USABILITY THEMES IN HIGH AND LOW CONTEXT CULTURES: 
A COMPARATIVE STUDY

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DECLARATION

I declare that this thesis is my own account of my research and contains as its main content work which has not previously been submitted for a degree at any tertiary education institution.

.....................................

Rukshan Alexander
ABSTRACT

Cultural diversity makes it difficult for website developers to depend on their own instinctive knowledge or personal experiences to design usable websites between cultures, yet studies on cross-cultural website usability are limited. The overall aim of this research is to advance cross-cultural HCI by providing an effective solution in terms of minimising cost and time for website cultural adaptation to improve user experience. This aim has been addressed with contributions in the areas of identifying prominent web design elements that encapsulate the significant characteristics of a culturally specific website, the development of a novel Cross-cultural Web Usability Model to offer both: cross-cultural web design guidelines and a usability measuring instrument, and subsequent empirical evaluation of the developed model that helps to attract culturally diverse users and improve their overall usability, specifically, increasing work efficiency and user satisfaction.

The first contribution examines the Australian, Chinese, and Saudi Arabian web pages for the presence of design attributes including layout, navigation, links, multimedia, visual representation, colour, and text. Significant differences were found in each of the listed design attributes, suggesting that different interfaces are needed for successful communication with different cultural groups.

The second contribution incorporates design elements, cultural factors, and HCI factors that describe the style of information processing and the user’s interaction characteristics, to create cross-cultural web design guidelines. These guidelines provide culturally specific functionality, look, and feel to enhance clear and effective communication between cultures. A usability measuring instrument is proposed, to measure usability attributes, which in turn may influence the overall satisfaction of a web page. By offering these cross-cultural web design guidelines and the usability measuring instrument, a novel Cross-cultural Web Usability Model was introduced. This model simplifies the creation of cross-cultural websites, while enabling developers to evaluate page usability for different cultures.

The third major contribution evaluated the developed model by hypothesising that website cultural adaptation improves the overall website usability. Australian and
Chinese cultures were chosen to minimise the cost involved in the usability tests. Cross-cultural websites were designed, and the efficacy of cross-cultural websites was evaluated. Behavioural data including: effectiveness (task success rate), efficiency (average time on task), and errors (average number of clicks for a task) was acquired. Attitudinal data such as perceived navigability, aesthetics, and satisfaction was also obtained based on a real-world study which required users to complete tasks on a web page. The results confirmed that the model can anticipate the culturally specific user preferences, and that there were statistically significant differences. Users who interacted with the culturally specific website had greater levels of user performance and perception than users who used the non-adapted version.

This research has theoretical and practical implications for website cultural adaptation. The findings confirmed that website cultural adaptation can improve user performance and perception. The resultant model contributes to the knowledge of how to design effective web pages for Australian and Chinese cultures and is replicable when designing for other cultures. This is the first model to be created using broad design attributes and variety of usability attributes. The proposed cultural adaptation closes the knowledge gap, the “divergence”, regarding the relationship between culture, HCI, and website design.
ACKNOWLEDGEMENTS

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Finally, I would like to thank Vavuniya Campus of the University of Jaffna to approve the study leave for my PhD study.
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<th>Description</th>
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<td>APVMA</td>
<td>Australian Pesticides and Veterinary Medicines Authority</td>
</tr>
<tr>
<td>AU-AUWeb</td>
<td>Australian participants in Australian website design</td>
</tr>
<tr>
<td>AU-CNWeb</td>
<td>Australian participants in Chinese website design</td>
</tr>
<tr>
<td>CA</td>
<td>Classic aesthetics</td>
</tr>
<tr>
<td>CN-AUWeb</td>
<td>Chinese participants in Australian website design</td>
</tr>
<tr>
<td>CN-CNWeb</td>
<td>Chinese participants in Chinese website design</td>
</tr>
<tr>
<td>EA</td>
<td>Expressive aesthetics</td>
</tr>
<tr>
<td>fMRI</td>
<td>Functional Magnetic Resonance Imaging</td>
</tr>
<tr>
<td>GACPRC</td>
<td>General Administration of Customs of the People's Republic of China</td>
</tr>
<tr>
<td>HCI</td>
<td>Human - Computer Interaction</td>
</tr>
<tr>
<td>IMC</td>
<td>Instructional Manipulation Check</td>
</tr>
<tr>
<td>PA</td>
<td>Perceived Aesthetics</td>
</tr>
<tr>
<td>PN</td>
<td>Perceived Navigability</td>
</tr>
<tr>
<td>SA</td>
<td>Satisfaction</td>
</tr>
<tr>
<td>SPSS</td>
<td>Statistical Package for Social Sciences</td>
</tr>
<tr>
<td>USA</td>
<td>United State of America</td>
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<tr>
<td>UK</td>
<td>United Kingdom</td>
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PUBLICATIONS ARISING FROM THIS RESEARCH

Journal Papers


Conference Papers


### SUMMARY OF THE CONTRIBUTIONS OF THIS THESIS

<table>
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<th>Chapter</th>
<th>Contributions</th>
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<tr>
<td>Chapter 1: Introduction</td>
<td>A literature survey on previous work in applying cultural factors and HCI factors in website design, to create a culturally sensitive world wide web are discussed. This addresses the gap with a novel cross-cultural web usability model to enhance usability as well as user experience. The findings of this study contribute to consider new cultural adaptation in website design, which should consider broad cultural preferences for layout, navigation, links, multimedia, visual representation, colours, and text. It also highlights how a cross-cultural web usability model can be created to design suitable web pages for different cultures. This is to enhance the clear and effective communication between user and web pages, based on the completion of tasks on web pages. This improvement will help to increase the usability of web pages between cultures.</td>
<td>J1, C1, C2</td>
</tr>
<tr>
<td>Chapter 2 and 3: Literature Review</td>
<td></td>
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<tr>
<td>Chapter 4: Evaluation of website design attributes</td>
<td>Cultures carry cultural preferences that can be used to enable effective communication between user and web pages. The evaluation of Australian, Chinese, and Saudi Arabian website designs investigates broad design attributes including layout, navigation, links,</td>
<td>J1</td>
</tr>
</tbody>
</table>
multimedia, visual representation, colour, and text. Prominent design elements or cultural markers that are highly prevalent within a particular cultural group are identified. These prominent design elements can be used to encapsulate the significant characteristics of a culturally specific website. The creation of these websites may improve website design in the era of globalisation.

Chapter 5: Creating a new cross-cultural web usability model

This chapter creates a novel cross-cultural website usability model that offers a set of cross-cultural web design guidelines and a usability measuring instrument. The previously identified prominent design elements are used to map with existing cultural as well as Human-Computer Interaction (HCI) values (factors) to create the model. A culturally-centred design methodology was used to fit the theoretical and practical aspects of website design.

Compared to early versions, this model offers detailed cross-cultural web design guidelines and several usability attributes that are suitable to measure the look, feel, and functionality aspects of website design. The model simplifies the creation of cross-cultural websites, while enabling developers to evaluate web page usability for different cultures.
<table>
<thead>
<tr>
<th>Chapter 6: Empirical evaluation of the cross-cultural web usability model</th>
<th>Evaluating usability attributes allows improve elements in the design. This study provides the platform and technical capabilities on how a user test can be conducted to collect behavioural and attitudinal data to evaluate the cross-cultural web usability between cultures.</th>
</tr>
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<tbody>
<tr>
<td>Chapter 7: Results and data analysis of the cross-cultural web usability test</td>
<td>The numerical, graphical, and statistical data provides trust and statistically significant evidence to support the hypotheses that cultural as well as HCI factors, and website designs interact to affect user performance and perception. The findings reveal the importance of considering cultural factors and HCI factors to improve user performance and perception in cross-cultural websites that carry different information presentation and interaction styles.</td>
</tr>
<tr>
<td>Chapter 8: Conclusion</td>
<td>This study makes a significant contribution to narrow the gap to the potential of cultural consideration in website design to enhance website usability as well as user experience. A new model that consider broad web design attributes, cultural factors, and HCI factors, and their relationships in cross-cultural web usability has been established. This model helps to accommodate culturally specific look, feel, and functionality to enhance web</td>
</tr>
</tbody>
</table>
usability and user experience. The results verify the cultural effects on user performance and perception. The model can be used to enhance the competitiveness of websites in the global economy.

Findings from this research can also be used for future research to test the model for its reliability and validity, particularly in countries other than Australian, China, or Saudi Arabia. Similarly, future research on website cultural adaptation can also benefit from this research.

The findings of this research contribute to optimise and enhance web usability as well as user experience that result in website use. It was found that the differences in the cultural preferences and needs of the users and hence the cultural differences in HCI on all levels of website cultural adaptation including look, feel, and functionality.

The findings further establish a connection between web design preferences, culture, and usability, in HCI, and suggests that culturally adapted web pages change the way people think and behave, imposing their own information processing style on users. A new cross-cultural web usability model is created to offer both: a set of cross-cultural design guidelines and a usability instrument. The web design elements, cultural factors, and HCI factors that describe the style of information processing and the user’s interaction characteristics with web pages are combined to offer richer and more comprehensive cross-cultural web design guidelines. And the usability measuring instrument consists of a variety of usability attributes suitable to measure the level of look, feel, and functionality aspects of website design.

The findings in this research also offer empirical evidence to show that the user performance and perception are enhanced with a culturally adapted version. Moreover, the studies reviewed in the literature show a paucity of systematic studies
concerning cross-cultural web usability, in HCI. Therefore, this research findings contribute to the literature and are dedicated to offer a validated cross-cultural web usability model, which is needed to optimise website design between cultures, in the global market place.
Chapter 1. Introduction

1.1 Background

Web-based applications are used to enable people around the world to be educated, conduct business, receive information, and communicate. With the integrated nature of website domains, people increasingly use websites as a source to exchange information, share knowledge, retrieve information, and utilise services (Kralisch et al., 2005; Nawaz, 2013). Thus, the Web has become an essential part of daily life for many people today.

As people are different, an identical website design for all cannot facilitate the demand of human diversity (Al-Badi, 2009). Users from different cultures have different psychological and social associations (Clemmensen, 2006; Collazos & Gil, 2011), which lead them to understand, believe, think and respond in different ways (Mushtaha & Troyer, 2009). When browsing web pages, users should be able to use their natural way of interaction rather than having to learn new ways of working (Thompson & McGill, 2012). The differences in cultural mentalities and environments lead to different requirements towards interfaces across different cultural groups (Fraternali & Tisi, 2008), and this will inevitably influence the interaction between interfaces and users (Rau et al., 2008). Therefore, designing websites that are usable, understandable and acceptable by users from different cultural background is important (Mushtaha & Troyer, 2012).

In the present global marketplace, a growing number of companies and organizations aim to provide worldwide access to their websites to promote products and services, exchange information, and connect with stakeholders (Punchoojit & Chintakovid, 2012; Singh et al., 2017). Organizations spend resources to improve websites for their stakeholders and make them accessible to everyone (Nawaz, 2013). This type of economy creates a need to design websites that can be used by different website users with different cultural backgrounds (Mushtaha, 2012; Nordhoff et al., 2018). Website designers may be culturally different from the users (Sun, 2004), making it difficult to depend on instinctive knowledge or personal experiences to understand the requirements, communication patterns, and mental models of users from different
cultures (Hsieh, 2015). Website designers must be aware of both local and international users to understand the cross-cultural issues (Kamihira et al., 2011; Nordhoff et al., 2018). It is critical for designers to understand various cultures and design websites that accommodate multicultural components (Hsieh et al., 2009; Reinecke & Gajos, 2014; Smith et al., 2004).

The challenges from both website users and web developers motivates the need to investigate cross-cultural issues in human–computer interaction (HCI) (Heimgärtner, 2017; Mushtaha & Troyer, 2016). Until recently, culture in HCI was considered a matter of website cultural adaptation, that localized web pages for specific target countries (Bernstein & Reinecke, 2013; Nordhoff et al., 2018). Current website cultural adaptation has been unsuccessful (Hsieh et al., 2009; Mushtaha & Troyer, 2016; Nordhoff et al., 2018). The early cultural adaption for localization started in the 1980s with software companies that started to adapt software to different markets. This cultural adaption only focused on translation of language, and date and time or adaption of some graphical design elements (Duncker et al., 2013; Reinecke & Bernstein, 2011). HCI researchers suggest that cultural adaptation should go deeper to consider the cultural differences of user’s culture for adjusting visual design, images, layout, symbols, navigation, and the utilisation of colours (Collazos & Gil, 2011; Cyr & Trevor-Smith, 2004; Mohammadi et al., 2012). This deep cultural adaption ensures that website are functionally, visually, and culturally acceptable for users of a particular cultural background (Mushtaha, 2012).

The growing number of websites featuring cultural adaptation can be also credited to many researchers who have demonstrated that considering culture in web page design is the key to improve work efficiency and user satisfaction (Fraternali & Tisi, 2008), and thus, to customer loyalty in global marketplaces (Ford & Gelderblom, 2003; Reinecke, 2010; Sheppard & Scholtz, 1999). Recently, China has published websites reflecting the US website design preferences for their English language versions that significantly differ from the Chinese version. This juxtaposition is shown in Figure 1-1. The English language version of the General Administration of Customs of the People's Republic of China (GACPRC, 2018) is designed based on Western values; this is simple, text-heavy,
and features soft colours and deeply structured content (Nordhoff et al., 2018; Reinecke & Bernstein, 2011). The Mandarin language version is designed based on East Asian values; this is a transformational, visual-heavy, brightly coloured website that is less structured (Bernstein & Reinecke, 2013). People from East Asian culture, such as China, have been shown in studies to efficiently filter dense information (Nisbett, 2003). The preferred design of a web page is strongly influenced by cultural values (Reinecke & Bernstein, 2011). This reinforces the argument that the look, feel, and aesthetics of web pages are important and differ between cultures.

At present, companies and organisations adapt websites with their own cultural adaptation process (Mushtaha, 2012; Reinecke, 2010). To identify cross-cultural design requirements for the target market, they may conduct on-site international user research (Walsh et al., 2010). They study people and cultures with wide-ranging focus group testing of their websites and consequently customized each website to appeal to its user group in each target culture (Würtz, 2005). This on-site research can be challenging without extensive knowledge of local cultures and product time frames can limit the feasibility of field research (Putnam et al., 2009; Walsh et al., 2010). Therefore, the present cultural adaptation development cycle is extremely time-consuming, making it prohibitively expensive (Mushtaha, 2012; Reinecke, 2010), and impossible to encompasses all countries. In this sense, it has not yet succeeded in making the Web into a usable environment for everyone by supporting users with different cultural backgrounds (Rau et al., 2008).

The next section describes the main contribution of this thesis: to bridge the gap between minimising the development cycle of the website cultural adaptation and enhancing usability. This thesis creates a new cross-cultural web usability model. The model will help website cultural adaptation to tailor look, feel, and aesthetics of the web pages, to make the Web into a usable environment.
Figure 1-1: English language version of the General Administration of Customs of the People’s Republic of China (GACPRC, 2018)
Figure 1-2: Mandarin language version of the General Administration of Customs of the People’s Republic of China (GACPRC, 2018)
1.2 Importance of the research

For user interface designers, the issue of globalisation directly relates to the principle of “Design for All” (Stephanidis et al., 1998). Globalisation is the process of making a product or service available for worldwide production and consumption, it comprises two different stages (Karreman et al., 2016; Sears & Jacko, 2007) including internationalisation and localisation. Internationalisation refers to the separation of data and resources that need to be localised from the primary functionality of a system. And localisation refers to the adaptation of the data and resources for a new target market. Website localization on the cultural level, often called website cultural adaptation (Smolina, 2015), adjusts design elements for aesthetic appeal, colours, logic, functionality, and communication patterns in culturally appropriate way (Mushtaha & Troyer, 2012).

Website cultural adaptation is worthwhile (Ganguly et al., 2010; Robins & Holmes, 2008) and improves user satisfaction and work efficiency (Fraternali & Tisi, 2008; Hsieh, 2015; Reinecke & Bernstein, 2011). The growing interest in cross-cultural usability arises from the findings in human-computer interaction that demonstrate the importance of considering culture in websites (Heimgärtner et al., 2017; Nordhoff et al., 2018). Research asserts that users from different countries have varying design preferences (Broeder & Scherp, 2018; Cyr & Trevor-Smith, 2004; Reinecke & Gajos, 2014), which has been recognized as an influential moderator of user behaviour and perception (Fraternali & Tisi, 2008; Hsieh, 2014). This may maximize the impact of the website, minimise frustration and increase acceptance (Chakraborty, 2009).

An important goal for cross-cultural website design is to incorporate the necessary level of social and cultural values to provide culturally specific look, feel, and functionality, to enhance user performance and perception (Nawaz, 2013). As the Internet reaches almost half of the world's population (ITU, 2017), developments in this area are applicable to a range of media interfaces including e-commerce sites, digital libraries, online banks, travel agents, kiosks, and e-government for information dispersion, and information sharing (Nawaz, 2013).
A basic problem in integrating cultural values into web pages is determining how theory-based cultural knowledge can be applied by website designers with different cultural preferences to the users culture. The field of cross-cultural web usability benefits from drawing on diverse fields of cultural preferences, perceptual, values, cognitive, and affective (Rau et al., 2008), but consequently is an area often not fully exploited by website designers, or even many researchers, due to the extensive knowledge of local cultures required.

Website design can benefit greatly from cross-cultural usability research, in HCI. Research has demonstrated that user’s information processing and interaction style are optimised in cross-cultural web pages (Heimgärtner, 2017). Providing web pages with the ability to accommodate cultural values into web pages should enhance user performance and perception, and have a positive impact on the user experience of website use (Bernstein & Reinecke, 2013). Furthermore, cultural consideration can help to adjust several design elements of the user interface to enhance usability for a specific user group (Sears & Jacko, 2007). Interest in cultural adaptation is not limited to the website design research community. Different fields such as educational courseware development (Goldfarb & Kondratova, 2004), e-learning (Kamentz, 2006), navigation system (Heimgärtner, 2005), and web-based to-do-list application (Reinecke et al., 2011) discuss the relevance of cultural adaptation. Whilst most cultural adaptation systems are in the proof of concept stage (Nordhoff et al., 2018), the advice given to website designers is to use the progress and developments in the cross-cultural web usability field and that those with large Internet users should see immediate benefits. Cross-cultural usability or cultural usability is the integration of cultural aspects into interaction (Cyr & Trevor-Smith, 2004), which allows interfaces to relate to the user’s culturally specific attributes and values (Kooijmans & Rauterberg, 2007; Steve et al., 2013).

A cross-cultural web usability model should provide both a set of cross-cultural web design guidelines and a usability measuring instrument to help web developers and designers to design cross-cultural websites and measure the level of usability between cultures. This remains an active area of research and development which has yielded many successful cross-cultural applications, such as web documents (Zahedi et al.,
2001), however a more advanced model is needed to consider broad website design attributes (Mushtaha & Troyer, 2016) that is to consider look, feel, and functionality aspects of website design and many cultural values that focus on users’ requirements and needs. The usability measuring instrument should organise usability attributes suitable to measure look, feel, and functionality aspects of web pages. Then the model will assist the integration of a culturally specific look, feel, and functionality of web pages, and measure the efficacy of web pages (Fraternali & Tisi, 2008). This approach supports the design process of website design that finally should lead to highly usable web pages with excellent user experience (Fraternali & Tisi, 2008; Karreman et al., 2016; Rau et al., 2008).

Despite the growing interest, research on culture in human-computer interaction and web design, is still limited (Karreman et al., 2016). The majority of the literature focuses on comparative studies that emphasise cultural differences rather than informing design decisions (Clemmensen & Roese, 2010; Nordhoff et al., 2018). When designers decide to adapt their websites, they still need to find out what design elements to change. Resources like marketing reports, for example, SimilarWeb LTD (2018), online magazines (Rozwens, 2014), handbooks (Lawrence & Tavakol, 2007) and blogs (Bock, 2017) can provide an overview of competitors and information about country-specific design preferences, but these resources do not include concrete design guidelines (Nordhoff et al., 2018). The same holds for literature that has reported on design differences between countries, for example de Castro Salgado et al. (2013), which, for the most part, only provides fuzzy design guidelines derived from comparisons between few countries (Nordhoff et al., 2018). A more contextual approach to cross-cultural human-computer interaction research should offer a model that contains a set of detailed cross-cultural web design guidelines and a usability measuring instrument. This can be particularly beneficial for the globalisation of web pages, which usually involves the adaptation of an existing web page from a Western design (Karreman et al., 2010; Sears & Jacko, 2007).

Global companies interested in offering their products and services to the foreign market may particularly benefit from incorporating aspects of users culture into their designs (Marcus, 2013; Nawaz, 2013; Nordhoff et al., 2018). It was also shown that a
culturally-competent website design can facilitate companies to lower the cost of entry to an international market, increase sales, meet global demands, and establish a trustworthy and professional image online (Cui et al., 2015; Szymanski & Hise, 2000). Companies may also gain financially benefit (Simões-Marques & Nunes, 2012): one related with website users’ productivity for less training time, because website users, aware of their culturally specific website design that offer simple information retrieval (Juric et al., 2003), for a faster task completion to find a product in web pages; and the other with product sells, in which products are easier to sell and market themselves, when users had positive experiences with web pages (Nunes, 2006).

1.3 Research aims

The research described in this thesis intends to advance the field of cross-cultural human-computer interaction. This was done by creating a new cross-cultural web usability model that contains a set of cross-cultural web design guidelines and a usability measuring instrument. Cultural preferences on the web and the proposed model were all evaluated empirically.

To adapt web pages manually (adaptation) or automatically (adaptability) to the cultural needs of the user, the first step is to investigate what must be adapted (Heimgärtner, 2007a; Nordhoff et al., 2018). This is to find out the differences in the cultural needs and preferences of the users and hence the cultural differences in HCI on all levels of website cultural adaptation including look, feel, and functionality. Web design attributes are aspects such as Layout, Navigation, Links, Multimedia, Visual Representation, Colour, and Text. Identifying broad cultural preferences in website design is still one of the largest gaps in cross-cultural HCI design (Nordhoff et al., 2018), which is bridged by investigating the usage of web design attributes for different cultures. Therefore, this project sought to explore the suitability of several web design attributes including layout, navigation, links, multimedia, visual representation, colour, and text, which can be use to provide culturally specific look, feel, and functionality (Mushtaha & Troyer, 2016). The first aim was to:

**Aim 1: Empirically measure the usage of web design attributes between cultures to identify cultural preferences.**
Secondly, a new cross-cultural web usability model is developed to simplify the creation of cross-cultural websites and to measure the level of cross-cultural web usability. Prior work uses existing anthropological cultural factors as cross-cultural web design guidelines, strategies, frameworks, and models. Prior work has suggested that there are insufficiently detailed (Ishak et al., 2015), usually based only on theoretical research (Smith et al., 2004), which lack the usability tests to support their claims (Hsieh et al., 2009). This gap is bridged by combining web design elements, cultural factors, and HCI factors that describe the style of information processing and the user’s interaction characteristics with web pages (Heimgärtner, 2017), to offer richer and more comprehensive cross-cultural web design guidelines. The usability measuring instrument consists of a variety of usability attributes suitable to measure the level of look, feel, and functionality aspects of website design. This is a step toward making websites that are usable to all. Therefore, the second aim of the project was to address this limitation with a model for cross-cultural web usability development:

**Aim 2: Establish a mapping between prominent design elements identified in Aim1, existing cultural factors, and HCI factors to create a new cross-cultural web usability model.**

Cross-cultural web usability study is a viable test-bed to validate the cross-cultural web usability model developed for the above aim 2. Prior work highlighted the connection between web design preferences, culture, and usability, and suggests that culturally adapted web pages change the way people think and behave, imposing their own information processing style on users (Heimgärtner, 2017; Rau et al., 2008). Theoretical evidence from Smith and Chang (2003) and Straub et al. (2002), and empirical evidence from Fraternali and Tisi (2008), Reinecke and Bernstein (2011), and Hsieh (2015) suggest that culturally adapted websites improve the work efficiency and satisfaction of those they were intended for. However, empirical studies on web cultural adaptation that consider broad design attributes is conducted less frequently. Empirically determinant relationship for the cultural factors influence on website usability is an essential implication for the HCI community for the short and long-term success of websites. Therefore, the third aim of the project was to address this limitation with a model for cross-cultural web usability development:
Aim 3: Evaluate the developed cross-cultural web usability model empirically.

1.4 Methodology

In order to achieve these aims, the first empirical study, Study 1, focussed on examining the usage of design attributes between Australian, Chinese, and Saudi Arabian cultures. Three languages have been chosen. English is used by Australians, Simplified Chinese is used by Chinese, and Modern Standard Arabic is used by Saudi Arabians. The categories of websites surveyed were ‘government’ and ‘news and media’. They were selected to maximise the visibility of cultural preferences and minimise corporate branding. Automated and manual techniques were used to investigate broad design attributes including layout, navigation, links, multimedia, visual representation, colour, and text. The large scale investigation of websites provided significant differences in each of the listed design attributes, suggesting that different interfaces may be needed for successful communication with different cultural groups.

A new cross-cultural web usability model was then developed to offer a set of cross-cultural web design guidelines and a usability measuring instrument. This work extends previous work by mapping the usage of web attributes with theories of culture to create website design guidelines and a usability measuring instrument. The development of this model includes: identification of prominent web design elements, organisation of existing anthropological cultural factors, organisation of HCI factors, development of cross-cultural web design guidelines, and development of the usability measuring instrument. This model was then simplified to enable the creation of cross-cultural websites, while evaluating web page usability for different cultures.

The final empirical part of the research consisted of a final study; a user test to validate the above developed model. The developed cross-cultural web design guidelines were used to create Australian and Chinese websites, and the usability measuring instrument was used to evaluate the efficacy of cross-cultural web pages. This study used unmoderated, remote usability testing techniques to evaluate website usability by testing it on many Australian and Chinese users, simultaneously, in their natural environment, and obtained large scale usable responses. A number of information-
seeking tasks were assigned to users to carry out on websites, followed by an online questionnaire. A web-based remote usability market research tool, (Loop11, 2018b), was used to record participants interaction with testing websites. From the behavioural and attitudinal data, user performance and perception were measured. The validated model will be used to provide different user interfaces for different cultural groups.

1.5 Delimitation of scope and key assumptions

The scope of this research is limited to the identification of web cultural preferences, the development of a new cross-cultural web usability model, and the evaluation of the developed model. This aimed to bring the benefits of cross-cultural web usability to the wider audience of website developers and end users. The cultural preferences were identified to provide proof as well as benefits of cultural consideration in website design as a means of cross-cultural human-computer interaction. The research contained in this thesis does not attempt to evaluate website design preferences from companies with a global reach which may either be more homogenized or more localised for different countries. This research suggests that web designers should localise their websites (Nordhoff et al., 2018), and provides guidance about the specific design elements they should adapt to local preferences.

