+ or -) from Universal Time. There is a database of current time zone-related algorithms at elsie.nci.nih.gov.

2.3.4 Measurements

Most of the world uses the metric system of measurement and temperature is expressed in degrees Celsius, but in the U.S. the British Imperial and Fahrenheit systems are used. Fortunately the conversion of the measures from metric to British Imperial, and temperatures from Celsius to Fahrenheit are straightforward, and algorithms for making the conversion are in the public domain.

2.3.5 Formats (Paper and Envelope Sizes, Address Formats)

There are differences between countries in the most commonly used paper types (e.g., letter, legal, folio, A4), and paper and envelope sizes (which may be specified in either or both inches and millimeters). The arrangement of the different components of an address also varies between countries. For example, the address format in China is:

Country
Province City
Address
Last Name First Name Honorific

If a system includes printing of forms or input of names and addresses, these differences must be accounted for in the design. A good source for these variations in format, as well as other aspects of localization are the appendices in Kano (1995).

2.3.6 Collating Sequences

Alphabet-based sorting sequences are different between languages and countries. This is particularly true when languages include diacritics and ligatures as well as letter combinations that sort in various sequences. For example, in Swedish, vowels with diacriticals sort after Z. How lists are arranged may not be based on alphabet; for example, in traditional Chinese arrangement is determined by the number of strokes it takes to draw each character. In Latin America the double character *ch* is treated as a single character and sorts between *c* and *d*. Sometimes the collating sequence is dependent upon what is being listed:, as in Spanish family names (Johnston, 1999).

2.3.7 Numeric Formats

Again, numeric formats differ between countries, with the major differences arising from whether a comma, a period, or a blank space are used to separate thousands and higher numbers and whether a decimal or a comma are used to separate the decimal part of a number. Even words used to express numbers can vary. For example, in the U.S. a *billion* is 1 followed by 9 zeros, in Latin America and Europe it means a 1 followed by 12 zeros (Miller 1994).

2.3.8 Color Scheme

Many colors carry meaning in any one culture, and there are dramatic differences between cultures on the meaning of the same color. In Western countries, red is alarm, white is pure, black is somber, and green indicates growth or money. In Asia, red is joy, white expresses mourning, and black is a lucky color. In Arabic countries, green is a holy color. If color is used as part of a design, when converting to other cultures the meaning of a color must be examined.

2.3.9 Images and Sounds

Again, there are differences in meaning and use of images and sounds between countries. In some countries, the flag is prominently displayed on products, but Saudi Arabia's flag includes holy symbols associated with the Koran, and thus anything with a Saudi flag on it cannot be thrown away. Symbols like a US-style

mailbox with the red flag or the US stop sign are not meaningful everywhere. The "thumbs-up" and "OK" hand signals used in Western countries are regarded as sexual gestures in others. The use of images of women and/or women and men together are also not acceptable in many cultures. Sound as a feature in a system (e.g., a beep indicates an error) may be appropriate in the U.S., but such a sound might embarrass Asian users in front of colleagues working nearby.

2.3.10 Telecommunications Infrastructre

There is great disparity between countries in telecommunications infrastructure, and so the capability of the infrastructure and cost of access in each country must be examined. Fortunately the importance of information technology to socio-economic development is currently driving policy changes in countries with poor infrastructure (International Telecommunication Union, 1999). Not all users worldwide have fast connections, and they may pay high, per-minute access charges. In general, the price of Internet access is higher in developing countries; for example, the price of access in Australia is 1.5% of GDP per capita, while in Mexico Internet access is 14.8% of GDP per capita, and in Ethiopia access is 76.8% of GDP per capita (International Telecommunication Union, 1999). While there is every expectation that bandwidth capability will improve and costs will lessen, in the near term it is important to minimize slow-to-load features such as graphics in Internet and intranet applications. Many sites have a text-only version available as an option.