The development of a new cross-cultural web usability model may come from differences in the values, attitudes, communications, social practices, and cognitive styles of users (Kayan et al., 2006; Nisbett, 2003; Plocher et al., 2012). These cross-cultural design concerns also exacerbate issues that already pose challenges in single-culture design. While differences exist in single culture design between subgroups of users, and between designers and (subgroups of) users, such differences become more profound in cross-cultural design (Nawaz, 2013).

The research contained in this thesis does not attempt to evaluate or explore the underlying psychological processes which result in the measurable phenomenon. The theory of culture, cultural factors, HCI factors, web design attributes, mapping aspects, and the usability attributes are based on existing research. However, the evaluation of the model gathered behavioural and attitudinal data, through remote user testing,
during the validation stages of this research. This testing showed how users from different cultures, such as Australia and China, interact with web pages in a variety of ways. This research explored whether and in what ways cultural factors as well as HCI factors can be used to provide culturally specific information processing and interaction style of users, to make web pages more locally relevant and competitive.

1.6 Structure of the thesis

This thesis is presented in eight chapters. Chapter 1 provides a brief introduction to the field of cross-cultural web usability, the importance of website cultural adaptation that consider culturally specific look, feel, and aesthetics of web pages, and its relevance in the human-computer interaction research domain. The overall research aims and methods are also introduced here.

Chapters 2 and 3 review the relevant literature on the two areas pertinent to this research. Chapter 2 presents existing theories and approaches to culture that encompass a broad set of theoretical concepts from sociocultural differences, cognitive psychology approaches, and anthropological cultural factors. The section further explains HCI factors that describe the style of information processing and the user’s interaction characteristics with web pages, usability, and user experiences. This section also provides a critical reflection on these concepts and opens up the discussion of the conceptual challenges surrounding the concept of culture.

In Chapter 3 the topic of cross-cultural web usability, is discussed, including the means by which web design cultural preferences may be used to combine with cultural factors, and HCI factors to create a new cross-cultural web usability model. The chapter also provides a review of other cross-cultural web usability model that have been developed, and the empirical evaluation of the existing models.

Chapter 4 discusses the study that was the empirical evaluation of the usage of web design attributes between cultures to identify cultural preferences, for aim 1. This measures broad web design attributes including layout, navigation, links, multimedia, visual representation, colour, and text.
Chapter 5 considers the creation of a new cross-cultural web usability model, for aim 2. The issues associated with the current approach that adapts cultural values into website design are discussed, and a solution is proposed in the form of a component-based model that contains a set of cross-cultural web design guidelines and a usability measuring instrument. The solution, known as the Cross-cultural Web Usability Model, is discussed in detail including the mapping that combine web design elements, cultural factors, and HCI factors to create cross-cultural web design guidelines and a usability measuring instrument.

Chapter 6 discusses the study that was conducted to empirically evaluate the efficacy of the Cross-cultural Web Usability Model described in Chapter 5. It describes the research methodology. Chapter 7 presents the results of each hypothesis.

The final chapter, Chapter 8, considers how the three research aims of the thesis have been met. These are linked together within the context of the cross-cultural web usability, in the human-computer interaction domain. The results of the two empirical studies, contributions of the study, a description of limitations of the study, and exciting possible directions of future work are also highlighted and related to the implications of the research.

This thesis makes a significant contribution to the field of cross-cultural usability, and ultimately opens up new possibilities for more natural, intuitive, and supportive web pages to enhance user experience for everyone.
Chapter 2. Literature review: cross-cultural human-computer interaction and user experience design

2.1 Introduction

Human society has been described as a global village, prompting calls for the integration of culture into website design as long as ten years ago (Patricia, 2008). Designers now increasingly face a diverse audience, and they need to design for different cultures with different needs (Nordhoff et al., 2018). Therefore, it is important for web designers to understand the cultural differences as well as values and know how these will affect the users. This chapter reviews research into the theories that underpin the field of cross-cultural human-computer interaction and user experience design in general. Five main areas are considered including: international usability, socio-cultural difference in values and communication style, interpreting culture to use in HCI, anthropological cultural models and factors, and HCI factors that describe how the information processing or interactional style between users and web pages can differ between cultures. The concepts described in this chapter form the theoretical basis upon which much of the research, presented later, is built.

2.2 Usability and Internationalisation

Usability is an umbrella term with origins in psychology, human factors, and ergonomics (Laura, 2006) and is an important theme in the field of human-computer interaction (HCI) (Y. Lee & Kozar, 2012; Shneiderman & Plaisant, 2004). In the early days of computing, usability was largely unconsidered (Kamppuri, 2011) as computers were developed and used by a limited group of computer experts for specific purposes. In the 1980s, computers invaded homes for the first time, a wave of cheap and futuristic devices that allowed millions of people to discover for themselves what a computer was (Tom, 2016). In 1990, when interactive software became increasingly complex and sophisticated, usability became a key element in the design of any interactive interfaces (Fraternali & Tisi, 2008). This ensures that user interfaces are easy to understand, learn, and use without any special training. Numerous usability principles and guidelines have been developed to enhance usability, which is a
dimension of quality of a user’s experience when interacting with a product or system such as a website, software application or computing device.

Usability has been bounded in multiple definitions (Korvald et al., 2014) and an ISO standard. ISO 9241-11 was published, to provide “guidance on usability”, which defines usability, under three central usability factors (Hussain et al., 2017), in terms of effectiveness, efficiency, and satisfaction in a particular context of use (ISO, 1998). Most research assumes that usability is understood similarly by users in different cultures, implying that the notion of usability and their interrelations are constant across cultures (Frandsen-Thorlacius et al., 2009). However, Bourges-Waldegg and Scrivener (1998), Winschiers and Fendler (2007), and George et al. (2010) pointed out that the cultural difficulties in understanding a website have a natural flow on effect on the usability. Frandsen-Thorlacius et al. (2009) found that the notion of usability is not constant across cultures. They found a basic difference in how the users understood and prioritised different aspects of usability between users from East Asia and Denmark. For example, users from East Asia were more concerned with visual appearance, satisfaction, and fun than the Danish users. The Danish users nominated effectiveness, efficiency, and lack of frustration as more important factors in the interface. These findings are corelated with Winschiers et al.’s (2007) study, who found that Namibian user groups have a significantly different understanding of usability from the commonly assumed one. Researchers now emphasise the importance of more specific aspects of usability and argue that usability is an outcome of interaction rather than a property of a product, and this is now widely accepted (Bevan et al., 2015). Some research focuses on various aspects of usability in the web environment (Palmer, 2002; Shneiderman & Plaisant, 2004).

Nielsen (2000) assumed that usability has much greater importance since the advent of Internet commerce. In product and software design, customers pay first and then experience the usability of the product or software package. On the web, usability is experienced first by the users and that may determine whether they will pay for the product (Masoeu & de Villiers, 2001). Krug (2014) stated that web usability is simply being certain that something functions well and can therefore be used without creating frustration. Any ambiguity in navigation or links and heavy use of aesthetic,
may frustrate culturally diverse users. For example, one culture’s preferred design elements, including, links opening in a new window, multimedia objects, and bright colours, may frustrate users from other cultural background (Fraternali & Tisi, 2008; Nordhoff et al., 2018). Therefore, adequate web usability is important to improve user experiences, website acceptability, reliability, and user satisfaction. Increasing globalization and technological development has led companies and web designers to consider the need for designing usable web pages. These web pages allow the user to experience an interaction that is closely related to the core aspects of user’s culture (Rauterberg, 2006).

International usability refers to localising user interfaces for specific target countries to enhance user experience (Mushtaha, 2012; Reinecke, 2012). Websites have to serve different types of users from countries other than the one in which they were designed (Del Galdo & Nielsen, 1996). Since website users are widespread over several countries with different national cultures (Aladwani, 2013), to achieve international usability, increasing internationalisation leads to consider users cultures more than ever before in the ICT industry (Nawaz, 2013; Nordhoff et al., 2018; Yaaqoubi & Reinecke, 2018).

A wider point of view on users culture in interaction design is more frequently taken in what could be called cross-cultural human-computer interaction or cross-cultural HCI (Kamppuri, 2011). From a cross-cultural HCI point of view, the challenge is how to design websites that can be used by different website users from different cultural backgrounds to ensure international usability. Prior research on cross-cultural usability in HCI focus the theories of cultural differences, existing anthropologists’ cultural models, and HCI factors to design culturally usable web pages (Heimgärtner, 2018; Jano et al., 2015). The next section discusses the cultural differences in values and communication styles, followed by cultural models, and HCI factors.

2.3 Socio-cultural differences in values and communication styles

Research in HCI has long acknowledged that socio-cultural differences can inhibit the usability of interfaces (Bernstein & Reinecke, 2013; Kappos & Rivard, 2008; Leidner & Kayworth, 2006).
Socio-cultural differences were systematically analysed by several cross-cultural studies to discover the most effective communication strategies for targeting users from different countries. Most of the socio-cultural differences have been analysed during the interface communication on a national level between countries (Cui et al., 2015; Leidner & Kayworth, 2006). Prior research found significant differences in cognitive style, thinking, behavioural patterns, ways to categorise objects, visual information processing, and values (Asimionoaei, 2009; Son & Park, 2012). These are discussed in the following sections.

Cognitive psychology is the study of the processes underlying mental events. The cognitive psychology approach examines how people perceive, remember, think, speak, and solve problems (Feist & Rosenberg, 2010). Research in cognitive psychology has indicated that people have differences in their cognitive processing styles during problem solving and decision making activities (Nawaz, 2013). The investigation of cognitive and cultural differences has focused on cognitive style and thinking pattern (Rau et al., 2004). Chiu (1972) reported that the Westerners cognitive style is inferential-categorical, frequently termed as functional. Westerners are context-independent (Nisbett & Miyamoto, 2005) and use functions or inferences to investigate components and general features within its context. However, the cognitive style of East Asians are relational-contextual commonly termed as thematic (Choong & Salvendy, 1999). East Asians favour to classify on the basis of interdependence and relationship within wholes (Marcus, 2003a), and emphasize contexts (Rau et al., 2004).

Thinking pattern differences between cultures have been reported by Choong and Salvendy (1999) and Nisbett (2003). They identified significant differences in thinking processes between East Asians and Westerners. East Asians are thematic while Westerners are functional. Results indicate that, for East Asian users, advantages were associated in terms of time and error rate. Their mental models favoured with concrete representation of knowledge and with thematic interface structure. East Asians had an easy time navigating on a “broad” website due to their often paying attention to the relationships among the objects and the relationships between objects and their context.
Similar results were found for Western users who used their mental models which favoured an abstract representation of knowledge and with functional interface structure. Westerners prefer an easy navigation process within a deep web structure due to their tendency to mentally represent objects in a categorical way and preference of exerting personal control. For Westerners, the decision-making process associated the navigation on a deep website produced a feeling of applying control over their actions. They will be comfortable with, or even enjoy, the process because it satisfies their pursuit of personal control (Cui et al., 2015), as exercising personal control can enhance the perceived ease of use (Venkatesh, 2000). Since effective functioning of users with interfaces depends on attention to context (Nisbett & Masuda, 2003), a web page should accommodate proper knowledge representation, and website structure for effective task performance and affecting user perception (Cui et al., 2015).

Cognitive styles of holistic Easterners and analytic Westerners are reflected in many behaviours, in which Easterners and Westerners categorise objects. Westerners make more use of rule-based categorization and taxonomy, to mentally process and represent information and objects, than East Asians (Cui et al., 2015). Prior research showed that Westerners are more likely to group objects on the basis of category membership and shared features (Nisbett et al., 2001). For instance, when asked to choose two words more closely related among the set of “Teacher, Postman, and Homework”, Westerners are more likely to choose “Teacher” and “Postman” than East Asians as these are both occupations (Ji et al., 2004). East Asians organize objects in a more relational and less categorical way than Westerner (Ji et al., 2004). They would be more likely to group “Teacher” and “Homework” together as “Teacher” has a contextual relationship with “Homework”, as “Teacher assigns Homework”. Such an orientation toward the relationships among objects may drive East Asians to prefer seeing a bigger picture instead of isolated objects (Cui et al., 2015). With a focus on the central object and the separation of it from its context, analytic Westerners tend to have a stronger belief in the controllability of external events than holistic Asians (Nisbett & Miyamoto, 2005).
Cognitive style differences are also found in visual information processing. Boduroglu et al.’s (2009) work on cultural differences in allocation of attention in visual information processing, and Chua et al.’s (2005) work on cross-cultural analysis of eye-movement pattern differences in scene perception reported that Western user perceptions tend to focus on the salient foreground object sooner while Asians attend more to the background context. East Asians may be more likely to construct relationships between focal objects and background elements or context (Colzato et al., 2010). Typically, Westerners are faster to detect changes in the centre of the interface. However, East Asians are faster to detect changes in the background of the interface. This findings correlated with a neural study conducted by Gutchess et al. (2006), using the Functional Magnetic Resonance Imaging (fMRI) technique for measuring brain activity (Devlin, 2007), showing that the Westerners focus on individual objects more than those from Asia who regularly concentrate on object correlations.

Prior research suggest that that analytic and holistic cognitive styles are closely associated with characteristics of socio-cultural environments (Miyamoto, 2013; Nisbett, 2003; Varnum et al., 2010). In particular, in socio-cultural environments, characteristic of users from North America or Western Europe, are considered to be fundamentally independent from social relationships, whereas in socio-cultural environments, characteristic of East Asia, individuals are considered to be inherently connected to and embedded in social relationships (Markus & Kitayama, 1991; Triandis, 1989). It has been theorized that, in the former, independent socio-cultural environments, individuals tend to focus on their own goals and their target objects without being too much influenced by surrounding others’ demands or contexts, which leads to an analytic cognitive style (Miyamoto, 2013). In contrast, in the latter, interdependent socio-cultural environments, it is theorized that individuals need to attend to relationships and to contexts, which leads to a holistic cognitive style (Miyamoto, 2013).

The increasing awareness of socio-cultural differences and users’ requirements, expectations, and behavioural possibilities may directly influencing effective communication, interaction, information processing, decision-making, and task
performance with websites (Collazos & Gil, 2011; De Angeli et al., 2004). This implies the need for localisation of web design (Clemmensen, 2011), which aims to ensure that products are easy to use and that they provide good user experiences across cultural boundaries (Walsh et al., 2010). To do this, HCI research tends to consider theories in anthropology to wider social-cultural differences (Huang & Deng, 2008), and also to interpret culture for the website cultural adoption.

2.4 Interpreting culture to use in HCI

Cultural knowledge is an important prerequisite to understand how culture relates to human-computer interaction and to identify the variables relevant to the cultural aspects of usability. To better understand the concept of culture, and how it is related to human-computer interaction, definitions of culture and meta-models of culture are reviewed in the following section.

2.4.1 Definitions of culture

There is no specific definition of culture even though many definitions of culture exist (Ciborowski, 1979; Ford & Kotzé, 2005; Hoft, 1996). However, researchers and website designers generally agree on the following:

- Culture is formed by historical experiences, traditions, customs, and surroundings.
- Culture is the mixing of human behaviour which contains attitudes, norms, values, beliefs, and actions.
- Culture affects the way people view the world, think, interact, behave, and how they respond.
- Culture influences the groups of people who have a similar way of thinking.
- Culture influences the groups of people from similar cultural surroundings to utilize a similar pattern of communication.

Constructing a specific definition from the above statements to meet the requirements of the impact of culture on user interfaces is possible. For the purposes of this
research, culture is defined as “the wrapping of human behaviour which contains attitudes, norms, values, and beliefs that influences groups of people to think, interact, behave, and respond in a similar way”.

2.4.2 Meta-model of culture

To understand cultural determinants and how to incorporate them in the user interface requires a deep understanding of cultural models and its factors. This is dealt with by the meta-model of culture, which offers a more detailed vision of culture (Mushtaha, 2012). This gives the opportunity to define different layers of culture for the high-level understanding of the dominant attitudes and principals of the philosophies surrounding the concept of culture (Dhar & Yammiyavar, 2012). Thus, the meta-model of culture is the root for the development of diverse cultural models (Ford et al., 2005; Mushtaha, 2012).

Hoft (1996) identified and organised four meta-models of culture including; (1) onion, (2) pyramid, (3) iceberg, and (4) objective and subjective. These meta-models give an over view of the various construct that has been identified and associated with culture (Dhar & Yammiyavar, 2012). Onion model considers the culture composed of several layers from core to the periphery as values, ritual, heroes, and symbols (Hofstede et al., 2010). The core values of a culture shape the cognitive processes of its members, which then determine their beliefs and behaviours (Li et al., 2009). Pyramid model describes culture-dependent features of human behaviour using layered structure, in which personality as the top level, culture as the middle level, and human nature as the bottom level (Hofstede et al., 2010). Since the onion and the pyramid meta-models influence of culture on website usability (Daniel et al., 2011; Mushtaha, 2012; Punchoojit & Chintakovid, 2012), is limited. For this research, two meta-models of culture including the iceberg and the objective and subjective cultural meta-models were adopted, as they are the most widely used meta-models of culture in the cross-cultural HCI research domain (Heimgärtner, 2017).

2.4.3 Iceberg as well as objective and subjective culture

In the iceberg meta-model of culture, only 10% of the attributes of a culture are visible and conscious (Heimgärtner, 2017; Hoft, 1996). Daniel et al. (2011) defines objective
culture as above the “water surface” in the iceberg meta-model of culture (Heimgärtner, 2017). Its elements are tangible, easy to examine feature of culture such as language, format of number as well as date and time, signs, symbols, colours, and metaphors (Lamoreaux, 2012; Punctoojit & Chintakovid, 2012; Rehman, 2018). They can be recognized very easily because they are directly accessible and less determined by cultural context (Heimgärtner, 2017).

Subjective culture has been defined as the psychological features of a culture (Hoft, 1996), including assumptions, perceptions, cognition, thinking patterns, and values (Rau et al., 2004). Its elements are defined as intangible, in which 90% of cultural elements, below the water surface, are invisible and unconscious. The intangible cultural elements affect website design for structuring menus, information complexity, positioning of design elements, information presentation, and interaction design, which have strong correlations to the cultural context (Heimgärtner, 2017). This is the role of subjective culture during the communication between user and web pages.

In early research, the objective culture has been treated as more real and concrete because of its tangible aspects (Ford et al., 2005; Rehman, 2018). However, Ford et al. (2005), Reinecke and Bernstein (2011), and Lachner et al. (2015) argued that subjective culture too is real and concrete. The nonverbal communication and values that are part of the subjective culture are associated with user experience characteristics and also contribute toward usability attitudes, while objective culture may influence the use of a product (Steve et al., 2013). Therefore, conducting research under the subjective cultural approach, to design usable websites for users from different cultural backgrounds is important (Punctoojit & Chintakovid, 2012).

This research focuses on subjective culture. To investigate invisible and unconscious elements of culture, prior research used cultural models from anthropologists to probe the unconscious areas of culture (Heimgärtner, 2017). The next section discusses cultural models and factors.
2.5 Cultural models and factors

Various cultural models have been developed and proposed by anthropologists to provide a detailed view of culture. These cultural models have been developed as systematic theories aimed at capturing humanity and characteristics of human experience from social and cultural perspective (Fraternali & Tisi, 2008). Each cultural model establishes its own set of cultural factors, which are used to organise cultural data, measure, compare, evaluate, and classify groups of people.

Understanding a single cultural model is not sufficient for effective communication between user and web pages (Zahedi et al., 2001). The research described in this thesis uses Hofstede et al. (2010) and E. T. Hall and Hall (1990) cultural models. These models are focused on human values (Lachner et al., 2015; Zakour, 2009) and are widely used as well as widely cited in the HCI domain (Mushtaha, 2012; Yaaqoubi & Reinecke, 2018). Also, Hofstede et al. (2010) and E. T. Hall and Hall (1990) cultural models sought to measure a number of cultural variables or factors that are relevant and useful to design usable web pages between cultures (Fitzgerald, 2004; Yaaqoubi & Reinecke, 2018). Therefore, Hofstede et al. (2010) and E. T. Hall and Hall (1990) cultural models are reviewed in detail.

2.5.1 Hofstede’s cultural model

Hofstede et al.’s (2010) cultural model was built from large-scale quantitative comparison among national cultures, by collecting survey data from employees of a multinational business organization, IBM, in 72 countries and in 20 languages. The cultural model determined that patterns of similarities and differences among national cultures. They identified that there is a dominant set of cultural attributes for each country, and that different cultures vary along the following cultural factors:

- Power distance: The degree of tolerance for the hierarchies that exist, and are accepted within a society. That is the extent up to which the less powerful members of institutions or organisations of a country expect that power is distributed dissimilarly. Those in high-power distance cultures are typically more accepting of disparities in wealth or status, whereas those in low-power distance cultures demand justification for such inequalities.
• Individualism vs. collectivism: The degree to which individuals are integrated into cohesive groups versus being expected to look after themselves.

• Uncertainty avoidance: A society’s tolerance for risk and ambiguity versus desire for predictability.

• Long-term vs. short-term orientation: How much society values long-standing as opposed to short-term traditions and values.

Hofstede et al.'s (2010) work provides new impulses in cross-cultural research where culture was increasingly approached from a quantitative point of view (Kralisch, 2005). To make the concept of culture largely quantifiable, each cultural factor was expressed through a numerical cultural index score that was normalized to values of 0 to 100. This helps to compare cultural distance between countries and provide the necessary basis for conducting quantitative empirical research within the field of cultural research. Hofstede et al.'s (2010) cultural distance between cultures is shown below in Table 2-1, which compares Australian, Chinese, Saudi Arabian, and US cultures. Since the US is conventionally considered to be a "reference frame" of Western culture (Hong & Schweitzer, 1996), the US is used to compare the cultural distance between chosen cultures.

According to the cultural index score for Power Distance (PDI), China (PDI=80) and Saudi Arabia (PDI=95) are higher power distance cultures than Australia (PDI=36) and US the (PDI=40). In Individualism (IDV), China (IDV=20) and Saudi Arabia (IDV=25) are more collectivistic than Australia (IDV=90) and the US (IDV=91). In Uncertainty Avoidance (UAI), Saudi Arabia (UAI=80) is a high uncertainty avoidance culture, followed by Australia (UAI=51) and US (UAI=46). Moreover, China (UAI=30) is a low uncertainty avoidance culture. In Long-term Orientation (LTO), Australia (LTO=21), US (LTO=26), and Saudi Arabia (LTO=36) are more short-term orientation cultures than China (LTO=87).
There is some criticism of Hofstede et al.’s (2010) cultural model for taking culture as static and monolithic state (Nawaz, 2013). The most common concerns in the use of Hofstede et al.’s (2010) cultural model are described at a national level as a unit of analysis, whereas most of the research studies apply it to an individual case or to a local group (Straub, 1994). To support the national culture as a unit of analysis, Minkov and Hofstede (2012) argued, with empirical evidence, that the nation as a unit of analysis is true even of countries like Malaysia and Indonesia, or Mexico and Guatemala, despite their shared official languages, religions, ethnic groups, historical experiences, and various traditions. Even the regions of neighbouring African nations, such as Ghana, Burkina Faso, and Mali, do not intermix much when they are clustered on the basis of cultural values (Minkov & Hofstede, 2012).

Despite the criticism towards Hofstede et al.’s (2010) cultural paradigm over the years, the cultural index scores were employed in a myriad of cross-cultural studies, making Hofstede one of the most cited authors of this century (Kralisch, 2005). The cultural index scores also provided value in the research domain in HCI, marketing, business, communication, interface design, and information system (Kralisch, 2005; Nawaz, 2013), and numerous cross-cultural studies (Xiang, 2008), which are still very relevant today (Rodrigue, 2007; Yaaqoubi & Reinecke, 2018).

### 2.5.2 Hall’s cultural model

The anthropologist Edward T. Hall (1914 - 2009) wrote several books about cross-cultural communication to show how members of different cultures interact and how they often fail to understand one another. Rather than equating culture to nationality, based on qualitative interviews and field studies, E. T. Hall and Hall’s (1990) cultural model positioned some cultures by dividing culture into two key factors: context and time.
• High-context vs. low-context: The continuum of high- to low-context culture refers to the degree to which communication is implicit and thus requiring an understanding of the context. High-context groups would typically share long-standing associations and thus may communicate more implicitly and rely on shared verbal and non-verbal cues for effective communication. Low-context cultures on the other hand rely less on the contextual cues, instead utilizing more explicit written and spoken communication which rely more heavily on the literal meaning of the words used.

• Monochronic vs. polychronic time perception: This relates to whether time is organised with a single task focus (monochronic) or multi-tasking (polychronic). The monochronic users like to schedule and complete one thing at a time. They value a certain orderliness and sense of there being an appropriate time and place for everything. They do not value interruptions. They like to concentrate on the job at hand and take time commitments very seriously. In polychronic cultures, users have the ability to attend multiple events simultaneously. They like to do multiple things at the same time. They also tend to manage interruptions well with a willingness to change plans often and easily. People are their main concern (particularly those closely related to them or their function) and they have a tendency to build lifetime relationships.

E. T. Hall and Hall’s (1990) cultural model does not rank different countries, but a positioning of some cultures, as in Table 2-2, was made by dividing culture into high vs. low-context and polychronic vs. monochronic classifications (Gong, 2009). According to the positioning of cultures, Chinese and Saudi Arabia are High-context as well as Polychronic cultures, while Australian and US are Low-context as well as Monochronic cultures.

E. T. Hall and Hall’s (1990) cultural model focuses on communication and is considered particularly and important as well as relevant for cross-cultural web page design (Lachner et al., 2015; Lamoreaux, 2012). Web page information processing and interaction characteristics take place in the context of Web communication (Heimgärtner, 2017), in which E. T. Hall and Hall’s (1990) cultural factors including
context and time are manifested in the structure of the functions and the style of usage of information in web pages (Fraternali et al., 2008). Therefore, it is relevant to assume that context and time factors influence the effectiveness of communication between user and web pages and resulting user experience.

Table 2-2: Positioning of cultures, for context and time

<table>
<thead>
<tr>
<th>Cultural factor</th>
<th>Context</th>
<th>Cultures</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>High-context</td>
<td>Japanese, Chinese, Italians, Spanish, Portuguese, French, Mediterranean peoples, Latin Americans, Arabs, Africans, Indians and other Indian sub-continent, Koreans, South East Asians, and Central Europeans.</td>
</tr>
<tr>
<td></td>
<td>Low-context</td>
<td>Slavs, Other American cultures, Benelux countries, British, Australians, Scandinavians, Finns, North Americans, Canadians, New Zealanders, (white) South Africans, Germans, Swiss, and Austrians.</td>
</tr>
</tbody>
</table>

| Time            | Polychronic      | Czechs, Slovakians, Slovenians, Croats, Hungarians, Chinese, Northern Italians, Chile, Other Slavs, Portuguese, Spanish, Southern Italians, Mediterranean peoples, Indians, and other Indian sub-continent, Polynesians, Latin Americans, Arabs, and Africans. |

Source: Morden (1999)

2.5.3 Other cultural models

Kluckhohn and Strodbeck (1961), Trompenaars and Hampden-Turner (1998), and Schwartz (1999) also presented some cultural factors. These cultural factors do not distinctly differ from Hofstede et al.’s (2010) and E. T. Hall and Hall’s (1990) cultural factors, besides their naming (Lachner et al., 2015; Zakour, 2009). Therefore, to understand and analysis the influence of cultural factors in website design, this thesis only focuses on the cultural factors from Hofstede et al.’s (2010) and E. T. Hall and Hall’s (1990) cultural models.

2.6 Human-computer interaction factors

A study on cross-cultural web usability should consider in the HCI domain. Human-computer interaction (HCI) is focused on the interaction between humans and computational machines (Hewett et al., 1992; Oh & Moon, 2013). Various definitions
for the term “human-computer interaction” exist (Ford, 2005). In the computer science domain, general consensus exists on the following:

- HCI improves the factors that influence the effectiveness and efficiency of the interactive computing systems by combining techniques from psychology, sociology, physiology, engineering, computer science, and linguistics for the human use (Ford, 2005).

- HCI concerns the design, evaluation, and implementation of interactive computing systems the effective human use while including the study of major phenomena surrounding the interactive systems (Hewett et al., 1992).

- HCI is a set of processes, dialogues, and actions that helps humans to efficiently use computer tools to perform tasks effectively, productively and safely (Baecker & Buxton, 1988; Dowell & Long, 1989; Preece et al., 2002).

For the purpose of this research, human-computer interaction is defined as an interdisciplinary field of study that aims to study and improve the factors that influence the usability of interactive systems by considering the major phenomena surrounding the interactive systems.

HCI factors describe how the nature of information processing, and the interactional style between users and web pages, can differ between cultures (Heimgärtner, 2013). HCI factors are strongly linked with time, context, and mental aspects and are used to determine the relationship between culture and HCI (Heimgärtner, 2012). To determine the information processing and interaction style of users from different cultural backgrounds, this research adopts the following definitions, as suggested by (Heimgärtner, 2013).

- Information speed is the duration of information presentation (E. T. Hall, 1956).

- Information density is the number of elements at a single point in time (E. T. Hall, 1956).
• Information frequency is the number of elements present per time unit (E. T. Hall, 1956).

• Information sequentiality is the sequence arrangement of information (E. T. Hall, 1956).

• Information redundancy is repetition of information (Heimgärtner, 2013).

2.7 Conclusion

This chapter has reviewed research in key areas in the field of cross-cultural web usability and user experience design, which are relevant to the research described in this thesis as well as the broader field of cross-cultural HCI. The chapter has considered the role of culture in website use in everyday behavioural and attitudinal patterns. The following chapter builds upon this and introduces culture-centred website design to enhance web usability and user experiences. Various aspects of cross-cultural HCI are discussed with emphasis on the cultural differences in website use. This theoretical understanding is later revisited and used as the basis for the subsequent identification of web cultural preferences and development of a new Cross-cultural Web Usability Model to offer a set of cross-cultural web design guidelines and a usability measuring instrument, which form some of the contributions of this research.
Chapter 3. Literature review: culture-centred web design to enhance usability

3.1 Introduction

This chapter builds upon the discussion of the influence of culture in human-computer interaction. Chapter 2 presented an overview of the methods and concepts that are central to culture-centred website design with a review of the relevant previous research in cross-cultural web usability and user experience design. Firstly, cultural usability is discussed to emphasize the importance of the relationship between culture and usability in website design (Chakraborty, 2009), followed by a review of the culture-centred design process as a methodological approach that has been used rigorously by prior research and in current research. Attention is paid to identify web design preferences for broad web design attributes, including navigation, layout, links, multimedia, visual representation, colour, and text, that may be used to design culturally specific web pages, which will be revisited later in Chapter 4. Next, there is a discussion of prior work that uses existing anthropological cultural factors as cross-cultural web design guidelines, strategies, frameworks, and models that is to develop a new Cross-cultural Web Usability Model, in Chapter 5. The latter section evaluates the developed model used in Chapters 6 and 7 of this thesis.

3.2 Cultural usability

Culture and usability are often merged into a single entity, “Cultural usability” or “Culturability” (Barber & Badre, 1998; Tsui & Paynter, 2004), for an important reason. The growing competition in global markets necessitates effective communication that goes beyond the borders of countries and cultures (Röse & Züblke, 2001) focusing attention on cultural usability research that studies the effect of culture on web page design and localisation of user interfaces (Barber & Badre, 1998; Cyr & Trevor-Smith, 2004; Rehman, 2018). An underlying premise is that when website users are more comfortable with the culturally adapted web pages, they are more likely to perceive the websites as credible (Oyibo et al., 2016), experience satisfaction, and revisit the website (Chakraborty, 2009; Chau et al., 2002; Diaz et al., 2017). The rationale for this thesis emanates from the desire to understand cultures within its socio-cultural
contexts to design usable web pages for different cultures. To study the influences of a user’s culture in website design and usability, this research uses the “culture-oriented design” (Röse & Züblke, 2001) or “culture-centred design” (Shen et al., 2006) method that address culturally rooted factors within website design and usability.

3.3 Culture-centred design process

The “one size fits all” - a single version of the website design to be used in all cultures - makes user interfaces compatible by standardisation (Shen et al., 2006). This standardisation has a homogenising effect on multi-cultural society by suppressing cultural expression and often ignoring socio-cultural context (Gozde, 2013; Shen et al., 2006), which may lead to a user feeling forced to receive disturbing messages or perform counter-intuitive tasks, even though the website is not meant to be offensive (Al-Badi, 2009; Bezuayehu et al., 2014). To bridge the knowledge gap between designers and their target users, a branch of user-centred design methodology, “Culture-Centred Design” process, was utilized by prior research.

The culture-centred design process is a new approach to HCI design, which was introduced by Shen et al. (2006) by studying the use of interface metaphors in China. The culture-centred design approach integrates factors from established concepts of culture-oriented system proposed by Röse and Züblke (2001) into existing literature on cross-cultural user interface design, in human-computer interaction design. The culture-centred design process consists of four iterative stages including analysis of the users’ culture, design implementation, iterative testing and evaluation, and reformulation of design (Aroshine, 2017; Shen et al., 2006). This process ensures that the cultural knowledge about cultural differences, values, as well as attitudes are integrated into existing methods their by culture and context are bound together due to the characteristics of culture, which are not applicable to other settings (Shen et al., 2006). The culture-centred design process approach has been utilized rigorously, by Huiyang et al. (2007), van Der Veer (2011), Alostatha et al. (2011), Oh and Moon (2013), Gozde (2013), Saidin et al. (2016), Parmaxi and Zaphiris (2016), Saidin et al. (2017), Heimgärtner (2017), and Aroshine (2017), to focus on the cultural preferences...
and cultural factors that influence the interface design to improve the usability of cross-cultural user interfaces.

Similar to Huiyang et al. (2007) and Heimgärtner (2017), this thesis uses the culture-centred design method, in which web design variables, cultural variables, HCI variables, and usability variables can be used to develop a new Cross-cultural Web Usability Model. The development of the model needs to be characterized by iterative analyses which check design choices in the design process on cultural appropriateness, relevance, semiotics, functionality, aesthetics, and usability (Oh & Moon, 2013). Therefore, an in-depth understanding of the web cultural preferences, and its relevance were mapped with existing cultural factors. This mapping focused on the difference in user intention and behavioural patterns, which is essential for the culture-centred design process, because user behaviour is affected by social or cultural background and experience (Oh & Moon, 2013). Advances in technology such as remote web usability evaluation make user testing for websites feasible by lowering the cost (Smith et al., 2004) of validating the developed model with users typically from home.

3.4 Web cultural preferences

This section provides background to the cultural preferences for website design and discusses the prominent web design elements that have been identified by prior research. The empirical evaluation methods, the web design attributes, the results of the perception of web design elements that impact on web usability are discussed. The effects of cultural preferences on website use are also reported where appropriate.

Prior work has identified some website design elements that may be culturally or website category specific, which may also be generalised as “cultural markers”. Barber and Badre’s (1998) investigated the intersection of culture and usability as well as the relationships between website design elements and culture. Hundreds of websites were categorised by country, website category, and language to create a large base of websites to investigate design preferences between cultures. From a detailed manual inspection of each website, they identified prominent design elements in web pages called cultural markers. Cultural markers are web design elements found in web pages,
and such elements become prominent design elements or cultural markers when they prove to be highly prevalent within a particular cultural group and less prevalent or absent in other groups (Barber et al., 1998). They organised cultural markers around colours, grouping arrangement, fonts, shapes, icons, metaphors, language, flags, sounds, motion, preferences for text and graphics, language orientation, help features, and navigation tools. They also suggested that these cultural markers identify cultural preferences and patterns on websites, as the cultural markers signify a cultural affiliation, and possibly preferred within a particular culture (Daniel et al., 2011).

Based on Barber and Badre’s (1998) cultural marker identification approach, Smith et al. (2004) presented “Culture Attractors” (Smith et al., 2004, p. 64). They defined culture attractors are culturally preferred design elements that are identified into different design attributes. These culture attractors together create a “look and feel” that matches the users’ cultural expectations (Duncker et al., 2013; Oh & Moon, 2013; Smith et al., 2004).

Several attempts have been made to suggest cultural markers or cultural attractors for different countries. There are some studies that investigated design elements into different design attributes, and manually applied the check list on websites to detect specific cultural markers, to describe design difference between cultures. Marcus and Gould (2000) investigated website design elements that are categorised by metaphors, mental models, navigation, interaction, and appearance. Sun (2001) investigated website design elements such as language, visual appearance, colour, and layout. Juric et al.’s (2003) developed a check-list by organising design elements into verbal attributes, visual attributes, and audio visual attributes. Cyr and Trevor-Smith (2004) categorised website design elements into eight attributes: language, layout, symbols, content and structure, navigation, links, multimedia, and colours. Würtz’s (2005) study looked at animation, structure, navigation, and images. Tong and Robertson (2008) organised design elements into four different categories of websites based on language, layout, symbol, colours, image and sound/music. Mohammadi et al. (2012) organised website design elements into layout, colour, text, language, and number of links. Calabrese et al. (2012) used website design elements that were categorised into promotion of the values, structure, navigation, interaction, appearance. Hsieh et al.
(2013), Hsieh and Hong (2013), and Al-Khalifa and Garcia (2014) categorised design elements into visual presentation of images, navigation, links, layout, and multimedia. Saidin et al. (2016) investigated the use of colour. These studies found that cultures carry web design preferences along with stable web design attributes including layout, navigation, links, multimedia, visual representation of images, colour, and text.

Using computational image metrics, Nordhoff et al. (2018) studied large-scale website designs across 44 countries. They found significant differences between several website design aspects, such as colourfulness, visual complexity, the number of text areas and the average saturation of colours. The results showed that web designs with a global reach, such as Google and YouTube, are more homogenized than local websites used within one country. The results suggest that there are a number of countries with relatively similar website designs, but web design localization is needed between some countries.

The perception of web design elements that impact on web usability is also investigated by Sun (2001) and Smith et al. (2004). They concluded that websites containing certain design elements could be strengthened by with the careful inclusion of cultural markers.

The effects of cultural preferences on website use has been examined by Badre (2000), Fraternali and Tisi (2008), and Hsieh (2014). They identified some design elements that are culturally specific and conducted empirical studies to examine whether the websites, that are embedded with the culturally specific design elements, would affect native user performance. The results indicated that both: user performance and communication effectiveness may improve by adapting culturally specific web design elements.

It was concluded that cultural preferences (cultural markers) influence website design and usability (Alostatha et al., 2011; Fraternali & Tisi, 2008; Juric et al., 2003). Enhancing website usability is possible with effective use of cultural markers in websites (Juric et al., 2003). Cultural markers are the major signifiers of functional and visual interface design (Fraternali & Tisi, 2008; Tong & Robertson, 2008). Culturally specific functionality, look, and feel can be brought through with the effective use of
cultural markers, to provide users with situational cues and help them absorb information within the context that they are familiar (Sun, 2001). This directly affects the way that a user interacts with the website and the perceived ease of use and visual appeal can be improved with culturally preferred website design elements (Daniel et al., 2011; Nordhoff et al., 2018). Therefore, this thesis examines broad web design attributes for layout, navigation, links, multimedia, visual representation, colour, and text.

### 3.5 Uses of web design attributes

The essential entities of effective website communication are called “web design attributes” (Marcus, 2002). Various web design attributes were defined by Cyr (2008). The stable sets of web design attributes to enable effective communication are layout, navigation, links, multimedia, visual representation of images, colours, and text (Alostatha et al., 2011; Calabrese et al., 2012; Hsieh et al., 2013). Website design attributes can be used to link culture and website design (Alostatha et al., 2011; Hsieh et al., 2013; Mushtaha & Troyer, 2014), and became key attributes to enhance website usability as well as user experience (Cyr, 2008; Goyal et al., 2012; Hsieh, 2014).

#### 3.5.1 Layout

Layout is the display structure that assigns meaning to the composition and orients users as they move through the website (Faisal et al., 2017). Web page layout acts as a communication bridge between the user and the web pages (Cyr & Trevor-Smith, 2004; Yu & Roh, 2002). Web page layout is a crucial and significant web design attribute, which has immediate implications for the usability of a website (Saidin et al., 2017). Well-structured websites help users easily access and understand the information and mirror the orderly flow of tasks (Hsieh et al., 2013; Yakunin et al., 2018). Prior research suggests some web design elements to improve the layout characteristics. These design elements are the column structure for general appearance, specific orientations as well as position of information, and page information density.

The use of columns, in web pages, varies between cultures. Hsieh and Hong (2013) and Hsieh et al. (2013) found that users from short-term orientation cultures, such as UK
and Australia, prefer 2-column structures, while users from long-term orientation cultures, such Taiwan, mainly use with 3-column structures. The 2-column structure is said to be monochronic Hsieh and Hong (2013), providing more focus to the content, in which users from short-term orientation may tend to get results quickly. In contrast, users from long-term orientation countries prefer to navigate in a parallel as well as polychronic structure (Fraternali et al., 2008). This remains consistent with the anthropological literature of Hofstede et al. (2010) and E. T. Hall and Hall (1990), in which users from high-context cultures are polychronic, while users from low-context culture are monochronic. This work suggests that preferences for single, 2-columns, 3-columns, 4-columns, 5-columns, or 6-columns may differ between cultures.

Specific orientations as well as the position of information varies by culture (Cyr et al., 2004). Abdulkhair (2004) showed that the organization and location of the pictorial information on a web page can be related to the script direction of the user’s first language. Arabic and Hebrew users read from right to left and users attention starts at the top right (Abdulkhair, 2004; Mushtaha & Troyer, 2014). English users, read from left to right and may initially be drawn to the top left (Abdulkhair, 2004; Barber & Badre, 1998). Barber and Badre (1998) showed how users from different cultural backgrounds have their preference for orientations and layout structure in web pages. In Barber and Badre’s (1998) work, Arabic and Hebrew pages had a high frequency of orienting text, links, and graphics from right-to-left; much like France had a centred orientation, suggesting that features on a French site would most likely be centred on the page.

Prior work suggests that users from low-context cultures prefer a logical structure with categories of grouping, while users from high-context cultures prefer visual representation of information (Calabrese et al., 2012; Sun, 2001; Würtz, 2005). Cyr and Trevor-Smith (2004) identified the heavy use of clickable banners, which are placed on the top and left, in Japanese homepages. These results suggest that the placement of banner, clickable banner, menu, functions, roles, and other layout characteristics may differ across cultures.
Page information density differs between cultures. Heimgärtner (2007a) showed that each culture has their own information density characteristics. Fraternali and Tisi (2008) and Chu and Yang (2010) found that culture effects on homepage information density. A difference has been reported including: page length; total amount of independent content elements including links, images, videos, titles, paragraphs, and captions; and information display density. They found that, because of the preferences for more information on details, the information density in Chinese websites is higher than Western websites. This findings were similar to Nordhoff et al. (2018) who found that Chinese and South Korean websites featured many more text areas and the visual complexity of web pages was also high. Although the Chinese language needs considerably fewer characters to represent words than English or German (Chu & Yang, 2010; Heimgärtner, 2007c) the information density of Chinese pages is still higher. The research suggests that page information density may differ between cultures.

Web page length differs between cultures. Marcus and Gould (2000), Burgmann et al. (2006), Reinecke and Bernstein (2011) and Calabrese et al (2012) found that users from low-power distance cultures, prefer less information at first interface, highly structured layouts, and shallow information hierarchies; this make pages horizontal. The users from high-power and high-context cultures, such as China, prefer more information at first interface level, less structure, and tall information hierarchies, which makes their sites vertical and longer. Long textual pages are considered more useful as all the information is in one place to provide greater context (Brejcha et al., 2013). For Arabic cultures, researchers claim that there is an affinity for high-context but low content (Liginlal et al., 2014). The nature of high uncertainty avoidance index would expect Arab countries to have more horizontal pages with a relatively low number of visible links (Khashman & Large, 2010). The research suggests that web page length may differ between cultures.
3.5.2 Navigation

Navigation is the degree of ease-of-navigation that support users' determination of paths through a website (Calabrese et al., 2012). Navigation and site interaction as part of the communication interface (Cyr & Trevor-Smith, 2004; Hsieh et al., 2013; Simon, 2001). The primary goal of navigation is to help the user easily navigate websites to find information and functionality, and encourage them to take desirable actions with minimal effort (Cardello, 2014; De-Marsico & LeviaLDi, 2004). The complexity of navigability is the top cause of user dissatisfaction (Brajnik, 2000), while ease of navigation is one of the biggest keys to increasing usability and user experience. If a website user easily finds what they are looking for, they will be more likely to stay on the website (Read et al., 2009). The effective navigation can help to optimise page views, improve the user experience, and even increase revenue and profit (Cui et al., 2015).

Various commonly used navigation components exist to navigate a website, which include (Cardello, 2014): 1. Main Navigation; 2. Sub Navigation; 3. Breadcrumbs; 4. Quicklinks; 5. Fat Footer; 6. Footer; 7. Skiplinks; and 8. Utilitylinks. With the use of these navigation components, efficient paths can be provided to navigate through web pages. However, most websites may use more than one navigation design pattern between its pages. For example, as shown in Figure 3-1, the homepage of the Department of Finance - Western Australia (2018) had navigation components including a Main Navigation, Breadcrumbs, Quicklinks (in this case, it is “Popular Pages”), Fat Footer, Footer, Skiplinks, and Utilitylinks, while, as shown in Figure 3-2, the “About Us” page of the Department of Finance - Western Australian (2018) had a Main Navigation, Sub Navigation, Breadcrumbs, Fat Footers, Footer, Skiplinks, and Utilitylinks. As the use of navigation components is vital to provide navigational effectiveness, this research analyses the use of Main Navigation, Quicklinks, and Fat Footer in homepages, and its impact between cultures.

Main navigation

Main navigation helps the user to navigate through the website. Traditionally, main navigation appears on every web page of a website, and allows users to switch
between top-level categories easily, irrespective of their current location (Cardello & Whitenton, 2014). Main navigation also ensures that users, who don't enter through the homepage, can quickly get a sense of what is available on the website. The types of main navigation are horizontal and vertical.

Figure 3-1: Navigation components in the homepage of the Department of Finance - Western Australia (2018)
Figure 3-2: Navigation components in the About Us page of the Department of Finance - Western Australia (2018)

Web pages generally rely on a menu for main navigation (Read et al., 2009). The role of the menu is to provide access to navigation items by facilitating functionality (Leuthold et al., 2011). Menu design provides a contextual or structural model for the logical and functional organisation of the web page, as well as a means of communication between the users and the website (Yu, 2001). The menu also builds a strong visual structure and adds contrast to the display (P. J. Lynch & Horton, 2008). Within the web
structure, the menu organises the web pages making the information easier to locate and increasing the page legibility (Abdulkhair, 2004; Lynch et al., 2008). The menu also helps to move through layout (Marcus, 2002), and take the user to another topic area of the website. If the user cannot understand how to reach different topics, then those topics will remain unseen. Effective menu design helps users to avoid feeling lost and disoriented when seeking information or finding functionality (Read et al., 2009).

Prior research analysing users’ information seeking behaviour found that menu design was impacted by culture. Kralisch et al. (2005) found that users from high uncertainty avoidance cultures collect more information on a website than users from low uncertainty avoidance cultures. Users from high uncertainty avoidance cultures prefer to get full information through navigation to minimize ambiguity when visiting a website (Cyr, 2013). They expect structures that allow a maximum amount of predictability (Kralisch et al., 2005). Marcus and Gould (2000), Marcus (2002), and Calabrese et al. (2012) found that web pages designed in high uncertainty avoidance cultures are characterized by limited choices and restricted quantities of data in first interface level. The reason for this preference is that the users from high uncertainty avoidance cultures tend to explore all available options in order to minimize the number of unknown situations and locations. On the other hand, users from low uncertainty avoidance cultures prefer greater page complexity with maximal content and choices.

The preference for different main menus varies between cultures. Callahan (2006), Reinecke (2010), Reinecke and Bernstein (2011) found that, reducing the overall complexity of the interface, users from low-context culture, such as Australia, prefer hierarchical multiple layer main menus. These hierarchical multiple layer main menus only show top-level categories at the first interface level with and sub categories are accessible on mouse-over or mouse-click. The events triggered via mouse-over or mouse-click requires distinct timing to avoid accidental activations and ensure that the user feels in control of the interface. When users decide to activate this type of menu, they seek routing options and rarely need the body content visible (Cardello, 2013), which provide less information in interface level. Advocates of this type of menu argue that users do not want the content in the body of the page to be covered by the
exposed menu (Cardello, 2013). In contrast, users from high-context cultures, such as China, prefer complex interfaces (Nordhoff et al., 2018), and prefer a greater number of displayed in one web page. This provides many available paths and navigational freedom.

When designing a main menu between cultures, Bernstein and Reinecke (2013) and Reinecke et al. (2011) showed that the breadth (number of items offered per menu) and depth (number of levels in the hierarchy) are important. They showed that users from low-power distance cultures prefer highly structured data, few links or choices in first interface level, linear navigation, and minimise navigation possibilities. Users from high-power distance cultures prefer: less structured data, more information at the first interface level, non-linear navigation, and redundant access and navigation possibilities. Prior work also suggests that the users from high-power cultures, such as China, prefer websites with tall information hierarchies, while the users from low-power distance cultures, such as America, prefer websites with shallow information hierarchies (Cui et al., 2015). This background knowledge may impact the breadth and depth of the main menu (Whitenton, 2013). The research suggests that preferences for main menu’s breadth and depth varies between cultures.

**Quicklinks**

Website users become familiar with certain methods of navigation. A common trend is to place a small set of links or commands at the high level on the page as well as in the information architecture (Ghaphery, 2005). Quicklinks are a list of unstructured links that are placed in a salient place on a page (Pernice, 2014b). Quicklinks are usually arranged as an on-page list of links; sometimes it can also be presented as a drop-down list (Ghaphery, 2005). Links in the Quicklinks provide additional possibilities for a user to move through the website.

Quicklinks have several benefits. In the homepage of a Federal Court website, a set of links including: Find a Judgement, Find a Form, Find a Rule, and Practice Documents, may help a user to easily navigate through the site to find information as quickly as possible (Makki & Leppert, 2006). In general, organizing a website by tasks has been shown to increase usability for all cultures (Makki & Leppert, 2006; Sun, 2001).
The Quicklinks block is “chunked” into sections to make it easier to scan for information, services, or functionality. With the use of headlines, bullets, and short sentences, (Fichter, 2005) and Makki and Leppert (2006) recommends “chunking” to increase usability to users. According to Pernice (2014b), Quicklinks chunking saves space and minimizes the user’s memory load. Quicklinks can contain a bit of everything such as most popular, most frequently used, and most important. If the website designer uses these names specifically, for each type of content, several panels of links is required. With the use of one pane that accommodates all the links, Quicklinks can save space on pages. This technique possibly attracts users attention on just one area instead of several, which minimizes a user’s cognitive load.

Quicklinks were introduced in the early 2000s (Pernice, 2014b) as a design feature to simplify common tasks to improve the usability of the website (Makki et al., 2006). Quicklinks containing frequently used information can be presented in a standard manner for ease as well as quick access (Ghaphery, 2005; Pernice, 2014b).

The use of Quicklinks may be impacted by culture. Short-term oriented countries will prefer design elements that allow a website user to accomplish tasks or get results quickly (Callahan, 2006; Würtz, 2005). In short-term orientation cultures, the immediacy of results and the achievement of goals are important issues (Kralisch et al., 2005). When navigating a website, users from short-term orientation countries prefer to scan sections to reach their navigational goal as fast as possible. According to Ghaphery (2005), the users from short-term orientation countries, such as America, are already aware of the navigation standard of the Quicklinks (Fichter, 2005; Makki et al., 2006). This may be the reason for the presence of the Quicklinks in the English language version of the General Administration of Customs People's Republic of China (GACPRC, 2018), in Figure 1-1, in Chapter 1. The use of Quicklinks is preferred by users from short-term orientation countries, such as the US.

Würtz (2005) and Calabrese et al. (2012) found that the users from long-term orientation as well as high-context cultures, such as China and Eastern countries, are process oriented, while users from low-context cultures, such as Australians, Germans, Scandinavians, and North Americans, are task-oriented. Since, Quicklinks are a
navigation tool for task-oriented procedures (Ghaphery, 2005), the label “Quicklinks” may be unfamiliar for users from long-term orientation countries, such as China. This may be the reason for the absence of the Quicklinks in the Mandarin language version of the General Administration of Customs People's Republic of China (GACPRC, 2018), shown in Figure 1-1, in Chapter 1. Chinese websites usually group process-oriented links for labels including: Related Links, Useful Links, or Links. The use of unfamiliar terminology, for example Quicklinks, in long-term orientation culture, such as China, can actually drive users away (Cardello, 2013). Therefore, Quicklinks may be a culturally preferred design element.

**Fat Footer**

Historically, web page footers were no more than a single line with a simple copyright notice and a link to the site designer. A modern trend is to create a long tail of a website. The Fat Footer is large footer at the bottom of a web page which helps navigation. The Fat Footer is mostly used as secondary navigation, which provides an additional chance to find what they need (Caya & Pernice, 2015). These oversized footers, separated from the main content area with a different background colour and containing distinctly headed sections, are expected and helpful links on the homepage (Caya & Pernice, 2015). The Fat Footer may contain links that do not fit within the main navigation or include a simplified site map of links. The Fat Footer can greatly increase usability for people who arrive at the end of a page without finding what they want (Nielsen, 2012).