2.3.11 Navigational Structure

Navigation between pages of a web site can be structured as a network or a hierarchy. Cultures that are high in Uncertainty Avoidance (Hofstede 1991) may not be comfortable will links that do not follow a strict order, especially when a user can get "lost" at the site. A recent comparison of German and U.S. websites found that German sites had a much more hierarchical navigational structure with few links to related sites, while U.S. sites exploit the use of hyperlinks extensively within the site and to related sites (Lehmair 1996).

2.3.12 Overall Design

In Latin-based languages, documents are laid out left to right, with the next line appearing below the previous line. Arabic and Hebrew read from right to left. East Asian languages follow a different layout. For instance, Japanese text typically is displayed top-to-bottom, with lines right to left. Development of international style sheets may provide part of the solution to this issue, but designers should be aware that the habitual pattern of scanning a page will differ between these languages. This means that in the West, the most important object may appear in the upper left corner of the web page, while in East Asia, Arabic countries and Israel that object should be positioned in the upper right.

3. METHOD

The key idea in developing global systems is "the culture, language and user-dependent parts of the software application are isolated from the software core during development" (Karkaletsis et al., 1998). Following is the sequence being used at GTC once the user requirements have been determined and modeled:

1. Isolate the interface and business objects and their relationship. Interface objects are granular components that make up the page, including toolbars, content blocks, graphic blocks, background design, links, input fields, sounds, cookies. Business objects are the processing (code, utilities) and data storage and retrieval (data model) needed to produce the interface objects.
2. Examine the interface objects to determine if they need to be changed or deleted, and/or if new objects need to be added
3. Design the new interface objects
4. Conduct usability tests of the new interface objects (see paragraph below)

5. Identify what new or changed business objects are required in order to implement the interface objects
6. Design the new business objects
7. Create a maintenance plan for the new, localized design, in concert with any existing designs

Localization teams in target countries play a major role in initial testing of product and interface designs and implementations. Staff who have lived or live in a country can edit content and designs for the linguistic and cultural anomalies that arise with translation (Bullinger and Ziegler, 1999). For example, Yahoo!'s localization team in Asia discovered that Yahoo!'s online address book that sorts names alphabetically should, in the Asian version, sort names by the number of keystrokes required to produce them (Lerner, 1999). In addition, the local presence prevents the image that a company is "the big, bad wolf, the outsider that everyone hopes will lose" (Spiegler 2000). At GTC, the initial testing of software is done by the staff of the local company office, with one of the developers from the central company office present to record issues and problems. While this has not yet occurred, it is expected that local IT developers will be brought in to assist in the testing and changes when the company and number of clients grow.

Implementation of localized software to date at GTC has required complete localization of the interfaces, and some localization of the business objects. The implementation of the user interface layer of the system is done with Java applets. While Java can support a better user interface, Java-based interfaces tend to consume more client system resources and take longer to load than HTML-based interfaces (Gao et al., 1998). Therefore an important part of usability testing has been to carefully examine resource usage and download times. While problems have not arisen in this area, it is expected that in some cases the interface may need to be redone in HTML in order to minimize use of system resources and download times.

4. CONCLUSION

The purpose of this paper has been to discuss the key issues in software localization, using examples from one specific company that is faced with localization of both an Internet portal and software products. The detailed review of the aspects and costs of localization, the outsourcing resources available from the localization industry, and the description of how the company is approaching the localization process is intended to be a useful summary of what confronts developers who need to localize software. In addition, this review is the basis for these research questions:

1) What is cultural heterogeneity (as described earlier in this paper), how can it be measured, what are its sources (education, travel, living or working abroad), and how does it impact localization? It is possible that worldwide some individuals will remain culturally homogeneous and monolingual (provincials), while others will develop through their experiences into transnationals who are multilingual and culturally heterogeneous.
2) What is the impact of automatic translation on interpersonal communications, especially when users are taught to change their writing style to facilitate automatic translation? Of special interest is whether communications that require richer channels for transmission fail to come through in this situation, and whether supplementary technology, such as emotion recognition software systems, can minimize negative impacts.
3) How do the localization development method and documentation impact maintenance costs and effort? In particular, how do current software engineering practices and methods or ideas such as "self adaptive software", apply to the localization context?

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