The use of the Fat Footer may vary between cultures. Hsieh and Hong (2013) and Hsieh et al. (2013) defined the Fat Footer as an “information guide in bottom” for their cross-cultural web design study. The use of this feature was more common in high-uncertainty avoidance cultures, such as Australia, than low-uncertainty avoidance cultures, such as Taiwan. Prior research suggests that users from high-uncertainty avoidance cultures prefer redundant cues to reduce ambiguity (Marcus & Baumgartner, 2004b; Marcus & Gould, 2000; Reinecke & Bernstein, 2011). The Fat Footer navigation, even if it is just repeating navigation that’s elsewhere, provides redundancy and convenience for users (Chapman, 2011) and prevents users from
getting lost. Accommodating the Fat Footer with repeating navigation may provide auxiliary pages for users from high-uncertainty avoidance cultures. This may be the reason for the presence of the Quicklinks in the English language version of the General Administration of Customs People’s Republic of China (GACPRC, 2018), in Figure 1-1, in Chapter 1. Therefore, the use of Quicklinks be preferred by users from high-uncertainty avoidance cultures, such as Australia and Saudi Arabia, than low-uncertainty avoidance culture, such as China.

Users from low-uncertainty avoidance cultures, such as China, prefer more information in interface level and the web pages are designed with less structured information (Nordhoff et al., 2018). This may impact the use of the Fat Footer and the structure of a Fat Footer. The definition of the Fat Footer forces us to consider the row or column arrange of items for a Fat Footer. However, for the easy identification of the Fat Footer, this research only considers the column arrangement of items as a Fat Footer, and suggests that the use of the Fat Footer may differ between cultures.

3.5.3 Links

In a web page, links are formatted differently from the surrounding text, which may attract user attention (Abdulkhair, 2004). This should be understandable to the users to take it out of context and use it to access information (Pernice, 2014a). Links and their distinguishing features differentiate web pages from the usual printed documents (Abdulkhair, 2004), which makes the website easier to navigate to its users. Since, links provide paths for navigation (Yu, 2001), how the links are presented on the web pages is important.

The preference for links varies between cultures. The culturally specific navigational behaviour with the use of links that open in a new browser window has been identified by Fraternali and Tisi (2008), Hsieh and Hong (2013), and Hsieh et al. (2013). They found that the users from polychronic cultures, such as Taiwan and China, prefer to navigate in a parallel structure and access information shown in a new browser window, while the users from monochronic cultures, such as UK, America, and Australia, prefer linear navigation patterns in a monochronic structure and tend to get results quickly in the same browser window. With the advent of the newest browser
generation where the use of multiple tabs in one browser window has become a common feature (Viermetz et al., 2006; Zhang & Zhao, 2011). The identified culturally specific browsing experience findings consistent with Kralisch’s (2005) analysing web server logfiles. These results show that users from monochronic cultures prefer linear navigation patterns, while users from polychronic cultures prefer non-linear navigation patterns and tend to switch between several open web pages. According to Fraternali and Tisi’s (2008) interpretation, the users from Western cultures tend to consider problems in a sequential way. Based on the simultaneous consideration of multiple problems, reasons, and explanations, the users from East Asia use a different problem-solving approach (Fraternali & Tisi, 2008). This tendency towards parallelism describes why users from East Asia prefer multi-window browsing. This research suggests that link opening preferences may differ across cultures.

3.5.4 Multimedia

Multimedia consists of slideshows, image/text animations, scrolling text/images and animated clickable banners. Multimedia is used to attract users, and yield tangible experiences (Hsieh et al., 2013). The appropriate use of multimedia may provide visual appeal, which is an important design aspect (Reinecke et al., 2013). Son and Park (2012) suggest that text, graphics, audio, and video can be used to build connections across web pages to respond to diverse interests of users. However, according to Miller (1956), too many elements may overburden users’ working memory, decreasing the effectiveness of processing information (Kalyuga et al., 1999). Therefore, the appropriate use of multimedia may be dependent on the cultural background of the users (Hsieh, 2008).

Sun (2001) and Würtz (2005) identified that the implicit culturally preferred design elements including graphics, images, moving text, streaming video, and flash animation were used in the high-context, collective, and long-term time orientation cultures, such as China. Flash animation or text in motion is believed to distract users from low-context cultures, such as Australia. User from low-context cultures prefer explicit culturally preferred design elements including text based logical and structured layout (Hsieh, 2008). This research suggests that the use of multimedia objects may differ across cultures.
3.5.5 Visual representation

Visual representation refers to images that promote cultural values to attract target users. Images are used to hold the clearest and most literal cultural information, and the everyday cultural experience can be provided using images (Calabrese et al., 2012; Tong & Robertson, 2008). Prior research suggests that the images that promote religious, traditional, and cultural values are important for users from Arab countries (Khan & Alhusseini, 2015). If a website uses inappropriate pictures that contradict the traditions, and cultural values of a country then users may avoid using it (AlArfaj, 2017). Therefore, culturally appropriate images must be understood by web designers (Russo & Boor, 1993).

Würtz (2005) found that high-context cultures prefer a human presence in images. Calabrese et al. (2012) found that collectivistic and high-power distance cultures favour images of groups, the elderly, leaders, authority, political, religious, and group achievement. Users from individualistic and low-context cultures prefer images of people in daily action or life, young individuals, personal achievements, and nature. This tendency remains consistent with the findings of Hsieh and Hong (2013), Hsieh et al. (2013), and Al-Khalifa and Garcia (2014). Therefore, the use of images must be considered very carefully to succeed in the global market.

3.5.6 Colour

The use of background as well as foreground colours have the potential to affect user’s perceptions, emotional reactions, and behavioural intentions (Bonnardel et al., 2011). Colour has been also shown to influence perceived trustworthiness (Cyr et al., 2010; Kim & Moon, 1998), satisfaction (Faisal et al., 2017), users’ loyalty (Cyr, 2008; Cyr et al., 2010), work efficiency (Reinecke & Bernstein, 2011), and purchase intention (R. H. Hall & Hanna, 2004). Apart from showing the importance of colour in user interface design, prior work also analysed how web page colour preferences might differ between countries. Duncker et al. (2000) compared colour preferences among websites created by students with different cultural backgrounds. English students tended to use light or soft colours and frequently utilized grey, while Scandinavians favoured dark hues. Jamaicans chose bright colours and used high contrasts. Black, as a background colour,
and colourful elements were frequently chosen by African students. These findings are similar to Oyibo et al.’s (2016) findings, in which Canadians preferred less colourful interface designs than Nigerians. Therefore, when colour is applied to web page design, considering the impact of colour on cultural recognition and user’s expectations and satisfaction (Kalban, 2007; Nordhoff et al., 2018) are important.

The interpretation of colours and their associated meaning differs across cultures (Hsieh, 2008). Russo and Boor (1993) and Barber and Badre (1998) provided a list of colours and their connotations in various cultures. Green, for example, is increasingly associated with the environment (Tong & Robertson, 2008), but is also the colour of Islam. As described in the “Holy Quraan”, green is associated with paradise, and it is considered to be the colour worn in heaven (Abdulkhair, 2004). Russo and Boor (1993) suggests that American banks using a website to promote services for French investors may want to avoid the use of the colour green, which is associated with criminality. On the other hand, the American bank may want to use green to attract investors from Middle Eastern countries where green has a positive connotation.

Prior research also found a connection between the use of colour and cultural factors. Collectivist cultures, such as China, for example, prefer colourful interfaces (Reinecke & Bernstein, 2011), in which they incorporate traditional colours and images (Barber & Badre, 1998). In contrast, users from individualist cultures, such as America, prefer monotone coloured interfaces (Marcus & Gould, 2000). Some of the advantages of creating monochromatic website designs are: the avoidance of colour clashes, no or fewer distractions, and more focus on the content. Therefore, the use of colour must be considered very carefully in the design of web pages between cultures.

3.5.7 Text

The most distinctive cultural symbol is language and the text on the page (Chu & Yang, 2010; Mohammadi et al., 2012). The language is part of the culture and the users preferences affect the usability of a web page (Abdulkhair, 2004). Nielsen (1997) found that users rarely read web pages word by word. They scan the web page, picking out individual words and sentences. As a result, web pages need to be scannable and
emphasize text, which can be indicated by: bold, italic, underlining, different font sizes, and colours.

Prior research found that users from different cultural backgrounds have different web page viewing patterns with their own language version of the prototype web page. Dong and Lee (2008) recorded American, Chinese, and Korean users’ eye movements, which can provide specific information about their cognitive processes, while browsing their own language, English, Chinese, and Korean, versions of the same web page, respectively. All these languages flow from left to right, and the prototype web page was divided into 3 x 3 areas of interest. From the eye-tracking data, it was found that American user’s eyes move sequentially from one area to the neighbouring area, continuously reading contents within one area. They also pay more attention to the text-based navigation bar and spend some time to read the navigation items. Dong and Lee (2008) also found that American users read sequentially with “5” shaped viewing pattern. However, Korean users had a circular as well as back and forth scan. Chinese users had the combination of “X” and “N” shaped viewing patterns. Since users from different countries scan and view a web page differently, the appropriate use of scannable as well as emphasized text would allow users from different cultural groups to more easily complete tasks.

Prior research also found possible variations in visual behaviour and eye movements on web pages among users from three different cultures including Arab, English, and Chinese. Alsaffar et al. (2018) conducted an eye tracking study of web page viewing behaviour and preferences of Arabic, English, and Chinese users. Each group were exposed to three types of web page including: image-based, text-based, and a web page that carry an unfamiliar design containing images and text with mainly right hand design elements. The image-based web page was mostly preferred by Chinese users, the text-based web page was preferred by English users, and Arab group preferred the web page that contained images and text with mainly right hand design elements. This study further discovered dissimilar scanning patterns that were exhibited from each cultural group. Chinese users were found to have short periods of fixation on various areas of a web page navigating more frequently through various sections of the whole page while English users concentrated their fixations more on specific areas. Arab
users were found to take a holistic view of a thing, and not just the part (Liginlal et al., 2014), like Chinese, rather than analytic minded like English users. Since visual behaviour of users from different cultures differ, the use of text must be considered very carefully in the design of web pages between cultures.

3.6 Cross-cultural Web Usability Model

Prior research has been conducted to find the relationship between website design and cultural factors in order to find cultural markers and anthropological cultural factors for designing localized websites (Mushtaha & Troyer, 2014). This section reviews prior work that uses existing anthropological cultural factors as cross-cultural web design guidelines, strategies, frameworks, and models.

Marcus and Gould (2000), Gould et al. (2000), Würtz (2005), Ahmed et al. (2008), and Calabrese et al. (2012) made theoretical contributions by using existing cultural factors as guidelines to design websites for different cultures. They showed the usefulness of cultural factors in website design; however, no usability test was performed.

Simon (2001), Sun (2001), and Díaz et al. (2013) used existing cultural factors to conduct empirical studies. They found a substantial difference in the way different cultures perceive web designs, which in turn, affects their satisfaction. Ford and Gelderblom (2003) also applied cultural factors to construct their empirical study. In their study, they examined human performance: speed, accuracy, and satisfaction, and observed notable improvements in work efficiency and user satisfaction. Their analysis indicated that cultural factors outside those tested also influenced their score. They indicated a need to build a more detailed model of usability before empirical research of this nature can be effectively carried out (Ford & Kotzé, 2006).

Yaaqoubi and Reinecke (2018) presented case studies that show how cultural factors informed decision making and conclusions drawn from experiments, as well as changes made to global product. Insights were gained from localisation teams in Booking.com (2018), in the marketing line of online travel and related services. Booking.com has a culture of experimentation and uses A/B testing for product development. The A/B tests, often called split testing compares two versions of a web page to see which one
performs better. The culturally adapted version of the homepage of Booking.com would increase performance as well as trust in the website and hence, increase the finalized bookings made by travellers from that country.

Research has shown that when anthropological cultural factors are combined and used in reference with other approaches, they can be used for cross-cultural usability studies (Jagne et al., 2004; Reinecke & Bernstein, 2011). Zahedi et al. (2001) developed a conceptual framework for web documents that combines existing cultural factors and individual factors. The considered individual factors: demographics; professional knowledge; information technology knowledge; flexibility; information processing abilities; and cultural knowledge. To measure effectiveness, they considered usability, reliability, clarity, and comprehension that, in turn, influence overall satisfaction with web documents. Sun (2002) developed a model that combines existing cultural factors together with Marcus and Gould’s (2000), and Zahedi et al.’s (2001) work. Smith et al. (2004) developed a model for developing usable cross-cultural websites that incorporated existing cultural factors and Barber and Badre’s (1998) cultural markers. Jagne et al. (2004) developed an investigative model that combines existing cultural factors, Marcus and Gould’s (2000) design guidelines, and Barber and Badre’s (1998) cultural markers. Hsieh et al. (2009) developed a model that combines existing cultural factors and cultural markers. To assess the effectiveness of interface design, they defined usability evaluation criteria including: learnability, efficiency, minimal errors, satisfaction, comprehension, and desirability. Heimgärtner (2013) created a model of culturally influenced HCI to cover cultural context in HCI design, which combined cultural factors and HCI factors. HCI factors described the style of information processing and the interactional characteristics of the user with the web page. However, empirical studies to support these models are lacking; therefore, this research creates a new Cross-cultural Web Usability Model.

3.7 Empirical evaluation of the model

Few studies have adapted cultural factors into website design and empirically measured cross-cultural web usability. In this section, these studies are presented in the chronological order.
Ford and Gelderblom (2003) applied Hofstede et al.’s (2010) cultural factors to construct their empirical study to examine whether the cultural factors would influence user performance. The results did not provide enough evidence to support the hypothesis that cultural factors influenced users’ performance, but the performance levels gained revealed that the usability of web pages increased for all users, as a result of incorporating Hofstede et al.’s (2010) cultural factors into the design.

Prior studies also measured task performance and satisfaction from culturally specific website designs. Fraternali and Tisi (2008) showed that user performance increased on websites that incorporate cultural factors from E. T. Hall and Hall’s (1990) that belong to their cultural group. Alostatha et al. (2011), Reinecke and Bernstein (2011), Bernstein and Reinecke (2013), and Hsieh (2014) showed that culturally adapted web versions increased user performance and satisfaction.

Díaz et al. (2017) applied Hofstede et al.’s (2010) cultural factors to create Cultural – Oriented Usability Heuristics, as a set of cross-cultural design guidelines. The empirical evaluation showed that websites which display characteristics relevant to specific Hofstede et al. (2010) cultural factors improve usability.

3.8 Summary

This chapter has reviewed the area of culture-centred website design to enhance web usability and user experience design relevant to the research described in this thesis. This chapter presents a collection of studies investigating culturally determined web design preferences for various web design attributes to ensure clear and effective website communication, which will later be revisited in this thesis. Next, there was a discussion of the use of existing cultural factors as cross-cultural web design guidelines, strategies, frameworks, and models that guide web designers to optimize web pages according to the users’ culture, followed by a review of the empirical evaluation of the existing models. This review demonstrates the relevance of the cultural as well as HCI factors described earlier into broad web design attributes to increase user performance and perception. The successes of existing user interface cultural adaptation demonstrates the feasibility of this stream of research and development.
The following chapter brings together the knowledge of cultural preferences to describes the relevance of its use in a socio-cultural context, which will map with existing cultural as well as HCI factors to later develop a new Cross-cultural Web Usability Model. This evaluation of the use of broad web design attributes addresses the limitations identified in the present website cultural adaptation to consider a large set of web design preferences.
Chapter 4. Evaluation of website design attributes

4.1 Introduction

This chapter details the evaluation of the presence of design elements in websites prepared for different cultures. The identified culturally specific website design elements are used in the next phase of this thesis. The background is first presented, followed by an overview and the methodology.

4.2 Background

Measuring and comparing local websites help to understand both: how existing websites have been designed for a particular cultural group; and how the target culture’s design preferences and expectations vary from other cultures. Prior research showed that design elements can directly map to the existing cultural factors to determine a country’s cultural preferences (Hsieh, 2015). Therefore, measuring and comparing local websites of a target culture is vital to link website design and culture (Cyr & Trevor-Smith, 2004; Hsieh et al., 2013).

As foreign website designers may be unaware of local cultural preferences (Zakaria et al., 2003), HCI usability researchers and practitioners are interested in accommodating cultural preferences during user interface design for enhancing usability (Daniel et al., 2011; Hsieh, 2015; Mushtaha & Troyer, 2012). Despite increased research interest in culturally preferred design elements (Kincl et al., 2013; Steve et al., 2013), few studies systematically investigate these preferences across cultures. This study conducts a manual and automated website audit to measure, compare, and analyse website designs between Australian, Chinese, and Saudi Arabian cultures with 460 websites.

Some of the culture-specific preferences observed in international website design may be explained by existing cultural models (Cyr & Trevor-Smith, 2004; Hsieh & Hong, 2013; Sun, 2001), such as those of Hofstede et al. (2010) and E. T. Hall and Hall (1990). This study highlights the similarities and differences in cultural preferences for layout,
navigation, links, multimedia, visual representation, colours, and text in Australian, Chinese, and Saudi Arabian cultures.

These culturally specific website design elements are suitable for creating reusable libraries that contain sets of website design elements. These libraries provide a set of useful building blocks to perform cultural translation. Cultural translation is rearranging the website design elements to improve the effectiveness of communication and enhance user experience.

4.3 Justification of the study

Users from different cultures have different psychological and social associations (Collazos & Gil, 2011; Hsieh, 2008), which led to design element preferences in colour, graphics, navigation, and orientation of the website (Mushtaha & Troyer, 2009; Nizamani et al., 2018). Barber and Badre (1998) merged culture and usability into “culturability”, in which cultural elements are considered in website design. The preferences of the web design elements are expected to directly affect the way users interact with the website (Liginlal et al., 2014).

To succeed in the global economy, adapting websites to a particular culture is important (Reinecke & Bernstein, 2011; Yaaqoubi & Reinecke, 2018). However, cultural adaptation often only provides language, date, time, currency, number formats translation, or modification of graphical design elements (CLDR, 2016; Cyr & Trevor-Smith, 2004; Mushtaha & Troyer, 2012). Modern “internationalisation” guidelines such as those of IBM (2016) identify that cultural norms must be considered when developing graphical interfaces, but to date there is no comprehensive set of cross-cultural guidelines which includes all aspects of web content. New cultural adaptation should consider cultural preferences for layout, navigation, links, multimedia, visual representation, colours, and text (Cyr & Trevor-Smith, 2004; Mushtaha & Troyer, 2014), expressing the national culture of a country (Calabrese et al., 2014).

Prior research indicated that preferences for design attributes vary between cultures (Bernstein & Reinecke, 2013; Hsieh, 2014; Mushtaha & Troyer, 2014). Hsieh et al.
(2013), Hsieh and Hong (2013), Goyal et al. (2012), and Cyr and Trevor-Smith (2004) identified significant difference in website design preferences between high-context and low-context cultures. Fraternali and Tisi (2008), Nordhoff et al. (2018), and Nizamani et al. (2018) gave examples of how cultural preferences (cultural markers) are widespread within a particular cultural group. They showed that cultural markers are introduced by the associated cultural group. Sun (2001) examined the effect of cultural markers on web usability and concluded that people preferred interactive interfaces with cultural markers from their own cultures.

The effects of cultural preferences on website use has been examined by Badre (2000), Fraternali and Tisi (2008), and Hsieh (2014). They identified some design elements that are culturally specific. They conducted empirical studies to examine whether the websites, which are embedded with the culturally specific design elements, would affect the native user performance. The results indicated that both: user performance and communication effectiveness can be improved by adapting culturally specific design elements.

Website users, aware of their cultural preferences, demand a browsing experience with simple information retrieval (Juric et al., 2003). However, to localize websites between cultures, a clear-cut list of cultural preferences is needed (Mushtaha, 2012). Foreign website designers may be less aware of local users’ cultural preferences. Hsieh (2008) and Smith et al. (2004) suggest that engagement of the target culture is important. Hsieh (2008), Liginlal et al. (2014), and Nordhoff et al. (2018) stated that properly applying cultural preferences will increase the cultural sensitivity of multilingual websites.

Mushtaha (2012) and Daniel et al. (2011) point out that much research is required to know what cultural issues influence the usability of websites and the level of influence. Such research should first study the local cultures specific preferences. HCI usability researchers and practitioners are interested in the level of cultural elements used
during the user interface design process (Clemmensen & Roese, 2010; Daniel et al., 2011).

The existing research suggests that preferences for website design differ across cultures. Design preferences vary for multimedia, layout, navigation, links, colour, and text. To increase effectiveness of communication between cultures, cultural adaption of these design attributes is required (Hsieh, 2014).

**4.4 Web design attributes to access clear and effective communication**

The literature has shown that there are important web design attributes that enable clear and effective communication between user and the web page (Hsieh, 2014; Marcus, 2002; Mushtaha & Troyer, 2014). To accommodate broad preferences for design elements between cultures, this research identifies seven website design attributes, these include: Layout, Navigation, Links, Multimedia, Visual Representation, Colour, and Text.

**4.4.1 Layout**

Well structured websites are easier to access and understand (Hsieh et al., 2013; Tong & Robertson, 2008). Kralisch et al. (2005) found that users from monochronic cultures prefer linear and hierarchical structures, while users from polychromic cultures prefer parallel structure. E. T. Hall and Hall (1990) describe how communication patterns vary between cultures, in which users from high-context culture, such as China and Saudi Arabia, are polychromic (synchronism), while users from low-context culture, such as Australia, are monochromic (sequential). This chapter will test whether the type of banner, presence of column structures, location of the clickable banners, location of the main menu, page height, total number of visible items on a web page, and page display density differ between cultures. This led us to construct the following hypothesis:

*H1: The usage of layout elements differs between Australian, Chinese, and Saudi Arabian cultures.*
4.4.2 Navigation

A navigation design should best support findability and discoverability of information and functionality. Navigation should support the user to better find and discover information and functionality (van Heerden & van Greunen, 2006; Yu & Roh, 2002). Calabrese et al. (2012), Reinecke and Bernstein (2011), and Marcus and Gould (2000) declare that culture would influence the navigation elements in web design. Users from low-uncertainty avoidance countries, who feel vulnerable taking risks in unknown situations, tend to prefer complexity with maximal content and choices that allow less control in navigation (Kralisch et al., 2005). However, users from high-uncertainty avoidance countries, where anxiety arises when uncertain situations are encountered, require a formal navigation structure that organizes information hierarchically in a predictable way (Kralisch et al., 2005). Analysis of website design, by Marcus and Gould (2000) shows that interfaces designed by members of high-uncertainty avoidance countries are characterized by limited choices and restricted amounts of data or information. Users from high-uncertainty avoidance countries tend to explore all available options in order to minimize the number of unknown situations and locations (Kralisch et al., 2005). Users from European and North Americans cultures have similar navigation preferences, in which they require navigation aids to make changes in navigation on the sites to improve movement while making it simpler to use (Simon, 2001). They prefer simple and quick navigation while browsing. Asian and South Americans prefer navigation aids to change the appearance of the page without any concern for movements specially; they prefer interaction and navigation that presents alternative choices to the user (Duygu & Eristi, 2009).

Calabrese et al. (2012) showed that for users from low-context cultures and short-term orientation cultures, simple navigation structures characterized by quick navigation are preferred. Reinecke and Bernstein (2011) suggest that users from high-uncertainty avoidance cultures prefer redundant cues to reduce ambiguity. Hsieh and Hong (2013) and Hsieh et al. (2013) found navigation similarities between Australian and UK cultures. They discovered the use of the “information guide” at the bottom in both cultures; however, this is not favoured by the Taiwanese culture.
The above literature review led us to assume that the preferences for navigation will vary between Australian, Chinese, and Saudi Arabian cultures. In this thesis, the navigation refers to: the type of main navigation, type of main menu, number of visible links in the main menu, level of choices in the main menu, use of Fat Footer, and use of Quicklinks. The following hypothesis was derived:

\textit{H2: The usage of navigation elements differs between Australian, Chinese, and Saudi Arabian cultures.}

\textbf{4.4.3 Links}

Web page organisation and navigation are grounded in links (Yu & Roh, 2002). The correct use of links provide paths for navigation (Yu, 2001), and may retain users (Calabrese et al., 2012; Hsieh et al., 2013). How the links are presented on the page is important. Sun (2001) found that links are set up in alphabetical order. The navigation bar is preferred by users from low-context cultures, for example Germany, but that preference was not favoured by users from high-context culture, for example China and Brazil, who prefer visual cues. Cyr and Trevor-Smith (2004), Hsieh and Hong (2013) and Hsieh et al. (2013) found that users from high-context cultures prefer a symbolic non-text navigation scheme. Cyr and Trevor-Smith (2004) identified the heavy use of clickable banners and culturally specific icons, which were used for navigation, in high-context cultures, such as Japan.

Barber and Badre (1998) and Badre (2001) showed that the number of internal and external links are a strong cultural marker. Gould et al. (2000), and Cyr and Trevor-Smith (2004) identified the heavy use of external links in collectivistic culture’s homepages compared with individualistic cultures. Gould et al. (2000) found that collectivistic culture focus on organizations and not on tasks. This leads to many links to other organizations to demonstrate the strength of the group's network to emphasize social as well as organizational goals. In individualistic cultures, individual goals are more important (Gould et al., 2000). Too many external links can distract the users, who prefer quick access to information.
This thesis will test whether preferences for links vary between Australian, Chinese, and Saudi Arabian cultures. We define links as: the use of internal clickable banner, external clickable banner, standard and culturally specific icons for links, internal links, external links, number of visible links, links opening in a new browser window, skip links including Skip to Content, Skip to Navigation, and Back to Top. The following hypothesis was derived:

**H3: The usage of links elements differs between Australian, Chinese, and Saudi Arabian cultures.**

**4.4.4 Multimedia**

Multimedia is a factor researchers have examined related to culture (Cyr & Trevor-Smith, 2004). Multimedia consists of slideshows, images/ text animations, text scrolling, image scrolling, and animated clickable banners, which are used to attract users, and yield tangible experiences (Hsieh et al., 2013; Marcus, 2002). However, the heavy use of multimedia is dependent on the cultural background of the users (Hsieh, 2008).

According to E. T. Hall and Hall (1990), Usunier (1991), and Hermeking (2005), users from high-context cultures prefer heavy use of multimedia elements on websites other than the users from low-context cultures. Sun (2001) and Würtz (2005) found that users from high-context cultures share a strong preference for visuals, which are based on graphics, while users from low-context cultures favour logical design. Würtz (2005) found that, by integrating animation and other communicative effects in their websites, high-context cultures incorporate human presence on their websites. Al-Khalifa and Garcia (2014), Hsieh et al. (2013), and Hsieh and Hong (2013) found that, to provide a sense of human representation, high-context cultures (for example Saudi Arabia, India, Philippines, and Taiwan) use multimedia elements including, flash animations and cartoon type images. The communication pattern of low-context cultures is direct, and explicit (E. T. Hall & Hall, 1990), in which users from this culture prefer to quickly get results and reach their goals (Hsieh et al., 2013). Flash animation
or text scrolling could distract users from low-context cultures, such as Australia and UK.

These findings suggest that preferences for multimedia elements vary between Australian, Chinese, and Saudi Arabian cultures. Our study defines the multimedia elements that refer to slideshows, image/text animations, text scrolling, image scrolling, animated clickable banners, cartoons, logos, and multimedia control capability with “Pause” or “Play” button. It is derived the following hypothesis:

H4: The usage of multimedia elements differs between Australian, Chinese, and Saudi Arabian cultures.

4.4.5 Visual representation

Differences exist in visual representation between cultures. Based on Hofstede’s cultural factors, Marcus and Gould (2000) and Calabrese et al. (2012) developed their cross cultural web design guidelines and strategies. On web pages, collectivistic and high-power distance cultures favour images with: groups, elderly individuals, leaders, as well as political or religious images, and group achievements. Users from individualistic and low-context cultures are inclined to take care of themselves, enjoying their lives, and usually remaining independent of other people; this leads them to prefer images of people in daily action/life, images of young individuals, images of personal achievements, and images of nature. This tendency remains consistent with Al-Khalifa and Garcia (2014), Hsieh et al. (2013), and Hsieh and Hong (2013). As the interpretation of images differs, they require careful consideration.

These findings suggest that preferences for visual representation of content vary between Australian, Chinese, and Saudi Arabian cultures. Our study defines visual representation to include images of: leaders or authority, young individuals, elderly or experienced individuals, smaller groups (with maximum 3 persons), larger groups (with more than 3 persons), people in daily action or life, political or religious, personal achievements or success, achievements or success, and nature. We derived the following two hypothesis:
**4.4.6 Colour**

Colour includes background and foreground colours. The colours recognize in one culture may have no meaning or even contradictory meaning in another culture (Mushtaha, 2012). For example, the colour red implies different things to different cultures: happiness for Chinese; anger, danger, and risk for Japanese; death for Egyptians; aristocracy for French; and danger and stop for Americans (Barber & Badre, 1998). It seems that some colour interpretations are strongly affected by English culture such as: blue for calm, white for purity, red for attention, and yellow for bright (Abdulkhair, 2004).

Barber and Badre (1998) noticed that the colours of the national flag were frequently used by government sites in the countries studied, with the exception of Brazil, which used a selection of bright colours. According to Barber and Badre (1998), Marcus and Gould (2000) and Reinecke and Bernstein (2011), collectivistic cultures prefer to have a colourfull interfaces, incorporating traditional colours and images, while users from individualistic cultures prefer to use colours to encode information and bright colours are uncommon. Careful use of colours will reduce the risk of error and improve user engagement with websites (Chan & Courtney, 2001).

The literature suggests that the use of colours will differ between Australian, Chinese, and Saudi Arabian cultures. The following hypothesis was derived:

**H6: The usage of colours differs between Australian, Chinese, and Saudi Arabian cultures.**

**4.4.7 Text**

In a web page, users would not read the text in a word-by-word manner (Nielsen, 2006). Scanning is more common than reading (Nielsen, 2007). Users can traverse the web page in variety of ways depending on their reading habits (Rukshan & Baravalle, 2011). However, in most cases, users scan the web page from top to bottom searching
for the desired data by concentrating on the emphasized text, which can be indicated by bold, italic, underlining, different font sizes, or different font colour. Abdulkhair (2004) and Nielsen (2007) showed that the scannability, as an aspect of web usability, which is independent of the content is not restricted to any particular category of web page. They showed that Arabic and English users’ language preferences for scanning in the web page vary. The scanability measure for the text specification includes bold, italic, underline, capital, letter size, and colour. For Arabic users the use of different colours was the most commonly preferred presentation for the headings and subtitles. The other presentation preference was bold text, followed by larger letter size; underline; the least popular was italic. The majority of English users considered bold text as the most recognisable presentation for important text, headings and subheadings. The other presentation preference for heading scanability was larger letters, followed by colours; the least popular was capitalisation. Several usability experts advise the use of at least one of the following text specifications: bold, italic, underline, larger font or different colour in order to differentiate headings and subtitles from the rest of the text. These design elements may, therefore, play an important role in cross-cultural website design and translation (Barber & Badre, 1998; Mushtaha, 2012).

The presence of text varies between Australian, Chinese, and Saudi Arabian cultures. In our study, text refers to the use of XHTML tags including: heading, bold, italic, and underline. We derived the following hypothesis:

*H7: The usage of text elements differs between Australian, Chinese, and Saudi Arabian cultures.*

With the overall review of the literature above, we assume that culturally specific website design elements are associated with website design attributes including layout, navigation, links, multimedia, colour, and text vary between cultures.
4.5 Website audit study

Since websites are developed and maintained by different cultures, web page design may be influenced by the culture in which they originated. This study aims to present the presence of design elements between cultures. This research conducts a website audit study to measure, compare, and analyse website design elements between cultures for identifying culturally specific design elements on websites. Exploring this will help to identify the presence of design elements between cultures.

To identify design elements on websites, a website design element checklist was developed. Websites were categorized by cultural groups. Cultural groups that contained country, language, and categories of websites were defined. Each cultural group encompassed a large population of existing websites. Websites were selected from a random sample within each cultural group. As the homepage is a face to the world (Abdulkhair, 2004; Rukshan & Baravalle, 2011) that provides consistency across the sample and is limited to a single page (Khashman & Large, 2010; Sun, 2001), homepages were evaluated to identify design elements.

This quantitative study used both automated processes and manual user entry to determine the presence of culturally specific design elements. Automation handled the website design elements that were difficult or time consuming for human evaluators. For example, number of total links in web page, precise colour, page width, page height, number of external and internal links, number of headings, number of bold, italic, and underline, and number of multimedia elements.

Not all website design elements could be automatically evaluated (Abdulkhair, 2004; Kondratova et al., 2005). A manual cultural audit study was conducted on the same websites, in which participants evaluate the availability of website design elements and its frequency of use in websites. This will be discussed in Section 4.5.5.

Both study results were combined and statistically analysed. Statistically significant differences in website design elements between cultures, are identified. The identified
culturally specific website design elements were used to explore the similarities and differences in websites design elements between cultures.

4.5.1 Development of measurement instrument

Systematic investigation of cultural preferences on websites requires the identification and organisation of available website design elements (Cyr & Trevor-Smith, 2004; Fraternali & Tisi, 2008). Rather than using a focus group to define design elements on websites for creating the website design elements checklist, a list of website design elements were derived by reviewing previous research.

Prior research in HCI has already studied website design elements to determine how linguistics, age and culture affect website usability, understanding, and acceptance. Previous research was reviewed to devise a checklist of website design elements. All website design elements were organised into six website design attributes including layout, navigation, links, multimedia, colour, and text. These website design elements are linked to one or more of Hofstede et al.’s (2010) and E. T. Hall and Hall’s (1990) cultural factors in the existing literature.

To conduct this research, the website design elements were split into automated and manual cultural audit studies. The study will identify the frequency of each design element for comparison across Australian, Chinese, and Saudi Arabian cultures. The website design element checklist is shown in Table 4-1 and 4-2.

Table 4-1: Design elements checklist for manual cultural audit studies

<table>
<thead>
<tr>
<th>Website design attributes</th>
<th>Web aspects</th>
<th>Variables of website design elements</th>
</tr>
</thead>
<tbody>
<tr>
<td>Layout</td>
<td>Type of banner</td>
<td>• Contain single colour</td>
</tr>
<tr>
<td></td>
<td></td>
<td>• Image banner</td>
</tr>
<tr>
<td></td>
<td></td>
<td>• Dynamic</td>
</tr>
<tr>
<td>Type of main navigation</td>
<td></td>
<td>• Horizontal</td>
</tr>
<tr>
<td></td>
<td></td>
<td>• Vertical</td>
</tr>
<tr>
<td></td>
<td></td>
<td>• Other</td>
</tr>
<tr>
<td>Location of the main navigation</td>
<td></td>
<td>• Before the banner</td>
</tr>
<tr>
<td></td>
<td></td>
<td>• Within the banner</td>
</tr>
<tr>
<td></td>
<td></td>
<td>• After the banner</td>
</tr>
<tr>
<td></td>
<td></td>
<td>• Left-hand</td>
</tr>
<tr>
<td>Use of columns</td>
<td>Location of the clickable banner</td>
<td>Navigation</td>
</tr>
<tr>
<td>----------------</td>
<td>----------------------------------</td>
<td>------------</td>
</tr>
<tr>
<td>• Right-hand</td>
<td>• Left</td>
<td>• Static</td>
</tr>
<tr>
<td>• Other</td>
<td>• Right</td>
<td>• Semi dynamic</td>
</tr>
<tr>
<td></td>
<td>• Centre of the web page</td>
<td>• Dynamic</td>
</tr>
<tr>
<td></td>
<td>• Bottom</td>
<td></td>
</tr>
</tbody>
</table>

- Available links in the main menu:
- Level of choices in the main menu:
- Quick Links:
- Use of the Fat footer/Information guide on bottom:
- Links:
- Multimedia:
- Visual representation:
4.5.2 Survey sample

Selection of culture

Culture has various layers; national, regional, gender, and a social class (Hofstede et al., 2010; Oh & Moon, 2013). National culture can be regarded as the collective programming of the mind and the interactive collective of common characteristics that
influence a collective response to the environment (Fink & Laupase, 2000; Hofstede et al., 2010; Raaij, 1997). This study defines culture based on nationality which is used to represent user culture. Three nationalities have been chosen: Australian, Chinese, and Saudi Arabian. These nationalities were selected, because they have diverse cultural characteristics, as determined by Hofstede et al.’s (2010) and E. T. Hall and Hall’s (1990) country cultural factors.

Language Selection

Three languages have been chosen. English is used by Australians, Simplified Chinese is used by Chinese, and Modern Standard Arabic is used by Saudi Arabians.

Category of website selection

The majority of prior studies examine academic, e-commerce, and tourism websites (Nawaz, 2013). The use of cultural factors to study website design preferences based on other categories of websites is limited. The categories of websites of “government” and “news and media” were chosen because these websites target a variety of local people. According to Barber and Badre (1998), Hsieh (2008), Mohammadi et al. (2012), and Mushtaha (2012), to some extent, the government and news and media websites reflect a country’s culture. Generally, government and news and media websites are designed by local designers (Hsieh et al., 2013; Mohammadi et al., 2012), and the design elements which are applied by the local designer will be an indication of custom, norm, value, bias, and preferences of local culture (Barber & Badre, 1998; Cyr & Trevor-Smith, 2004; Hsieh, 2008). These categories of websites provide a large enough sample size for each country. In addition, the sites are less influenced by foreign partners or parent companies from other cultures. They were selected to maximise cultural preferences and minimise corporate branding.

4.5.3 Selection of websites

Sample websites were chosen from the free and crowdsourced Dmoz (2017) database. The Dmoz database was a most comprehensive human-reviewed category of the Web links. Dmoz was owned by AOL (2018) and maintained by a vast, global community of
volunteer editors under the Open Directory Project. Because AOL no longer wished to support the project, DMOZ was closed on March 17, 2017. When it closed, DMOZ had 1,031,722 Categories and 3,861,210 Sites and contained hierarchically structured website with web pages. A non-editable static mirror of Dmoz remain available at dmoztools.net. The typical Dmoz category of websites included: Arts and Entertainment; Business and Economy; Education; Employment; Government; Guides and Directories; Health; Maps and Views; News and Media; Real Estate; Recreation and Sports; Science and Environment; Shopping; Society and Culture; Transportation; Travel and Tourism; and Weather. The list enabled the selection of websites with local languages from categories, which include: Government, and News and Media. The selected websites were Government websites from Australia in English, News and Media websites Australia in English, Government websites from China in Simplified Chinese, News and Media websites from China in Simplified Chinese, Government websites from Saudi Arabia in Arabic, and News and Media websites from Saudi Arabia in Arabic.

WinHTTrack (HTTrack, 2018), an open source website copying program, was used to download Dmoz categories and its files. All required categories and their files were downloaded and stored in November 2014. To filter website addresses, an open source offline tool AwebHUT (Rukshan & Baravalle, 2011) was used. As this tool is used to conduct automated cultural audit study, more description will be given in section 4.3.3. The AwebHUT tool recursively scans through all stored Dmoz categories’ “index.html” files to scan and filter website address and its sub category, which were stored into a database. The list of websites were uploaded into a Microsoft Excel spreadsheet, and each website was assigned a number.

As our study only tests homepages, a screening process was conducted. In the government, category, it was observed that websites’ domains were repeated within cultural groups. For example, the websites addresses including:

websites of Australia. All of these have a same website address to its homepage that is http://www.aph.gov.au. In such a case, our screening process only retains one website address from the repeated and discarded all repeated websites pointing to the same homepage to reduce duplication. Also, other countries culture may influence websites of foreign embassies. For example, the http://www.philembassy.org.au/, website address for Philippine embassy in Australia, may promote Philippine’s cultural identity in website. Therefore, the screening process further discarded all websites from foreign embassies. After the screening process, a complete list of websites were derived.

Websites were selected based on the Dmoz website category of a country. Initially, it was decided that each cultural group would be represented with 200 websites, 100 from each category of websites. In some categories, the number of websites were greater than 100, while others were less that 100. If the websites were less than 100, it was decided to take all websites from a category of each country. However, if the websites were greater than 100 for a specific country, it was decided to randomly select 100 websites from a category of each country. Similar to Callahan (2006), the Excel spreadsheet's RANDBETWEEN function was used to randomly select 100 websites from each category of countries. The final sample consisted of 487 websites. However, during the both manual and automated evaluation, some websites were inaccessible. Table 4-3 shows the results of the sampling process from the original sample. Finally, 460 websites evaluation results were used for analysis.

4.5.4 Automated website audit study

For this study, PHP, and a MySQL based offline tool, AwebHUT: Automated Web Homepage Usability Tester (Rukshan & Baravalle, 2011), was chosen. This tool was designed for automated usability evaluation of homepages to reach a larger number of subjects with a larger geographic demographic. A large, full scale, Dmoz Asia websites usability evaluation was conducted and presented by Rukshan and Baravalle (2012).
Table 4-3: Sampling process

<table>
<thead>
<tr>
<th>Country</th>
<th>Saudi Arabic</th>
<th>Australia</th>
<th>China</th>
<th>Total</th>
</tr>
</thead>
<tbody>
<tr>
<td>Initial Sample</td>
<td>58</td>
<td>86</td>
<td>322</td>
<td>427</td>
</tr>
<tr>
<td>After applying the screening process</td>
<td>51</td>
<td>36</td>
<td>253</td>
<td>210</td>
</tr>
<tr>
<td>Sample after applying the RANDBETWEEN function</td>
<td>51</td>
<td>36</td>
<td>100</td>
<td>100</td>
</tr>
<tr>
<td>Available websites during the manual website cultural audit study</td>
<td>45</td>
<td>34</td>
<td>94</td>
<td>97</td>
</tr>
<tr>
<td>Available websites during the automated website cultural audit study</td>
<td>45</td>
<td>34</td>
<td>94</td>
<td>96</td>
</tr>
</tbody>
</table>

Where: N & M – News and Media; and Govt. – Government

The tool quantifies the Web aspects identified in Table 4-2. The analysis phase of the tool performs XHTML tag identification and the design element computation. Font effects such as strong and bold can be analysed by STRONG and B XHTML tags respectively. Headings can be analysed from XHTML heading tags from h1 to h6. All the images used can be examined from the IMG XHTML tag. The link’s opening behaviour can be examined from the “target” value of the anchor tag. Internal and external links can be count from the “href” value of the anchor tag. To compute page width, page height, and overall use colour, the tool gets the homepage’s screen shot and measures its width, height, and overall colour values. All computed values are saved into a database.

For the colour analysis, the tool takes the website’s screenshot as an image. This image is used to obtain the most common colours in that image. The tool computes hexadecimal colour codes and their ratio of colours in a web page. The ratio of colours is defined as: \( \text{Ratio-of-colours for } X = \frac{\text{Number of colour count for } X}{\text{Total number of colour count on page}} \).
4.5.5 Manual website audit study

To conduct this study, the allocated design elements in Table 4-1 and Table 4-2 were incorporated into an online questionnaire that was created using an online survey software. The questionnaire is presented in Appendix A.

Using the online questionnaire, the human participants assessed websites. The design elements associated with visual parameters of websites: images, banners, symbols, logos, navigation, and layout were manually measured. If a website design element was not found in a website, evaluators gave a value of “0”, otherwise they informed the number of occurrences of that particular design element on website.

For this study, three final year students from Faculty of Business Studies of the Vavuniya Campus of the University of Jaffna were selected to be involved in a small-scale pre-test study. A user manual was prepared for this website design elements evaluation survey, and was sent to participants to explain the terminology. The participants acted as evaluators to check the presence of cultural markers in the Dmoz websites. Six websites, two per cultural group, were chosen for a pilot study. All six websites were piloted by all participants. Cyr and Trevor-Smith (2004) used a similar pilot study to check coding consistency between participants, and to ensure reliability of the results. The pilot scoring was compared for consistency.

Any inconsistencies were discussed to resolve points of ambiguity and disagreement by training participants. Website design elements were reviewed for implicit and explicit language by the researcher and the participants. After the training, sample websites were re-evaluated to ensure scoring consistency by all participants. The participants, one per entire cultural group, were appointed to evaluate websites.

Each cultural group’s websites were empirically evaluated by participants. Non-overlapping websites selection list was given to each participant. Each participant evaluated a maximum of 200 unique homepages. Based on the website availability, 191 Australian, 190 Chinese, and 79 Saudi Arabian websites were evaluated. In total, 460 websites were evaluated. Each participant completed the online questionnaire,
and received a financial payment from Murdoch University, for their website evaluation.

4.6 Results

Due to the influence of cultural factors, the use of design elements may be culturally specific. The identification of such design elements would require a notion of usability for the target user group (Fraternali & Tisi, 2008; Hsieh, 2014), which is a major goal of this thesis. This study examines whether there is any significant difference between Australian, Chinese, and Saudi Arabian groups. The frequency of occurrence of each website design attribute was compared between cultures. SPSS Version 22 (IBM, 2014) was used to carry out the cross-tabulation comparison to examine if there were significant differences. The results were presented as tables with columns for each country. A total of 460 websites were examined, 191 Australian, 190 Chinese, and 79 Saudi Arabian.

Two different statistical methods were used to analyse the results. To deal with the categorical data that was derived from manual website audit study, Chi-Square analysis was applied to perform cross-tabulation comparisons. To conduct multiple comparisons between countries, a z-test was performed, which adjust p-values with Bonferroni method for multiple comparisons. In each variable, the number of occurrences on each web page and a binary value of present or not present were also measured. Percentages of the number of websites (% within country) were reported due to the differences in sample size. Categorical data were presented in Table 4.4, Table 4.6, Table 4.7, Table 4.9, and Table 4.11.

To deal with the numerical data that was gathered by the automated audit tool, pairwise comparison for mean difference was performed on the numerical (continuous) variables. Before conducting this comparison for each variable, outliers were identified through boxplots and stem and leaf diagrams. This procedure removed all outliers where their distance from the median exceeded 1.5 times the interquartile range. A relatively small number of outliers were identified for each variable. All the
pairwise comparison results are presented in Table 4-5, Table 4-8, Table 4-10, and Table 4-13.

From the results, significant website design element usage differences have been identified between Australian, Chinese, and Saudi Arabian cultures.

**Layout**

Hypothesis 1, the presence of layout differs between Australian, Chinese, and Saudi Arabian cultures, was accepted. Results of layout were presented in Table 4-4 and 4-5, which outlines that the type of banner, location of the clickable banner, use of column structures, specific orientations, position of information, number of items in a web page, and page display density are statistically significant at the 0.05 level between cultures.

Location of the main menu was considered whether cultures prefer horizontal or vertical main navigation, and its location. Differences exist across cultures with regard to the location of the main navigation. The majority of Chinese (98.4%) and Australian (94.8%) websites used top horizontal navigation, while 83.5% of Saudi Arabian websites used this. 16.5% of Saudi Arabian websites used vertical navigation on right, but none of the Australian and Chinese websites used this. 5.2% of Australian and 1.6% of Chinese websites used vertical navigation on left, but none of the Saudi Arabian websites used this. The different scanning and reading patterns of users from different cultural background may influence the positioning of the main navigation on websites.

The type of banner also differs between countries. Australian (79.1%) websites preferred a single colour banner, while only 35.4% of Saudi Arabian and 61.6% of Chinese websites preferred single colour banner. Chinese (16.8%) and Saudi Arabian (10.1%) websites preferred dynamic banner, while only 1.6% of Australian websites used this. The images banner was popular in (35.3%) Chinese and (38%) Saudi Arabian websites, but was unpopular and found in only 11% of Australian websites.
### Table 4-4: Chi-Square comparisons of categorical design elements for Layout

<table>
<thead>
<tr>
<th>Variable</th>
<th>Australia (n=191)</th>
<th>China (n=190)</th>
<th>Saudi Arabia (n=79)</th>
<th>Deg. of Freedom</th>
<th>Chi-square</th>
<th>Sig.level</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>% within country</td>
<td>% within country</td>
<td>% within country</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Banner - single colour</td>
<td>79.1_a</td>
<td>61.6_b</td>
<td>35.4_c</td>
<td>2</td>
<td>47.420</td>
<td>.000</td>
</tr>
<tr>
<td>Banner - image</td>
<td>11_a</td>
<td>35.3_b</td>
<td>38.0_b</td>
<td>2</td>
<td>37.008</td>
<td>.000</td>
</tr>
<tr>
<td>Banner - dynamic</td>
<td>1.6_a</td>
<td>16.8_b</td>
<td>10.1_b</td>
<td>2</td>
<td>26.282</td>
<td>.000</td>
</tr>
<tr>
<td>Main navigation on top</td>
<td>94.8_a</td>
<td>98.4_a</td>
<td>83.5_b</td>
<td>2</td>
<td>23.264</td>
<td>.000</td>
</tr>
<tr>
<td>Main navigation on right</td>
<td>0.0_a</td>
<td>0.0_a</td>
<td>16.5_b</td>
<td>2</td>
<td>64.520</td>
<td>.000</td>
</tr>
<tr>
<td>Main navigation on left</td>
<td>5.2_a</td>
<td>1.6_a</td>
<td>0.0_a</td>
<td>2</td>
<td>7.412</td>
<td>.025</td>
</tr>
<tr>
<td>2-column</td>
<td>81.7_a</td>
<td>61.6_b</td>
<td>72.2_a,b</td>
<td>2</td>
<td>18.982</td>
<td>.000</td>
</tr>
<tr>
<td>3-column</td>
<td>69.6_a</td>
<td>93.2_b</td>
<td>84.8_b</td>
<td>2</td>
<td>36.170</td>
<td>.000</td>
</tr>
<tr>
<td>4-column</td>
<td>48.7_a</td>
<td>16.3_b</td>
<td>29.1_b</td>
<td>2</td>
<td>46.268</td>
<td>.000</td>
</tr>
<tr>
<td>Clickable banner on left</td>
<td>27.2_a</td>
<td>58.9_b</td>
<td>65.8_b</td>
<td>2</td>
<td>52.113</td>
<td>.000</td>
</tr>
<tr>
<td>Clickable banner on right</td>
<td>56.0_a,b</td>
<td>66.3_b</td>
<td>48.1_a</td>
<td>2</td>
<td>8.777</td>
<td>.012</td>
</tr>
<tr>
<td>Clickable banner on centre of the web page</td>
<td>19.4_a</td>
<td>47.9_b</td>
<td>25.3_a</td>
<td>2</td>
<td>37.565</td>
<td>.000</td>
</tr>
<tr>
<td>Clickable banner on bottom</td>
<td>49.7_a</td>
<td>71.1_b</td>
<td>46.8_a</td>
<td>2</td>
<td>22.689</td>
<td>.000</td>
</tr>
</tbody>
</table>

Note: Each subscript letter denotes a subset of Country categories whose column proportions do not differ significantly from each other at the .05 level.

### Table 4-5: Pairwise comparison of numerical design elements for Layout

<table>
<thead>
<tr>
<th>Variable</th>
<th>Country (I)</th>
<th>Country (J)</th>
<th>Mean Australia</th>
<th>Mean China</th>
</tr>
</thead>
<tbody>
<tr>
<td>Total number of items (in a web page including headings, links, and images)</td>
<td>Australia</td>
<td>-</td>
<td></td>
<td>189.6</td>
</tr>
<tr>
<td></td>
<td>Saudi Arabia</td>
<td>-</td>
<td>123.830* (.000)</td>
<td>-</td>
</tr>
<tr>
<td>Web page length (in pixels)</td>
<td>Australia</td>
<td>-</td>
<td></td>
<td>3839.2</td>
</tr>
<tr>
<td></td>
<td>China</td>
<td>-</td>
<td>129.792 (.598)</td>
<td>3709.4</td>
</tr>
<tr>
<td></td>
<td>Saudi Arabia</td>
<td>-</td>
<td>-453.888 (.163)</td>
<td>3385.3</td>
</tr>
<tr>
<td>Display density = Total number of items / Web page length</td>
<td>Australia</td>
<td>-</td>
<td>0.05</td>
<td></td>
</tr>
<tr>
<td></td>
<td>China</td>
<td>-</td>
<td>0.035* (.000)</td>
<td>0.08</td>
</tr>
<tr>
<td></td>
<td>Saudi Arabia</td>
<td>-</td>
<td>0.009* (.002)</td>
<td>0.06</td>
</tr>
</tbody>
</table>

Note: * is the mean difference (I-J) that is significant at the .05 level.
The use of clickable banners was considered to evaluate if websites were designed with visual, as opposed to logical imperatives. Both Chinese and Saudi Arabian websites used more clickable banners than Australian websites. Chinese websites showed a much higher occurrence of clickable banners in all locations (left, right, centre, and bottom) on its web pages. Chinese websites used more clickable banners on the bottom (71.1%), while only 50% of Australian and 47% of Saudi Arabian websites used this. Nearly half of the Chinese websites used clickable banners in the centre of the web page, while 25.3% of Saudi Arabian and only 19.4% of Australian websites used clickable banners in the centre. Saudi Arabian (60%) and Chinese (58.9%) websites greatly used clickable banners on left, while 27.2% of Australian websites used this. All cultures used clickable banner on right. 66.3% of Chinese, 56% of Australian, and 48.1% of Saudi Arabian websites used this.

The use of column structures was considered to identify how web pages are structured. Different columns can be used to construct a web page structure. The use of 2-column, 3-column, and 4-column were evaluated and found to vary between Australian, Chinese, and Saudi Arabian cultures. The use of 2-column structures, provides more focus on the content (Hsieh et al., 2013; Hsieh & Hong, 2013), and is more popular in Australian (81.7%) websites than Chinese (61.6%) websites. However the proportions used in Saudi Arabian (72.2%) websites is not statistically differentiated from those in Australian and Chinese websites. Modern websites are mostly designed into 3-column structures rather than 2-column structures (Al-Khalifa & Garcia, 2014). The use of 3-column structures was most popular in Chinese (93.2%) websites, followed by Saudi Arabian (84.8%) websites, but was least popular in Australian (69.6%) websites. The 4-column structure was popular in Australian (48.7%) websites but was less preferable in Chinese (16.3%) and Saudi Arabian (29.1%) websites. Results suggest that, within a web pages structure, Australian websites used more multi column structures than others.
Web page length is not statistically significant between Australian, Chinese and Saudi Arabian cultures. The average web page length of Australian, Chinese, and Saudi Arabian websites were 5, 4.8, and 4.4 respectively.

Chinese websites are denser which is reflected in the display density and the total number of items. To find the display density, the total number of items was defined as the sum of links, images, and headings. With a relatively higher mean of 313.4 average items per page, Chinese websites average total number of items was higher than Australian (189.6) and Saudi Arabian (197.3) websites. The identified web page length and total number of items were directly connected to the display density. With the web page length that is not statistically significant between cultures, display density differs. Since Chinese web pages had a higher average total number of items and display density, Chinese (72.1) web pages are far denser than Australian (41.5) and Saudi Arabian (55.5) web pages. Results suggest that Saudi Arabian websites are denser than Australian web pages.

**Navigation**

Hypothesis 2, the presence of navigation differences between Australian, Chinese, and Saudi Arabian cultures, was supported. As demonstrated in Table 4-6 there are significant cultural navigation differences such as: type of main navigation and main menu, level of choices in the main menu, number of visible links in the main menu, different navigation aids including Quicklinks and Fat Footer.

The type of main menu including static, and dynamic were considered. The static menu, including simple and all-visible-multi-level, always displays headers and its sub headers while the dynamic menu, including drop-down and megamenu, opens up sub headers when the user selects a header. The use of static vs. dynamic menus varies between cultures. The majority of Chinese (83.2%) websites used static main menus, while 43% of Saudi Arabian and only 24.6% of Australian websites used this. The use of dynamic main menu were popular in Australian (71.2%) websites, followed by Saudi
Arabian (53.2%) websites, but was unpopular and found in only 8.4% of the Chinese websites.

Table 4-6: Chi-Square comparisons of categorical design elements for Navigation

<table>
<thead>
<tr>
<th>Variable</th>
<th>Australia (n=191)</th>
<th>China (n=190)</th>
<th>Saudi Arabia (n=79)</th>
<th>Degree of Freedom</th>
<th>Chi-square</th>
<th>Sig.level</th>
</tr>
</thead>
<tbody>
<tr>
<td>% within country</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Main navigation - horizontal</td>
<td>94.8&lt;sub&gt;a&lt;/sub&gt;</td>
<td>98.4&lt;sub&gt;a&lt;/sub&gt;</td>
<td>83.5&lt;sub&gt;b&lt;/sub&gt;</td>
<td>2</td>
<td>23.264</td>
<td>.000</td>
</tr>
<tr>
<td>Main navigation - vertical</td>
<td>5.2&lt;sub&gt;a&lt;/sub&gt;</td>
<td>1.6&lt;sub&gt;a&lt;/sub&gt;</td>
<td>16.5&lt;sub&gt;b&lt;/sub&gt;</td>
<td>2</td>
<td>23.264</td>
<td>.000</td>
</tr>
<tr>
<td>Main menu - static</td>
<td>24.6&lt;sub&gt;a&lt;/sub&gt;</td>
<td>83.2&lt;sub&gt;b&lt;/sub&gt;</td>
<td>43.0&lt;sub&gt;c&lt;/sub&gt;</td>
<td>2</td>
<td>133.852</td>
<td>.000</td>
</tr>
<tr>
<td>Main menu – semi dynamic</td>
<td>4.2&lt;sub&gt;a&lt;/sub&gt;</td>
<td>8.4&lt;sub&gt;a&lt;/sub&gt;</td>
<td>3.8&lt;sub&gt;a&lt;/sub&gt;</td>
<td>2</td>
<td>3.830</td>
<td>.147</td>
</tr>
<tr>
<td>Main menu – dynamic</td>
<td>71.2&lt;sub&gt;a&lt;/sub&gt;</td>
<td>8.4&lt;sub&gt;b&lt;/sub&gt;</td>
<td>53.2&lt;sub&gt;c&lt;/sub&gt;</td>
<td>2</td>
<td>158.675</td>
<td>.000</td>
</tr>
<tr>
<td>Level of choices in the main menu (=2)</td>
<td>41.4&lt;sub&gt;a&lt;/sub&gt;</td>
<td>0.0&lt;sub&gt;b&lt;/sub&gt;</td>
<td>13.9&lt;sub&gt;c&lt;/sub&gt;</td>
<td>2</td>
<td>105.472</td>
<td>.000</td>
</tr>
<tr>
<td>Visible links in the main menu (&gt;10)</td>
<td>8.9&lt;sub&gt;a&lt;/sub&gt;</td>
<td>71.6&lt;sub&gt;b&lt;/sub&gt;</td>
<td>27.8&lt;sub&gt;c&lt;/sub&gt;</td>
<td>2</td>
<td>162.963</td>
<td>.000</td>
</tr>
<tr>
<td>Quicklinks</td>
<td>7.9&lt;sub&gt;a&lt;/sub&gt;</td>
<td>0.5&lt;sub&gt;b&lt;/sub&gt;</td>
<td>2.5&lt;sub&gt;a,b&lt;/sub&gt;</td>
<td>2</td>
<td>14.084</td>
<td>.001</td>
</tr>
<tr>
<td>Fat footer</td>
<td>70.2&lt;sub&gt;a&lt;/sub&gt;</td>
<td>0.0&lt;sub&gt;b&lt;/sub&gt;</td>
<td>44.3&lt;sub&gt;c&lt;/sub&gt;</td>
<td>2</td>
<td>204.065</td>
<td>.000</td>
</tr>
</tbody>
</table>

Note: Each subscript letter denotes a subset of Country categories whose column proportions do not differ significantly from each other at the .05 level.

To demonstrate how link density in the main menu differs between cultures, the number of visible links in the main menu was considered. 72% of Chinese websites used over 10 links in the main menu with 28% in Saudi Arabian websites and much less than, 9%, Australian websites.

Main menus are often used to categorise data for structuring the content. The level of choices (sub headings) in the main menu was considered to identify how content was structured in the main menu. The use of this varies between Australian, Chinese, and Saudi Arabian cultures. The presence of 2 levels of choices, which is used to create highly structured data, was more popular in (41.4%) Australian websites than Saudi Arabian (13.9%), and completely absent in Chinese websites. Results suggest that
Australian websites feature more categories, while Saudi Arabians moderately categorise, with Chinese being the least categorical.

A Quicklinks block is used for easy and quick access to important pages, and varies between Australian, Chinese, and Saudi Arabian cultures. This was most popular in Australian (7.9%) websites, followed by Saudi Arabian (2.5%) websites, but was unpopular and found in only 0.5% of the Chinese websites.

A Fat Footer is a form of a repeating navigation, which gives the users one more chance to find what they need when at the bottom of a web page. This was most popular in (70.2%) Australian websites, followed by (44.3%) Saudi Arabian websites, but was unpopular and completely absent in all Chinese websites.

**Links**

Hypothesis 3, the presence of links differ between Australian, Chinese, and Saudi Arabian cultures, was supported. As noted in Table 4-7 and Table 4-8, except the use of local icons or culturally specific icons, all other design elements including: the use of standard icons; local icons with captions; use of internal and external clickable banners; use of skip links; total number of links in a web page; number of links open in a new browser window; and number of external links, are statistically significant at the 0.05 level between cultures.

To identify preferences for symbolic navigational aids, the use of standard and local icons, and local icons with captions were considered. The use of standard icons was most popular in (94%) Australian websites, followed by (89.9%) Saudi Arabian websites, but only 61.6% of Chinese websites used this. Local icons with captions was most popular in (60%) Chinese websites, followed by (50.3%) Australian websites, but was least popular in (46.8%) Saudi Arabian websites.

Many external links may demonstrate the strength of the group's network to emphasize social as well as organizational goals (Gould et al., 2000). The use of external links varies between Australian, Chinese, and Saudi Arabian cultures. With a
higher mean of 28.4 external links, Chinese websites featured more than (7.8) Australian and (10.4) Saudi Arabian websites. Too many external links may be a distraction to Australian and Saudi Arabian users.

Table 4-7: Chi-Square comparisons of categorical design elements for Links

<table>
<thead>
<tr>
<th>Variable</th>
<th>Australia (n=191)</th>
<th>China (n=190)</th>
<th>Saudi Arabia (n=79)</th>
<th>Degree of Freedom</th>
<th>Chi-square</th>
<th>Sig.level</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>% within country</td>
<td>% within country</td>
<td>% within country</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Standard icons</td>
<td>93.7&lt;sub&gt;a&lt;/sub&gt;</td>
<td>61.6&lt;sub&gt;b&lt;/sub&gt;</td>
<td>89.9&lt;sub&gt;a&lt;/sub&gt;</td>
<td>2</td>
<td>67.013</td>
<td>.000</td>
</tr>
<tr>
<td>Local icons</td>
<td>57.6&lt;sub&gt;a&lt;/sub&gt;</td>
<td>63.7&lt;sub&gt;a&lt;/sub&gt;</td>
<td>64.6&lt;sub&gt;a&lt;/sub&gt;</td>
<td>2</td>
<td>1.916</td>
<td>.384</td>
</tr>
<tr>
<td>Local icons with captions</td>
<td>50.3&lt;sub&gt;a&lt;/sub&gt;</td>
<td>60.0&lt;sub&gt;a&lt;/sub&gt;</td>
<td>46.8&lt;sub&gt;a&lt;/sub&gt;</td>
<td>4</td>
<td>18.177</td>
<td>.001</td>
</tr>
<tr>
<td>Internal clickable banner</td>
<td>52.9&lt;sub&gt;a&lt;/sub&gt;</td>
<td>85.3&lt;sub&gt;b&lt;/sub&gt;</td>
<td>73.4&lt;sub&gt;b&lt;/sub&gt;</td>
<td>2</td>
<td>47.968</td>
<td>.000</td>
</tr>
<tr>
<td>External clickable banner</td>
<td>51.8&lt;sub&gt;a&lt;/sub&gt;</td>
<td>78.4&lt;sub&gt;b&lt;/sub&gt;</td>
<td>57.0&lt;sub&gt;a&lt;/sub&gt;</td>
<td>2</td>
<td>30.990</td>
<td>.000</td>
</tr>
<tr>
<td>Skip to content</td>
<td>30.9&lt;sub&gt;a&lt;/sub&gt;</td>
<td>0.0&lt;sub&gt;b&lt;/sub&gt;</td>
<td>0.0&lt;sub&gt;b&lt;/sub&gt;</td>
<td>2</td>
<td>95.320</td>
<td>.000</td>
</tr>
<tr>
<td>Skip to navigation</td>
<td>8.9&lt;sub&gt;a&lt;/sub&gt;</td>
<td>0.0&lt;sub&gt;b&lt;/sub&gt;</td>
<td>0.0&lt;sub&gt;b&lt;/sub&gt;</td>
<td>2</td>
<td>24.861</td>
<td>.000</td>
</tr>
<tr>
<td>Back to top</td>
<td>10.5&lt;sub&gt;a&lt;/sub&gt;</td>
<td>1.6&lt;sub&gt;b&lt;/sub&gt;</td>
<td>11.4&lt;sub&gt;a&lt;/sub&gt;</td>
<td>2</td>
<td>14.536</td>
<td>.001</td>
</tr>
</tbody>
</table>

Note: Each subscript letter denotes a subset of Country categories whose column proportions do not differ significantly from each other at the .05 level.

Table 4-8: Pairwise comparison of numerical design elements for Links

<table>
<thead>
<tr>
<th>Variable</th>
<th>Country (I)</th>
<th>Country (J)</th>
<th>Mean</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Australia</td>
<td>China</td>
<td></td>
</tr>
<tr>
<td>Number of links</td>
<td>-</td>
<td>101.282* (.000)</td>
<td>222.3</td>
</tr>
<tr>
<td></td>
<td>Australia</td>
<td>160.705* (.000)</td>
<td>-</td>
</tr>
<tr>
<td>Number of links open in a</td>
<td>Saudi Arabia</td>
<td>1.636 (.842)</td>
<td>9.5</td>
</tr>
<tr>
<td>new window</td>
<td>Saudi Arabia</td>
<td>159.068* (.000)</td>
<td>-</td>
</tr>
<tr>
<td></td>
<td>Australia</td>
<td>2.559 (.147)</td>
<td>7.9</td>
</tr>
<tr>
<td>Number of external links</td>
<td>China</td>
<td>20.490* (.000)</td>
<td>28.4</td>
</tr>
<tr>
<td></td>
<td>Saudi Arabia</td>
<td>17.930* (.000)</td>
<td>10.4</td>
</tr>
</tbody>
</table>

Note: * is the mean difference (I-J) that is significant at the .05 level.

For visual navigation scheme (non-text) clickable banners are used. The use of internal and external clickable banners is considered. Clickable banners that direct to internal pages are considered as internal clickable banners and clickable banners that directs to external pages are considered as external clickable banners. Internal clickable banners were more common in Chinese and Saudi Arabian websites than Australian websites.
Internal clickable banners were more common in (85.3%) Chinese websites, followed by (73.4%) Saudi Arabian websites, but were less common in (52.9%) Australian websites. External clickable banners were frequently found in (78.4%) Chinese websites, and 57.0% of Saudi Arabian and 51.8% of Australian websites used this feature. Australian users may prefer a logical text-based navigation scheme.

Skip to Content feature was considered to identify whether website provide support to skip repetitive navigation links. This was only present in 30.9% Australian websites. The skip to Navigation feature was also measured, and found in only 8.9% of Australian websites. The Back to Top option was present in 10% of Australian and 11% of Saudi Arabian websites, but was uncommon and found in only 1.6% of Chinese websites.

Link opening behaviour, including: open in a same window and open in a new window, varies between Australian, Chinese, and Saudi Arabian cultures. With a higher mean of 168.6, Chinese websites have more links that open in a new window than Australian (7.9) and Saudi Arabian (9.5) websites. Users from Australia and Saudi Arabia may prefer sequential browsing styles, conducted within the same browser window throughout.

**Multimedia**

Hypothesis 4, the presence of multimedia differs between Australian, Chinese, and Saudi Arabian cultures, was accepted. As outlined in Table 4-9, except slideshow that did not differ significantly between cultures, other multimedia design elements, pop-ups, image or text animation, image or text scrolling, animated clickable banner, use of logos (>5) and cartoons, and multimedia control capability, are statistically significant at the 0.05 level between cultures. The results of numbers of images in Table 4-10 also show statistically significant outcomes at the 0.05 level between cultures.

The number of images used in web pages was considered. With a relatively higher mean of 55.3, Chinese websites average feature more images, than Saudi Arabian (46.7), or Australian (30.9) websites.
Table 4-9: Chi-Square comparisons of categorical design elements for Multimedia

<table>
<thead>
<tr>
<th>Variable</th>
<th>Australia (n=191)</th>
<th>China (n=190)</th>
<th>Saudi Arabia (n=79)</th>
<th>Degree of Freedom</th>
<th>Chi-square</th>
<th>Sig.level</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>% within country</td>
<td>% within country</td>
<td>% within country</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Pop-ups</td>
<td>0.5&lt;sub&gt;a&lt;/sub&gt;</td>
<td>19.5&lt;sub&gt;b&lt;/sub&gt;</td>
<td>11.4&lt;sub&gt;b&lt;/sub&gt;</td>
<td>2</td>
<td>37.430</td>
<td>.000</td>
</tr>
<tr>
<td>Slideshow</td>
<td>67&lt;sub&gt;a&lt;/sub&gt;</td>
<td>74.7&lt;sub&gt;a&lt;/sub&gt;</td>
<td>64.6&lt;sub&gt;a&lt;/sub&gt;</td>
<td>2</td>
<td>3.928</td>
<td>.140</td>
</tr>
<tr>
<td>Image/ text animation</td>
<td>0.5&lt;sub&gt;a&lt;/sub&gt;</td>
<td>66.3&lt;sub&gt;b&lt;/sub&gt;</td>
<td>40.5&lt;sub&gt;c&lt;/sub&gt;</td>
<td>2</td>
<td>183.779</td>
<td>.000</td>
</tr>
<tr>
<td>Image/ text scrolling</td>
<td>3.1&lt;sub&gt;a&lt;/sub&gt;</td>
<td>50.0&lt;sub&gt;b&lt;/sub&gt;</td>
<td>46.8&lt;sub&gt;b&lt;/sub&gt;</td>
<td>2</td>
<td>112.465</td>
<td>.000</td>
</tr>
<tr>
<td>Animated clickable banner</td>
<td>15.7&lt;sub&gt;a&lt;/sub&gt;</td>
<td>55.8&lt;sub&gt;b&lt;/sub&gt;</td>
<td>38&lt;sub&gt;c&lt;/sub&gt;</td>
<td>2</td>
<td>66.497</td>
<td>.000</td>
</tr>
<tr>
<td>Multimedia control</td>
<td>16.2&lt;sub&gt;a&lt;/sub&gt;</td>
<td>0.5&lt;sub&gt;b&lt;/sub&gt;</td>
<td>11.4&lt;sub&gt;a&lt;/sub&gt;</td>
<td>4</td>
<td>94.465</td>
<td>.000</td>
</tr>
<tr>
<td>capabilities</td>
<td>Cartoon</td>
<td>38.7&lt;sub&gt;a&lt;/sub&gt;</td>
<td>40.5&lt;sub&gt;a&lt;/sub&gt;</td>
<td>78.5&lt;sub&gt;b&lt;/sub&gt;</td>
<td>2</td>
<td>39.839</td>
</tr>
<tr>
<td>Use of logos (&gt;5)</td>
<td>28.8&lt;sub&gt;a&lt;/sub&gt;</td>
<td>51.1&lt;sub&gt;b&lt;/sub&gt;</td>
<td>27.8&lt;sub&gt;a&lt;/sub&gt;</td>
<td>2</td>
<td>24.100</td>
<td>.000</td>
</tr>
</tbody>
</table>

Note: Each subscript letter denotes a subset of Country categories whose column proportions do not differ significantly from each other at the .05 level.

Table 4-10: Pairwise comparison of numerical design elements for Multimedia

<table>
<thead>
<tr>
<th>Variable</th>
<th>Country (I)</th>
<th>Country (J)</th>
<th>Mean</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Australia</td>
<td>China</td>
<td></td>
</tr>
<tr>
<td>Number of images</td>
<td></td>
<td></td>
<td>30.9</td>
</tr>
<tr>
<td></td>
<td>China</td>
<td></td>
<td>55.3</td>
</tr>
<tr>
<td></td>
<td>Saudi Arabia</td>
<td></td>
<td>46.7</td>
</tr>
</tbody>
</table>

Note: * is the mean difference (I-J) that is significant at the .05 level.

To incorporate human presence on websites, cartoons are used (Hsieh & Hong, 2013; Würtz, 2005). Cartoons were popular in (78.5%) Saudi Arabian websites, while only 40.5% of Chinese and 38.7% of Australian websites used this.

For graphical representation, logos are used. The use of more than five logos in a web page, was found in 51% Chinese websites, but less common in Australian, 28.8%, and Saudi Arabian, 27.8%, websites.

Pop-ups that appear or move across web pages, images or text animations, scrolling text, and animated clickable banners are used to gain users’ attention. Pop-ups were common in (19.5%) Chinese and (11.4%) Saudi Arabian websites, than Australian websites, 0.5%. The use of image or text animation is most frequently found in (66.3%)
Chinese websites, followed by (40.5%) Saudi Arabian websites, but was uncommon and found in 0.5% of Australian websites. Images or scrolling text was most frequently found in 50.0% of Chinese and 46.8% of Saudi Arabian websites, but was uncommon and in 3.1% of Australian websites. Animated clickable banners was most common in (55.8%) Chinese websites, followed by (38%) Saudi Arabian websites, but was less common and found in only 15.7% of Australian websites. It is possible that Animated designs may be more distracting for users from Australia.

Multimedia control capabilities with “play” or “pause” buttons were most common in (16.2%) Australian websites, followed by (11.4%) Saudi Arabian websites, but were unpopular and found in only one Chinese website.

**Visual representation**

Hypothesis 5, which stated that the presence of visual representations differs between Australian, Chinese, and Saudi Arabian cultures, was supported. As outlined in Table 4-11, image characteristics including images of: leaders or authority; people in daily action or life; nature; young individuals; smaller groups; elderly or experienced individuals; personal achievements or success; larger groups; political or religious; and achievements are statistically significant at the 0.05 significant level between cultures.

Images of leaders or authority figures was most common in (72%) Saudi Arabian websites, followed by (42%) Chinese websites, but was uncommon and only found in 14% of Australian websites. Images of people in daily action or life was popular in (62.3%) Australian websites, but found in only 33.2% of Chinese and 25.3% of Saudi Arabian websites. Images of nature was most found in 27.2% of Australian websites, followed by 21.5% of Saudi Arabian websites, but was uncommon and found in only 5.3% of Chinese websites.

With regards to individualism vs. collectivism: the use of images including: young individuals; smaller groups; elderly or experienced individuals; personal achievements; larger groups; political or religious; and group achievements are considered. Young individuals were more common in 78% of Australian websites, and less common in
(37%) Chinese and (44%) Saudi Arabian websites. Images of smaller groups were more common in (64.9%) Australian and (64.6%) Saudi Arabian websites, then (26.8%) Chinese websites. Images of personal achievements were used in 20.3% of Saudi Arabian websites, but only 7% of Australian and only 2% of Chinese websites.

Table 4.11: Chi-Square comparisons of categorical design elements for Visual representation

<table>
<thead>
<tr>
<th>Variable</th>
<th>Australia (n=191)</th>
<th>China (n=190)</th>
<th>Saudi Arabia (n=79)</th>
<th>Degree of Freedom</th>
<th>Chi-square</th>
<th>Sig.level</th>
</tr>
</thead>
<tbody>
<tr>
<td>% within country</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Image of leaders</td>
<td>13.6a</td>
<td>41.6b</td>
<td>72.2c</td>
<td>2</td>
<td>89.683</td>
<td>.000</td>
</tr>
<tr>
<td>Image of people in daily life</td>
<td>62.3a</td>
<td>33.2b</td>
<td>25.3b</td>
<td>2</td>
<td>46.244</td>
<td>.000</td>
</tr>
<tr>
<td>Image of nature</td>
<td>27.2a</td>
<td>5.3b</td>
<td>21.5a</td>
<td>2</td>
<td>33.563</td>
<td>.000</td>
</tr>
<tr>
<td>Image of young individuals</td>
<td>78.0a</td>
<td>37.4b</td>
<td>44.3b</td>
<td>2</td>
<td>68.468</td>
<td>.000</td>
</tr>
<tr>
<td>Image of smaller groups</td>
<td>64.9a</td>
<td>26.8b</td>
<td>64.6a</td>
<td>2</td>
<td>64.345</td>
<td>.000</td>
</tr>
<tr>
<td>Image of elderly individuals</td>
<td>44.5a</td>
<td>54.2a,b</td>
<td>67.1b</td>
<td>2</td>
<td>11.859</td>
<td>.003</td>
</tr>
<tr>
<td>Image of personal achievements</td>
<td>6.8a</td>
<td>2.1a</td>
<td>20.3b</td>
<td>2</td>
<td>27.663</td>
<td>.000</td>
</tr>
<tr>
<td>Image of larger groups</td>
<td>51.8a</td>
<td>58.4a,b</td>
<td>72.2b</td>
<td>2</td>
<td>9.494</td>
<td>.009</td>
</tr>
<tr>
<td>Image of political</td>
<td>4.2a</td>
<td>48.9b</td>
<td>57.0b</td>
<td>2</td>
<td>116.083</td>
<td>.000</td>
</tr>
<tr>
<td>Image of group achievements</td>
<td>20.9a</td>
<td>53.2b</td>
<td>39.2b</td>
<td>2</td>
<td>42.366</td>
<td>.000</td>
</tr>
</tbody>
</table>

Note: Each subscript letter denotes a subset of Country categories whose column proportions do not differ significantly from each other at the .05 level.

Images of elderly or experienced individuals were more common in (67.1%) Saudi Arabian websites, followed by (54.2%) Chinese websites, but was uncommon and found only in 44.5% of Australian websites. Images of larger groups was more common in (72.2%) Saudi Arabian websites, followed by (58.4%) Chinese websites, but was uncommon and found only in 51.8% of Australian websites. Images of a political or religious nature were common in (57.0%) Saudi Arabian and (48.9%) Chinese websites, while only 4.2% of Australian websites. Group achievements were common in 53% of Chinese and 39.2% of Saudi Arabian websites but present in only 20.9% of Australian websites.
Colour

Hypothesis 6: the presence of colours differs between Australian, Chinese, and Saudi Arabian cultures, was supported. Since several colours are used in websites, it was difficult to manually decide which one was dominant and should be coded. Therefore, automation was provided to more thoroughly examine the overall use of colours between Australian, Chinese, and Saudi Arabian cultures. Results of colours were presented in Table 4-12 and Figure 4.1.

Table 4-12: The use of 17 unique colours between cultures

<table>
<thead>
<tr>
<th>S.No</th>
<th>Colour Name</th>
<th>Hex. Code</th>
<th>Colour</th>
<th>Percentage in the page</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
<td></td>
<td>Australia</td>
<td>China</td>
</tr>
<tr>
<td>1</td>
<td>Very light grey</td>
<td>#e0e0e0</td>
<td>48.6</td>
<td>46.4</td>
</tr>
<tr>
<td>2</td>
<td>White</td>
<td>#ffffff</td>
<td>13.7</td>
<td>8.6</td>
</tr>
<tr>
<td>3</td>
<td>Light grey</td>
<td>#d3d3d3</td>
<td>7.5</td>
<td>12.1</td>
</tr>
<tr>
<td>4</td>
<td>Black</td>
<td>#000000</td>
<td>2.9</td>
<td>0.5</td>
</tr>
<tr>
<td>5</td>
<td>Very dark grey</td>
<td>#5d5d5d</td>
<td>5.2</td>
<td>1.6</td>
</tr>
<tr>
<td>6</td>
<td>Dark grey</td>
<td>#8f8f8f</td>
<td>4.0</td>
<td>3.3</td>
</tr>
<tr>
<td>7</td>
<td>Light greyish cyan</td>
<td>#d0dddd</td>
<td>1.3</td>
<td>3.5</td>
</tr>
<tr>
<td>8</td>
<td>Light greyish blue</td>
<td>#a1a1d5</td>
<td>1.0</td>
<td>2.5</td>
</tr>
<tr>
<td>9</td>
<td>Light greyish yellow</td>
<td>#d9d9c2</td>
<td>0.8</td>
<td>0.9</td>
</tr>
<tr>
<td>10</td>
<td>Light greyish red</td>
<td>#dcc0c0</td>
<td>0.7</td>
<td>1.3</td>
</tr>
<tr>
<td>11</td>
<td>Greyish cyan</td>
<td>#92bbbb</td>
<td>0.7</td>
<td>0.6</td>
</tr>
<tr>
<td>12</td>
<td>Very dark (mostly black) blue</td>
<td>#00002b</td>
<td>0.7</td>
<td>0.0</td>
</tr>
<tr>
<td>13</td>
<td>Very dark greyish lime green</td>
<td>#5f6b5f</td>
<td>0.1</td>
<td>0.0</td>
</tr>
<tr>
<td>14</td>
<td>Very soft blue</td>
<td>#9292fe</td>
<td>0.1</td>
<td>3.9</td>
</tr>
<tr>
<td>15</td>
<td>Slightly desaturated blue</td>
<td>#8491b7</td>
<td>0.1</td>
<td>1.2</td>
</tr>
<tr>
<td>16</td>
<td>Dark blue</td>
<td>#0c0ca6</td>
<td>0.2</td>
<td>1.0</td>
</tr>
<tr>
<td>17</td>
<td>Strong red</td>
<td>#cd0000</td>
<td>0.0</td>
<td>1.0</td>
</tr>
<tr>
<td>18</td>
<td>Other colours</td>
<td></td>
<td>12.5</td>
<td>11.6</td>
</tr>
</tbody>
</table>
Figure 4-1: Over-all use of colour pattern between cultures

Hexadecimal colour codes and their usage were considered. (ColorHexa, 2018) was used to obtain the colour name. By defining: \( \text{Ratio-of-colours for } X = \frac{\text{Number of colour count for } X}{\text{Total number of colour count on page}} \), colour usage were recorded. To analyse colour usage, the colour usage percentage was sorted in descending order for each website. Since several colours were recorded, the top 12 colours were used. However, within the top 12 colours, there were some colours highly prevalent or absent within a particular culture. For example, highly contrasting bright colours, including: “very soft blue”, “slightly desaturated blue”, “dark blue”, and “strong red”, were highly used in Chinese websites. The use of green was found in Saudi Arabian websites. Australian and Saudi Arabian websites used “very dark gray”, “grayish cyan”, and “black”. Australian websites used “very dark (mostly black) blue”. The use of these colours were further analysed for their presence or absence and its amount of usage to identify whether they are less prevalent or absent in other culture(s). All colours were found although in all cases the percentages were very small. The Table 4-12
outlines the cross-check identified 17 unique colours that can be considered to identify the colour usage pattern between cultures. The Figure 4.1 outlines the overall use of colour pattern between cultures. The analysis of the use of these colours cover 87.5%, 88%, and 84% of the total colour usage in Australian, Chinese, and Saudi Arabian websites respectively.

### Text

Hypothesis 7: the presence of text differs between Australian, Chinese, and Saudi Arabian cultures, was supported. Results of text were presented in Table 4-13, which outlines the use of emphasized text including: number of bold and strong; and number of headings are statistically significant at the 0.05 level between Australian, Chinese, and Saudi Arabian cultures.

<p>| Table 4-13: Pairwise comparison of numerical design elements for Text |</p>
<table>
<thead>
<tr>
<th>Variable</th>
<th>Country (I)</th>
<th>Country (J)</th>
<th>Mean</th>
</tr>
</thead>
<tbody>
<tr>
<td>Number of bold and strong</td>
<td>Australia</td>
<td>-</td>
<td>1.0</td>
</tr>
<tr>
<td></td>
<td>China</td>
<td>2.367* (.000)</td>
<td>3.4</td>
</tr>
<tr>
<td></td>
<td>Saudi Arabia</td>
<td>0.205 (.629)</td>
<td>1.2</td>
</tr>
<tr>
<td>Number of headings</td>
<td>Australia</td>
<td>-</td>
<td>31.1</td>
</tr>
<tr>
<td></td>
<td>China</td>
<td>- 17.653* (.000)</td>
<td>13.4</td>
</tr>
<tr>
<td></td>
<td>Saudi Arabia</td>
<td>- 14.650* (.000)</td>
<td>16.4</td>
</tr>
</tbody>
</table>

*Note: * is the mean difference (I-J) that is significant at the .05 level.

When scanning a web page, emphasized text, including bold, strong, and headings, are used. With a relatively higher mean of 3.4 number of bold and strong features, Chinese websites average use of bold and strong features was greater than Saudi Arabian (1.2) and Australian (1.0) websites. With a higher mean of 31.1 number of headings, Australian websites average use of headings was greater than Saudi Arabian (16.4) and Chinese (13.4) websites.

### 4.7 Discussion

This study explores how website design attributes differ between Australian, Chinese, and Saudi Arabian cultures. The results of the study provide statistically significant evidence to support the hypotheses that the presence of the design attributes varies
between cultures. All hypotheses were supported. Various website design attributes were measured to evaluate the hypotheses.

**Layout**

The type of layout differs between Australian, Chinese, and Saudi Arabian cultures. The Chinese language is more dense than English (Chu & Yang, 2010). This is because the Chinese writing system, is drastically different from Latin alphabetic systems (Dyson & Suen, 2016). Chinese does not have an alphabet but uses a logographic system for its written language, using stroke modulations. With 10 strokes on average Chinese characters are far denser than English letters. Each Chinese character generally represents one syllable of spoken Chinese, and may be word on its own or a part of a polysyllabic word. Comparatively in the Latin alphabetic systems words are made up of various letters. Further, each Chinese character stands as a discrete-unit within an imaginary square box, and a line of Chinese text is not separated by spaces into individual words (Dyson & Suen, 2016). Because of the inevitable typological differences between Chinese and English languages, the web pages of Chinese websites are significantly more dense for non-Chinese users.

Despite the differences of Chinese typography in character shape and alphabetic versus non-alphabetic writing systems, which influences the density of website, this research also evaluated the total number of items including links, images and headings. Although, the Chinese language requires considerably fewer characters to represent words than English (Chu & Yang, 2010; Heimgärtner, 2007c), the information density of Chinese web pages is higher. Australian pages were the least dense. High-context cultures such as China depend on verbal and non-verbal cues to communicate effectively (Goyal et al., 2012; Hsieh et al., 2013; Hsieh & Hong, 2013). The high density of textual and non-textual items aids Chinese users to navigate. These findings are comparable with Fraternali and Tisi (2008) and Chu and Yang (2010), who also found that Chinese web pages are denser than Western web pages. Prior research claims that Arabic pages have an affinity for high-context but low content (Liginlal et al., 2014). However, the results suggest that Saudi Arabian websites are slightly more
dense than Australian pages. Australia is considered a low-context culture. The direct and explicit communicating pattern (E. T. Hall & Hall, 1990), and preference for less information in low-context cultures (Fraternali & Tisi, 2008; Sun, 2001), means that Australian web pages feature lower information density.

The average page length was similar between Australian, Chinese and Saudi Arabian web pages. These results are contrary to prior work by Callahan (2006) which shows that high uncertainty avoidance cultures prefer shorter pages, while low uncertainty avoidance cultures prefer longer pages. This study found that that high uncertainty avoidance cultures, including Australian and Saudi Arabian, are designed with Fat Footers. The appearance of these oversized footers that are separated from website content makes Australian and Saudi Arabian web pages vertically longer. However, if the recently introduced Fat Footers were discounted from the length, then Australian and Saudi Arabian web pages would be statistically shorter than the Chinese web pages, and would thus be in line with prior research.

The column structure varies between cultures, with 2-column structures predominantly used by Australian websites, while 3-column structures are preferred by Chinese and Saudi Arabian cultures. According to E. T. Hall and Hall (1990) study, high-context cultures are polychromatic, while low-context cultures are monochromatic. A 2-column structure, which is said to be monochromatic, and yields fewer distractions and focuses on the content, allowing users from low-context cultures to get results quickly. Users from high-context cultures prefer to navigate in a parallel structures (Hsieh et al., 2013; Hsieh & Hong, 2013; Kralisch et al., 2005), which is a polychromatic structure. These findings are comparable with Al-Khalifa and Garcia (2014), Hsieh and Hong (2013) and Hsieh et al. (2013), who also found that users from low-context cultures, prefer a two column structure, while users from high-context cultures prefer 3-columns.
Navigation

The results of the navigation elements studied suggest that the use of content that is commonly grouped in a text-based navigation scheme is popular in Australian web pages, while moderately popular in Saudi Arabian websites and less popular in Chinese websites. These differences may be attributed to thought patterns and browsing behaviours. According to Dong and Lee (2008), Nisbett (2003), and Nisbett and Norenzayan (2002), Asians are thematic while Westerners are functional. When navigating web pages, users from Australia, are analytically-minded, and employ a sequential reading and navigating pattern among areas (Dong & Lee, 2008). By grouping information, the content is usually placed in the centre of the web page (Reinecke & Bernstein, 2011). Results suggest that Australian website main menus only show top-level grouping headers and deeper layers are discovered with a click. Using text-based context-independent design along with a sequential reading and navigating pattern, conducted in the same browser window, users from Australia prefer greater navigation control, with fewer options, to get faster results (Hsieh et al., 2013; Hsieh & Hong, 2013). Users from China are holistically-minded. They obtain an overall big picture of the web page by scanning the entire page (Dong & Lee, 2008). Since, Chinese are more likely to classify on the basis of interdependence and relationship within wholes (Marcus, 2003b), and emphasize contexts (Rau et al., 2004), their design focuses on the whole context of the website, and content is placed more freely on web pages, with less structure.

In terms of navigation, the Fat Footer, which is an information guide on bottom (Al-Khalifa & Garcia, 2014; Hsieh et al., 2013; Hsieh & Hong, 2013), varies between cultures. This feature is very common in Australian websites, while somewhat common in Saudi Arabian websites but absent in Chinese websites. According to Hofstede et al. (2010), Australian and Saudi Arabian cultures are considered high uncertainty avoidance cultures, with a preference for avoiding ambiguity (Al-Khalifa & Garcia, 2014). Users from this culture prefer redundant cues to reduce ambiguity (Marcus & Baumgartner, 2004b; Reinecke & Bernstein, 2011). The Fat Footer navigation, even if it
is just repeating navigation that’s elsewhere, provides strong additional support to find out about information or functionality, and prevent users from getting lost. However, the Chinese culture, has been categorised as a low uncertainty avoidance culture, uses web pages with detailed information (Fraternali & Tisi, 2008), and the users from this culture are more relaxed when faced with new features (Al-Khalifa & Garcia, 2014), which are not considered a threat. These findings are consistent with Al-Khalifa and Garcia (2014), Hsieh and Hong (2013), and Hsieh et al.’s (2013), who also found that high uncertainty avoidance cultures’ use the Fat Footer more extensively than the low uncertainty avoidance cultures.

**Links**

Link opening behaviour varies between cultures. Fraternali and Tisi (2008) suggested that the heavy use of links opening in a new window in Chinese web pages may be related to dependent technical reasons. Limited bandwidth may induce Chinese users keep multiple windows open for parallel download and browsing. But a possible cultural reason can also be brought through with E. T. Hall and Hall (1990) monochronic vs. polychronic cultural factor, which classifies that low-context cultures are monochronic, and high-context cultures are polychronic. Users from the Australian culture, who are low-context, tend to consider problems in a sequential way (Fraternali & Tisi, 2008; Kralisch et al., 2005). However users from Chinese cultures, who are high-context culture based on simultaneous consideration (Fraternali & Tisi, 2008). The heavy use of links that open in a new browser window aids parallel browsing. These finding is similar to Kralisch et al. (2005) and Fraternali and Tisi (2008), who found that monochronic culture prefer for linear navigation patterns, while polychronic cultures, in contrast, show non-linear navigation behaviour and tend to switch between several open web pages. However, Saudi Arabian culture that is also a high-context culture and its high-uncertainty avoidance nature limit the links that opens in the new windows to prevent users from getting navigation lost, when browsing web pages.
The heavy use of Links in Chinese homepages may be related to a technical reason. It may be difficult to type Chinese characters on an alphabet-based keyboard, so instead of using search, Chinese users may prefer to click links.

Interestingly the use of “local icons” and “local icons with captions” are common in all three cultures, and the use of standard icons is not only popular in the Australian culture, but also popular in Saudi Arabian culture. This could be because of growing westernization of the cultures (Goyal et al., 2012), being reflected the website design.

**Multimedia**

The amount and type of multimedia varies between cultures. Chinese and Saudi Arabian websites use a higher number of images, cartoons, and animated objects than Australian websites. Chinese and Saudi Arabian cultures are considered high-context cultures, in which additional information beyond a written format is preferred (Calabrese et al., 2012; Cyr & Trevor-Smith, 2004). Users from these cultures are polychronic (Chao et al., 2002), doing many things at once. The heavy use of images, cartoons, and animated objects including scrolling text, images, pop-ups, and animated clickable banners in high-context cultures aids their understanding of a page. The aesthetics of website design for high-context cultures’ may appear overwhelming for members of low-context cultures (Heimgärtner, 2007b; Mandl, 2009).

Australia is considered a low-context culture, and users from these cultures are monochronic (Chao et al., 2002). They prefer the direct and explicit communicating pattern of formal information (E. T. Hall & Hall, 1990), often by way of written texts (Sun, 2001). Users from low-context cultures aim to quickly get results and reach goals (Hsieh et al., 2013; Reinecke & Bernstein, 2011). The heavy use of images and animation may be distracting for many Australian users. This may lead the Australian websites to use static text, fewer images, less use of animated objects, and multimedia controlling capabilities with “play” or “pause”. Interestingly, in all three countries the use of slideshow was equally common.
Visual representation

Image characteristics on web pages vary between cultures. Images of leaders, elderly individuals, larger groups, as well as political or religious images, and group achievements are commonly found in Chinese and Saudi Arabian websites. The heavy use of these types of images may be a result of the high-power distance and collectivistic culture of the Chinese and Saudi Arabian cultures, as described by Hofstede et al. (2010). The high-power distance demonstrates that there is unequal power distribution among them and is readily apparent in their environment (Al-Khalifa & Garcia, 2014; Reinecke & Bernstein, 2011). The collectivistic culture uses images that promote characteristics of collectivistic societies. However, as described by Hofstede et al. (2010), people in Australia, with low-power distance and individualism, share equal power distribution. Images of people in daily life, nature, and images that promote values characteristic of individualistic societies are more common in Australian websites.

Colour

The presence of colour differs between Australian, Chinese, and Saudi Arabian cultures. Chinese and Saudi Arabian websites frequently used their traditional or one of the colours that are found in their national flags. With nearly 1% usage, Chinese websites used colour red, which means happy in China (Barber & Badre, 1998; Russo & Boor, 1993). However, the usage of this colour in Australian and Saudi Arabian websites was only 0.04% and 0.03% respectively. With 0.7% usage, Saudi Arabian websites used “very dark grayish lime green”, where the green meaning was associated with paradise, and it considered to be the colour worn in heaven (Abdulkhair, 2004), as described in the “Holy Quraan”. However, the use of this colour in Australian and Chinese websites was only 0.07% and 0.005% respectively. Very dark (mostly black) blue’ was observed at a rate of 0.65% in the Australian culture, but this colour was less common in Chinese (0.02%) and Saudi Arabian (0.01%) websites. Barber and Badre (1998), found that high-context countries usually employ their traditional or national colours throughout websites.
Highly contrasting bright colours are prevalent in Chinese culture, while the use of softer colours is more frequently used in low-context cultures. The high-context nature of the Chinese websites may use these attractive bright colours to emphasize information. These findings are similar to Calabrese et al. (2012), Sun (2001), and Barber and Badre (1998), who found that high-context cultures use highly contrasting bright colours.

Australian websites frequently used white as a background colour. In Chinese websites, the use of white is lower. Russo and Boor (1993) state that the colour white can imply death for Chinese, which may help to explain the results.

**Text**

The use of text differs between cultures. Chinese websites use more strong and bold effects compared to Australian and Saudi Arabian websites, while Australian websites use more formal headings than Chinese and Saudi Arabian websites. With highly structured data, Australian websites generally organise information hierarchically (Reinecke & Bernstein, 2011). For example, as shown in Figure 4.2, even the Fat Footers use different headings. Less structured and detailed content may necessitate the use of strong and bold effects to emphasise important text. The high-context with low content nature of the Saudi Arabian culture lead to greater use of bold and strong effects than Australian websites but still less than Chinese websites.

![Fat Footer to display information hierarchically (APVMA, 2018)](image)
4.8 Conclusion

The automated and manual website audit described in this Chapter provides a updated view on design preferences in websites, and is the first such study to conduct a largescale evaluation of 460 websites. Results of the study show statistically significant differences between websites in the three countries examined. All hypotheses, that address website design were accepted. The study provides evidence of culturally sensitive website design elements. The findings are consistent with most of the previous research. The strongest design differences were observed between Chinese and Australian websites. This study shows that E. T. Hall and Hall (1990) and Hofstede et al. (2010) cultural models can be used to compare design similarities and differences, in categories of websites of “government” and “news and media”, between cultures.

The findings of this study suggest that taking cultural issues into account during website design may be important when designing websites for different cultures. Web designers should carefully adapt interface features for culturally diverse users. Since different cultures have differing needs (Hsieh et al., 2013; Hsieh & Hong, 2013), Web designers should appropriately align the web pages to the culture. Such websites would help users to think and act in culturally natural ways (Nasrul, Nor, et al., 2012).

Finally, website designs are different across countries, and adapting Web designs to the visual and functional norms of a specific country is needed in some cases (Cui et al., 2015; Nordhoff et al., 2018). However, websites with a global reach - websites that have users from multiple countries - usually do not significantly localise their designs, while being among the most popular in every country. Although there are examples of international companies that localize their websites to specific countries, such as Adobe (2018), Micro Focus (2018), or SAS (2018), the majority of global players do not adapt their website designs to other countries (Dranch & Austin, 2016). For example, there are no design changes between countries for the websites of Google (2018) and YouTube (2018), and these website designs do not significantly differ in visual complexity, colour fulness, number of text areas, or saturation (Nordhoff et al., 2018).
This indicates a homogenized, globally popular, website design. It is also identified that many of globally popular websites, such as Google (2018) or YouTube (2018), do not localize their design. Their global reach and popularity, while evidently ignoring country-specific aesthetic preferences, suggests that potential benefits of cultural adaptation might be outperformed by brand recognition and network effects. Therefore, website designs of global players could indicate whether website cultural adaptation is a promising investment, or if people align more and more with a global design taste. If the global players choose the promising investment for the website cultural adaptation, the proposed cultural preference, will help Web designers to adapt a target culture into website design.
Chapter 5. Creating a new Cross-cultural Web Usability Model

5.1 Introduction

The previous chapter evaluated the presence of website design elements in websites prepared for different cultures. The culturally specific website design elements, identified in Chapter 4, are used in this chapter to create a cross-cultural website usability model. Using this model, Web developers and designers may measure the usability of a web page for different cultures. Background and related work are followed by an approach detailing the proposed model.

5.2 Background

The cultural differences of target users are important to consider when designing a localized website (Bernstein & Reinecke, 2013; Heimgärtner, 2014; Mushtaha & Troyer, 2014). Culture works as the mental software for humans, playing a significant role in forming ways of feeling, thinking, and acting (Hofstede et al., 2010). This makes users differ in their website design expectations, preferences, and perceptions of usability at the country level (Fraternali & Tisi, 2008; Reinecke & Bernstein, 2011).

However, current website cultural adaptation suffers from a narrow and static vision of culture. Most English websites, viewed by users worldwide, still only adopt Western values (Nunberg, 2002; Reinecke, 2010). This results in usability problems (Collazos & Gil, 2011; Sun, 2004). This chapter focuses on incorporating anthropological cultural values into web page design to create web pages that relate to the users’ specific characteristics and values to enhance cultural usability.

Prior work suggests that, Hofstede et al.’s (2010) and E. T. Hall and Hall’s (1990) cultural factors are indeed useful to consider how to adapt website design concepts for cultural diversity (Heimgärtner, 2013; Hsieh et al., 2009). Cultural factors were applied, as cultural variables for website design, to study cross-cultural website design interaction, information processing, and communication (Calabrese et al., 2012; Hsieh & Hong, 2013; Würtz, 2005). HCI researchers, as well as some website designers, used
cultural factors to show that web pages with culturally relevant characteristics are more usable (Díaz et al., 2013; Fraternali & Tisi, 2008; Hsieh, 2014), and can increase user satisfaction and work efficiency (Reinecke & Bernstein, 2009).

To incorporate cultural factors into website design, some website developers and researchers use cross-cultural website design guidelines and models. However, the existing guidelines and models are insufficiently detailed (Ishak et al., 2015), and lack usability tests to support their claims (Hsieh et al., 2009). Therefore, a new cross-cultural website usability model is required.

The aim of this chapter is to create a cross-cultural website usability model that will offer both cross-cultural design guidelines, and a usability measuring instrument. Using this model, cross-cultural websites can be easily designed, and the effective communication on usability of the design can be empirically measured. This model will be evaluated through a usability test detailed in the next chapter.

5.3 Related work

International standards and guidelines have been developed to characterize and ensure website usability. There are international usability standards, namely, ISO 9241-151:2008 (2018) that are developed by International Organization for Standardization and HHS.gov’s (2018) usability guidelines that are developed by U.S. Department of Health & Human Services, which cater for all users in all countries and cultures. However, Mousavi and Marthandan (2012) found the difference between the usability score given based on these international guidelines and the perceived usability by Iranian users due to the influence of the cultural factors. Also, the usability factors and the priorities set by the international guidelines are only partially reflect local users interests. To improve website usability for local users, prior research developed models that offer cross-cultural design guidelines and usability attributes.

Hsieh et al.’s (2009) model combined existing cultural factors and cultural markers, to assess the effectiveness of interface design. This model defined usability evaluation criteria including: learnability, efficiency, minimal errors, satisfaction, comprehension,
and desirability. Heimgärtner’s (2013) model combined cultural factors and HCI factors to create a model of culturally influenced human-computer interaction, to cover cultural contexts in HCI design. However, empirical studies to support these models are lacking.

Some website developers and researchers have demonstrated the limitations of using prior cross-cultural design guidelines and models. They are not sensitive enough (Ishak et al., 2015), usually based only on theoretical research (Mushtaha, 2012). In cases where experiments were performed, sample sizes were small (Reinecke et al., 2011). They also considered limited website design attributes (Mushtaha, 2012), and lack usability tests to support their claims (Hsieh et al., 2009). The validity of these existing cross-cultural website design models for cultural usability requires more empirical work. To address these concerns, a new cross-cultural website usability model is proposed in the next section.

### 5.4 Cross-cultural website usability model

Prior work highlighted the need for a new cross-cultural website usability model. The model will include a cross-cultural website design guideline, and a usability measuring instrument.

To adapt cultural values into website design, most previous research directly applied theory-based cultural factors into website development. Our model will incorporate design elements, cultural factors, and HCI factors that describe the style of information processing and the interaction characteristics of the user.

There are several reasons that motivated the consideration of design elements, cultural factors, and HCI factors in a large set of cross-cultural design guidelines. Both design elements and cultural factors are already the subject of cross-cultural investigation of website design (Choong et al., 2005; Isa et al., 2007). The HCI factors describe the style of information processing and interaction characteristics of the user with the web page, are generally linked with time, context, and mental aspects (Heimgärtner, 2013). Therefore, it is believed that design elements and cultural factors
are incorporated, by considering information processing, interaction style, and preferences of users, from different cultural backgrounds.

To translate the theoretical culture factors as cross-cultural design guidelines, the literature is used to map the culturally specific website design elements with cultural factors and HCI factors. The proposed guidelines are used to create cross-cultural websites that are suitable for the target culture.

Based on the literature, a usability measuring instrument is proposed, to measure usability attributes, which may subsequently influence overall satisfaction with web pages. This instrument is suitable to measure both: the effect of culture on website use, and the overall usability between cultures.

Finally, a new cross-cultural website usability model is developed to test specific propositions on how web page design could be impacted by cultural factors and the level of usability between cultures. The following describes the development of the proposed model.

5.5 Development of new cross-cultural website usability model

The proposed model includes both: cross-cultural website design guidelines, and a usability measuring instrument. Using this model, cultural values or characteristics can be incorporated into website design, and the effectiveness of communication of website designs can be empirically measured, between cultures. To evaluate this model, cross-cultural websites will be developed and a usability test will be conducted, in the next chapter. The development of the model is described in the following sections.

5.5.1 Evaluation of the usage of design elements between cultures

Nordhoff et al. (2018) suggest to identify the similarities and the differences in the usage of design attributes between cultures, which is essential to link website design and culture (Lachner et al., 2018). Website design contains design attributes that enable effective communication between the user and the web page (Hsieh, 2014;
Marcus, 2002; Mushtaha & Troyer, 2014). Such design attributes are Layout, Navigation, Links, Multimedia, Visual Representation, Colour, and Text. Therefore, a website audit, that evaluates the usage of design attributes between cultures, was conducted and detailed in the previous chapter. The evaluation of design attribute usage demonstrated that many website design elements are culturally specific. The study provided quantitative evidence of cultural differences in website design elements.

5.5.2 Identify prominent design elements

The previous section identified design elements that were prevalent within particular cultures. According to Fraternali and Tisi (2008), due to influential cultural factors, cultures carry some prominent design elements. These prominent design elements can be used to match the cultural needs, expectations, and preferences of the users from different cultures (Hsieh, 2014). In principle, the identification of such preferences would require a notion of usability for the target culture. Therefore, to strengthen the proposed model, prominent design elements were derived. This section applies rules regarding previously identified statistically significant design elements to determine the prominent design elements.

A design element is marked as a prominent design element if the difference between two cultural groups is greater than or equal to 40%. Table 5-1 lists the discovered prominent design elements. These prominent design elements are used in the cross-cultural website usability model. They are used to directly map to the existing cultural factors organised in section 5.5.3, and HCI factors organised in section 5.5.4, to define the proposed model. These prominent design elements will be verified by usability testing in the Chapter 6.

Table 5-1: Prominent design elements

<table>
<thead>
<tr>
<th>Design attributes</th>
<th>Web aspects</th>
<th>Prominent design elements</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Total number of items (including headings, links, and images)</td>
<td>Australia</td>
</tr>
<tr>
<td>Layout</td>
<td>• High use of items</td>
<td></td>
</tr>
</tbody>
</table>

102
<table>
<thead>
<tr>
<th>Display density (Total number of items / Web page length)</th>
<th>High display density</th>
</tr>
</thead>
</table>

### Navigation

<table>
<thead>
<tr>
<th>Type of main menu</th>
<th>Dynamic</th>
<th>Static</th>
<th>Dynamic*</th>
</tr>
</thead>
<tbody>
<tr>
<td>Number of visible links in the main menu</td>
<td>More than 10 links</td>
<td>More than 10 links</td>
<td></td>
</tr>
<tr>
<td>Num of choices in the main menu</td>
<td>Level of 2 choices</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Use of the Fat footer</td>
<td>Fat footer</td>
<td>Fat footer</td>
<td></td>
</tr>
</tbody>
</table>

### Links

<table>
<thead>
<tr>
<th>Number of links</th>
<th>High use of links</th>
</tr>
</thead>
<tbody>
<tr>
<td>Links opening behaviour</td>
<td>Open in a new window</td>
</tr>
<tr>
<td>Number of external links</td>
<td>External links</td>
</tr>
</tbody>
</table>

### Multimedia

<table>
<thead>
<tr>
<th>Animation</th>
<th>Image/ text animation</th>
</tr>
</thead>
<tbody>
<tr>
<td>Scrolling</td>
<td>Image/ text scrolling</td>
</tr>
<tr>
<td>Number of images</td>
<td>High use of images</td>
</tr>
</tbody>
</table>

### Visual representation

<table>
<thead>
<tr>
<th>Image characteristics</th>
<th>Image of young individuals</th>
<th>Image of political</th>
<th>Image of leaders</th>
<th>Image of political</th>
</tr>
</thead>
</table>

### Colour

<table>
<thead>
<tr>
<th>Use of colour</th>
<th>Black</th>
<th>Very dark (mostly black) blue</th>
<th>Dark blue</th>
<th>Very dark gray</th>
<th>Black</th>
<th>Very dark gray</th>
<th>Slightly desaturated blue</th>
<th>Light grayish: blue and cyan</th>
<th>Very dark grayish lime green</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Very dark gray</td>
<td>Dark blue</td>
<td>Slightly desaturated blue</td>
<td>Strong red</td>
<td>Very soft blue</td>
<td>Light grayish red, blue, and cyan</td>
<td>Light gray</td>
<td>Very soft blue</td>
<td>Light grayish red, blue, and cyan</td>
</tr>
</tbody>
</table>

### Text

<table>
<thead>
<tr>
<th>Use of bold and strong</th>
<th>Bold and string</th>
</tr>
</thead>
<tbody>
<tr>
<td>Use of headings</td>
<td>Headings</td>
</tr>
</tbody>
</table>

Note: * For the design attribute navigation, for the web aspects the type of the main menu, it is decided to take either ‘Static’ or ‘Dynamic’, as design elements. In the Saudi Arabian culture, the usage...
differences of both: ‘Static’ and ‘Dynamic’ were more than 40%. It was then decided to take the highest value.

5.5.3 Organising cultural factors

Some cultural standards are established by (Thomas, 1996, p. 112), which expresses the cultural normal in terms of perceptions, thoughts, judgments, and actions. As described by Heimgärtner (2013) and Hodicová (2007), anthropological cultural models such as, Hofstede et al.’s (2010) and E. T. Hall and Hall’s (1990) cultural factors serve as a basis for the identification of cultural standards. Cultural factors and values should be used in website design (Yaaqoubi & Reinecke, 2018). Therefore, this research adopts cultural factors including: power distance, individualism vs. collectivism, uncertainty avoidance, and long-term vs. short-term orientation, from Hofstede et al. (2010), and context and time, from E. T. Hall and Hall (1990), which are suggested by Marcus and Baumgartner (2004a), Hsieh et al. (2009), and Heimgärtner (2013).

5.5.4 Organising HCI factors

The HCI factors are chosen to describe the style of information processing and the interactional style of the users with the web pages. User information processing and interaction style differ between cultures (Heimgärtner, 2013). The information processing and interaction style can be derived by considering physical factors, including: frequency, speed, density, redundancy, and sequentiality. By differentiating at least one of the identified physical factors, website users’ culturally specific information processing and interaction style can be derived.

The HCI factors can be connected to culturally dependent concepts of context, time orientation, and mental aspects. Time can be connected to interaction speed, frequency, and sequentiality. Context can be connected to information speed, frequency, density, and sequentiality. Mental aspects can be connected to relations, redundancy, tradition, and thoughts. HCI factors are strongly linked with time, context, and mental aspects. The view of HCI is also culturally dependent.
Therefore, to find culturally dependent information processing and interaction style of users from different cultural backgrounds, this research defines the following, as suggested by Heimgärtner (2014).

- Information speed is the duration of information presentation (E. T. Hall, 1956).
- Information density is the number of visible pieces of information during information presentation (E. T. Hall, 1956).
- Information frequency is the amount of information presented per time unit (E. T. Hall, 1956).
- Information sequentiality is the sequence arrangement of information (E. T. Hall, 1956).
- Information redundancy is the amount of repeated information during information presentation.

5.5.5 Developing cross-cultural Web design guidelines

Cultural influence on website design, in HCI, can be connected via the relationship across prominent design elements, cultural factors, and HCI factors. The identified prominent design elements, from section 5.5.2, map with cultural factors and HCI factors discussed in section 5.5.3, and section 5.5.4 respectively. With the support of the literature, correlations between prominent design elements, cultural factors, and HCI factors are identified and offered as cross-cultural website design guidelines.

Layout

For layout the total number of items in a web page and display density were identified as prominent design elements between cultures. The prominent design elements are used to investigate the relationship with cultural factors and HCI factors, by accounting for the information processing and interaction style of users with websites.
The total number of items in a web page, including headings, links, and images, and display density vary among cultures. The total number of items and display density in Australian web pages are lower than Chinese and Saudi Arabian web pages. One possible explanation for this difference is that Australian culture is considered a medium-uncertainty avoidance culture. The users from this culture avoid interruptions and information loss (Heimgärtner, 2012). To minimize the possibility of uncertainty, they restrict the flow of the information (Heimgärtner, 2012) and organise formal information into categories, hiding non-essential information.

The direct and formal communication pattern of low-context countries, such as Australia, and the preference for less information means Australian web pages feature fewer textual and non-textual items, which lower display density. Numerous studies including Fraternali and Tisi (2008) and Chu and Yang (2010) have confirmed this in prior work.

In low-uncertainty avoidance countries, such as China, web pages provide more detail. Even though, the Chinese language requires considerably fewer characters to represent words (Chu & Yang, 2010), the indirect and implicit communication of high-context cultures prefer high density pages (Chu & Yang, 2010; Fraternali & Tisi, 2008).

Researchers claim that Arabic cultures have an affinity for high-context but low content (Liginlal et al., 2014). Saudi Arabia is a member of the Arabic culture, and its high-uncertainty avoidance nature leads to lower page density (Khashman & Large, 2010).

The culturally dependent preference for the total numbers of items in a web page and the display density are supported by HCI research (Heimgärtner, 2013). Denser web pages feature more in less space (Chu & Yang, 2010). If many pieces of information are presented, users from high-uncertainty avoidance countries, such as Australia, may experience higher stress levels (Heimgärtner, 2013).

In dense websites, Chinese users, have been shown to efficiently filter when overloaded with information (Nisbett, 2003b). If the numbers of items in a web page
and display density of a web page are high, then the information density, frequency, and speed as well as the interaction frequency and speed are also high. Users from high-context and low-uncertainty would be rendered uncertain if only a few pieces of information could be exchanged because of their habit to obtain and to hand over many pieces of information (Heimgärtner, 2013). Therefore, in cross-cultural website design, information density, frequency, and speed as well as the interaction frequency and speed being high are important for high-context and low-uncertainty avoidance countries.

The culturally different use of information processing and interaction style of users are the motivation for cross-cultural website design guidelines, in Table 5-2.

Table 5-2: Layout cross-cultural website design guidelines

<table>
<thead>
<tr>
<th>Cultural factors</th>
<th>Web pages characteristics</th>
<th>HCI factors</th>
</tr>
</thead>
<tbody>
<tr>
<td>Low-context and medium-uncertainty avoidance country, such as Australia</td>
<td>Abstract information design</td>
<td>Low information density, speed, and frequency, as well as low interaction speed and frequency.</td>
</tr>
<tr>
<td>High-context and low-uncertainty avoidance country, such as China</td>
<td>Detailed information design</td>
<td>High information density, speed, and frequency, as well as high interaction speed and frequency.</td>
</tr>
<tr>
<td>High-context and high-uncertainty avoidance country, such as Saudi Arabia</td>
<td>Abstract information design</td>
<td>Low information density, speed, and frequency, as well as low interaction speed and frequency.</td>
</tr>
</tbody>
</table>

**Navigation**

Navigation methods also differ between cultures. Websites featuring more than 10 links in the main menu, two levels of choice in the main menu, main menu type including dynamic and static, and Fat Footer are identified as prominent design elements. They are used to investigate the relationship with cultural factors and HCI factors.

More than 10 links in the main menu and 2 levels of choices in the main menu are used to identify website structure. Website structure is related to its breadth and depth in presentation and the interrelated contents contained on the website (Galletta et al., 2006). Breadth is defined as the number of hyperlinks, as options or choices, per
level, and depth refers to the number of levels in a hierarchy (Cui et al., 2015). Website structure varies among cultures.

Chinese and Saudi Arabian web pages frequently feature more than 10 links in the main menu. However, 2 levels of choice in the main menu is popular in Australian web pages. This demonstrates that, Australian and to a lesser extent Saudi Arabian main menus are designed with fewer initial links at first sight, but contain a deeper hierarchical structure. This is further explained by the fact that short-term orientation cultures prefer a hierarchical navigation structure to accomplish tasks (Callahan, 2006). In short-term orientation cultures, such as Australian and Saudi Arabian, the immediacy of results and the achievement of goals are integral (Kralisch et al., 2005). When navigating a website, users from short-term orientation countries prefer fewer main menu links. Australian and Saudi Arabian websites favour deep or hierarchical structures, respectively. According to Reinecke and Bernstein’s (2011) and Kralisch et al.’s (2005) interpretation, short-term orientation cultures favour deep hierarchical structures, to reduce information density, while long-term orientation cultures prefer less deep hierarchical structure.

China is a long-term orientated culture (Hofstede et al., 2010). To process a task, long-term oriented cultures prefer detail (Chu & Yang, 2010; Fraternali & Tisi, 2008) and tolerate longer paths (Calabrese et al., 2012). This translates to a greater number of links in main menu, with a less deep or flatter hierarchical structure.

The culturally dependent preference for web page structure is supported by HCI research (Heimgärtner, 2013). The deep hierarchical information structure, identified in short-term orientation cultures, reduces the communication overhead by limiting information flow. This further reduces the overall visual complexity of the interface (Reinecke & Bernstein, 2011). If the number of first level links in the main menu is low and the hierarchical level in the main menu is high, then the information speed, and frequency, as well as interaction speed and frequency are low. As users from low-context and short-term orientation cultures, such as Australia, have inferential-categorical or functional cognitive style (Chiu, 1972), the interaction speed and
frequency being low may help to them to use functions or investigate components and general features in a given context (Heimgärtner, 2013). By considering deep vs. flat web page structure, the following cross-cultural website design guidelines are created and shown in Table 5-3.

**Table 5-3: Navigation cross-cultural website design guidelines**

<table>
<thead>
<tr>
<th>Cultural factors</th>
<th>Web pages characteristics</th>
<th>HCI factors</th>
</tr>
</thead>
<tbody>
<tr>
<td>Low-context, short-term orientation, and medium- or high-uncertainty avoidance country, such as Australia</td>
<td>Deep hierarchical structure with more controlled and high effort to navigation</td>
<td>Low information speed, and frequency, as well as low interaction speed and frequency. And high information and interaction sequentiality.</td>
</tr>
<tr>
<td>High-context and long-term orientation, low-uncertainty avoidance country, such as China</td>
<td>Flat hierarchical structure with Less controlled and low effort to navigation</td>
<td>High information speed, and frequency, as well as high interaction speed and frequency. And low information and interaction sequentiality</td>
</tr>
<tr>
<td>High-context and short-term orientation, and high-uncertainty avoidance country, such as Saudi Arabia</td>
<td>Medium deep hierarchical structure with medium controlled and medium effort to navigation</td>
<td>Medium information speed, frequency, and sequentiality as well as medium interaction speed. Frequency, and sequentiality</td>
</tr>
</tbody>
</table>

The type of main menu (dynamic vs. static) varies among cultures. The dynamic menu opens sub menus when the user selects a header while the static menu always displays headers and sub headers. The use of the static menu in Chinese websites is higher than Australian and Saudi Arabian websites. Chinese websites adopt a broad strategy by increasing the number of hyperlinks on the main menu, in which users may only need to click once or twice to reach the required target page. This low effort to click to reach the target pages provides navigation freedom, which can be explained with the amount of uncertainty avoidance. Users from low-uncertainty avoidance countries, such as China, tends to prefer less control in navigation (Reinecke & Bernstein, 2011) and Chinese websites feature static type main menus.

Users from high-uncertainty avoidance countries, such as Australia and Saudi Arabia, prefer more control in navigation to prevent them from getting lost (Marcus, 2002; Reinecke & Bernstein, 2011). These pages generally only show headers at first level,
and sub headers are only accessible on selection. This event triggered via hover or click design requires distinct timing to avoid accidental activations. High-uncertainty avoidance countries, such as Australian and Saudi Arabia frequently use this dynamic type of main menu.

The culturally dependent preference for the dynamic vs. static type main menu is supported by HCI research (Heimgärtner, 2013). In the deep hierarchical structure, dynamic menus provide more navigation control, in which users require greater effort to access low level navigation items. Users from high-uncertainty avoidances countries, such as Australia, feel uncertain if they cannot do tasks sequentially one by one because they are more sensitive, in this regard, than people who deal with very dense information (Heimgärtner, 2012). Thereby users from high-uncertainty avoidances cultures expect sequential information processing (Bernstein & Reinecke, 2013). Thus, high information sequentiality and interaction sequentiality is important for low-context and high-uncertainty avoidances countries. The relation found above yields the cross-cultural design guidelines shown in Table 5-4.

**Table 5-4: Navigation cross-cultural website design guidelines**

<table>
<thead>
<tr>
<th>Cultural factors</th>
<th>Web pages characteristics</th>
<th>HCI factors</th>
</tr>
</thead>
<tbody>
<tr>
<td>Low-context and high-uncertainty avoidance country,</td>
<td>More controlled and high effort to navigation</td>
<td>High information and interaction sequentiality.</td>
</tr>
<tr>
<td>such as Australia</td>
<td></td>
<td></td>
</tr>
<tr>
<td>High-context and low-uncertainty avoidance country,</td>
<td>Less controlled and low effort to navigation</td>
<td>Low information and interaction sequentiality</td>
</tr>
<tr>
<td>such as China</td>
<td></td>
<td></td>
</tr>
<tr>
<td>High-context and high-uncertainty avoidance country,</td>
<td>Medium controlled and medium effort to</td>
<td>Medium information and interaction sequentiality</td>
</tr>
<tr>
<td>such as Saudi Arabia</td>
<td>navigation</td>
<td></td>
</tr>
</tbody>
</table>

The Fat Footer, described as an information guide at the page bottom (Al-Khalifa & Garcia, 2014), provides redundant pieces of information in a structured and clear way. This feature is popular in Australian and Saudi Arabian websites, but not in Chinese websites. One possible explanation for this difference is that Australia and Saudi Arabia are high-uncertainty avoidance cultures, and prefer to avoid ambiguity (Al-Khalifa & Garcia, 2014). They also prefer redundant cues to reduce ambiguity (Marcus & Gould, 2000; Reinecke & Bernstein, 2011), and subsequently Australian and Saudi Arabian
web pages feature the Fat Footer. According to Al-Khalifa and Garcia’s (2014) interpretation, high-uncertainty avoidance cultures use the Fat Footer more extensively to prevent information loss.

The culturally dependent preference for the Fat Footer is supported by HCI research (Hsieh & Hong, 2013). If the Fat Footer appears, then there is some level of redundancy in information as well as interaction activities. The redundant pieces of information give strong additional support to find information or functionality (Chapman, 2011), which is desirable for users from high-uncertainty avoidance countries, such as Australia and Saudi Arabia, to prevent them from getting lost. The relation found here yields the cross-cultural design guidelines, in Table 5-5.

**Table 5-5: Navigation cross-cultural website design guidelines**

<table>
<thead>
<tr>
<th>Cultural factors</th>
<th>Web pages characteristics</th>
<th>HCI factors</th>
</tr>
</thead>
<tbody>
<tr>
<td>High or medium uncertainty avoidance countries, such as Australia and Saudi Arabia</td>
<td>Additional support with redundant pieces of information in a structured and clear way, to reduce ambiguity</td>
<td>Medium redundant pieces of information and redundant interaction.</td>
</tr>
<tr>
<td>Low-uncertainty avoidance country, such as China</td>
<td>Less additional support</td>
<td>High redundant pieces of information and redundant interaction</td>
</tr>
</tbody>
</table>

**Links**

The links in a web page and in particular the number of links also vary between cultures. The number of links, links that open in a new browser window, and numbers of external links have been identified as prominent design elements. They are used to investigate the relationship between cultural factors and HCI factors.

The number of links in Australian and Saudi Arabian websites were lower than Chinese websites. This can be related to the high-uncertainty avoidance nature of Australian and Saudi Arabian cultures (Callahan, 2006), in which the navigation possibilities are restricted, to prevent the users from getting lost.
Chinese websites feature more navigational freedom and more links. Numerous studies, including those of Goyal et al. (2012), and Reinecke and Bernstein (2011), have confirmed this in prior work.

The culturally dependent preference for links is supported by HCI research. If a greater number of links are presented, the probability of filtering information is high. Then, the information speed and frequency, as well as the interaction speed and frequency are high (Heimgärtner, 2013). In cross-cultural website design, high information speed and frequency, as well as the high interaction speed and frequency are important for low-uncertainty avoidance countries, such as China. The thinking processes of Asian cultures are thematic while Western cultures are functional (Nisbett, 2003). Results indicate that, for the Asian users, advantages were associated in terms of performance time and error rate when their mental models favoured concrete and thematic rather than abstract representation of knowledge. Therefore, keeping the information speed and frequency, as well as the interaction speed and frequency high supports low-uncertainty avoidance countries, such as China, and accommodates proper knowledge representation, and interface structure for effective task performance. Cross-cultural website design guidelines relating to links are shown in Table 5-6.

Table 5-6: Links cross-cultural website design guidelines

<table>
<thead>
<tr>
<th>Cultural factors</th>
<th>Web pages characteristics</th>
<th>HCI factors</th>
</tr>
</thead>
<tbody>
<tr>
<td>High-uncertainty avoidance countries, such as Australia and Saudi Arabia</td>
<td>High navigation control</td>
<td>Low information speed, and frequency, as well as low interaction speed and frequency</td>
</tr>
<tr>
<td>Low-uncertainty avoidance country, such as China</td>
<td>Low navigation control</td>
<td>High information speed, and frequency, as well as high interaction speed and frequency</td>
</tr>
</tbody>
</table>

External links vary among cultures. Some organizations and cultures use more external links to demonstrate the strength and emphasize social and organizational goals (Gould et al., 2000). The use of external links in Chinese websites is higher than Australian and Saudi Arabian websites. The high-power and long-term orientation nature of the Chinese culture may demonstrate the strength of the organisational network.
The culturally dependent preference for external links is supported by HCI research (Heimgärtner, 2013). If more external links are presented, the probability of filtering external information and performing external interaction with external websites is high. The external information frequency and speed as well as the external interaction are high for high-power distance, low-uncertainty avoidance, and long-term orientation countries, such as China, to focus on organisation. However, users from low-power distance, high-uncertainty avoidance, and short-term orientation countries may get lost with too many external websites. Therefore, the external information frequency and speed as well as the external interaction are low for low-power distance, high-uncertainty avoidance, and short-term orientation countries, such as Australia. The relation found here yields the cross-cultural design guidelines, in Table 5-7.

Table 5-7: Links cross-cultural website design guidelines

<table>
<thead>
<tr>
<th>Cultural factors</th>
<th>Web pages characteristics</th>
<th>HCI factors</th>
</tr>
</thead>
<tbody>
<tr>
<td>Low-power distance, high-uncertainty avoidance, and short-term orientation, countries, such as Australia</td>
<td>Focus on task</td>
<td>Low external information speed and frequency, as well as low external interaction speed and frequency</td>
</tr>
<tr>
<td>High-power distance, low-uncertainty avoidance, and long-term orientation country, such as China</td>
<td>Focus on organisation</td>
<td>High external information speed and frequency, as well as high external interaction speed and frequency</td>
</tr>
<tr>
<td>High-power distance, high-uncertainty avoidance, and short-term orientation, countries, such as Saudi Arabia</td>
<td>Focus on task</td>
<td>Low external information speed and frequency, as well as low external interaction speed and frequency</td>
</tr>
</tbody>
</table>

The use of Links opening in a new browser window is greater in Chinese websites than Australian and Saudi Arabian websites. An explanation can be brought through the work of E. T. Hall and Hall’s (1990) single task focus (monochronic) vs. multi-tasking (polychronic). Chinese culture is considered as polychronic, which uses a parallel problem-solving approach, based on the simultaneous consideration of multiple problems, reasons, and explanations (Fraternali & Tisi, 2008). The multitasking ability and the preferences for non-linear navigation mean Chinese websites feature higher number of links opening a new browser window. According to Kralisch et al.’s (2005),
interpretation polychronic cultures, show non-linear navigation behaviour and tend to switch between several open pages, while monochronic cultures, such as Australia, prefer linear navigation patterns.

Saudi Arabia is also a polychronic culture. However, its high-uncertainty avoidance may limit the links opened in the new browser window, to avoid interruptions and information loss.

The culturally dependent preference for the Links opening in a new browser window is supported by the HCI research (Heimgärtner, 2013). If the number of links opening a new browser window is high, then the information and interaction sequentiality are low. Then the probability of conducting sequential action is low. Minimising sequential activity is important for polychronic and low-uncertainty avoidance countries such as China. The cognitive style of East Asians is relational-contextual or thematic (Choong & Salvendy, 1999), compared to Westerners who are functional. East Asians prefer to classify on the basis of interdependence and relationship within wholes (Marcus, 2003b), and emphasize contexts (Rau et al., 2004). The parallel processing may support users from a polychronic and low-uncertainty avoidance, country, such as China, to gather information and construct relationships to perform tasks. Therefore, in cross-cultural website design, the information and interaction sequentiality being low is important for polychronic and low-uncertainty avoidance countries, such as China. The relation found above yields the cross-cultural website design guidelines in Table 5-8.

<table>
<thead>
<tr>
<th>Cultural factors</th>
<th>Web pages characteristics</th>
<th>HCI factors</th>
</tr>
</thead>
<tbody>
<tr>
<td>Monochronic and medium- or high-uncertainty avoidance, country, such as Australia</td>
<td>Linear navigation patterns</td>
<td>High information and interaction sequentiality</td>
</tr>
<tr>
<td>Polychronic and low-uncertainty avoidance, country, such as China</td>
<td>Non-linear navigation patterns</td>
<td>Low information as well as interaction sequentiality</td>
</tr>
<tr>
<td>Polychronic and high-uncertainty avoidance, country, such as Saudi Arabia</td>
<td>Linear navigation patterns</td>
<td>High information and interaction sequentiality</td>
</tr>
</tbody>
</table>
Multimedia

The identified prominent design elements for Multimedia are numbers of images, image or text animation, and image or text scrolling. They are used to investigate the relationship with cultural factors and HCI factors.

The number of images, animated, and scrolling objects in Chinese and Saudi Arabian websites are higher than Australian websites. The high-context cultures dependency upon the verbal and non-verbal cues to communicate effectively, and the preferences for visual information beyond written text (Alayed et al., 2016; Goyal et al., 2012) means Chinese and Saudi Arabian web pages feature more images with animated and scrolling objects.

Australia is considered a low-context culture. The direct and explicit communication pattern of formal information (E. T. Hall & Hall, 1990), often by way of written texts (Hsieh & Hong, 2013; Sun, 2001) means Australian web pages to use less visual information. Goyal et al. (2012) and Reinecke and Bernstein (2011) have confirmed this in prior work. They found that low-context cultures prefer interfaces that contain high text-to-image ratio.

The culturally dependent preferences for the number of images, animated and scrolling objects in web pages are supported by HCI research (Heimgärtner, 2013). Effective communication means transporting information quickly or slowly, depending on users’ culture. According to (E. T. Hall, 1983), some cultures prefer fast message speed, and other prefer slow message speed. Generally, images, animation, and graphics draw attention to items of information (Noiwan & Norcio, 2006). They provide parallel information and support high communication speed (Heimgärtner, 2013), but this may also be a distraction (Brinck & Gergle, 2002). Users have a certain approach to gather information and construct relationships from these types of objects according to their culture.

The cognitive style of Chinese are relational-contextual (Choong & Salvendy, 1999), and they classify on the basis of interdependence and construct relationship within
wholes (Marcus, 2003b), and emphasize contexts (Rau et al., 2004). Images, animation, and graphics support parallel thinking patterns of users from high-context cultures such as China and Saudi Arabia (Liginlal et al., 2014), to gather information and construct relationships to perform tasks. This also improves the aesthetic experience of the website in high-context cultures, rather than the informative function, which might be expected to be prioritized in low-context cultures (Liginlal et al., 2014; Würtz, 2005). The increased visual information transmitted in fast communication media provides fast information flow. Therefore, high information speed and frequency, as well as interaction speed and frequency is important for high-context countries, such as China and Saudi Arabia.

The Western cognitive style is inferential-categorical, in which they prefer functions or inferences to investigate components and general features within its context (Nisbett & Miyamoto, 2005). This context-independent style prefers to reduce ambiguous information. Adding graphics and animated objects can make website information more ambiguous and increase difficulty for users, from low-context cultures, to concentrate on the information (Noiwan & Norcio, 2006). Therefore, in cross-cultural website design, interaction speed and frequency being low is important for a low-context country, such as Australia. The following cross-cultural website design guidelines, in Table 5-9, are created.

### Table 5-9: Multimedia cross-cultural website design guidelines

<table>
<thead>
<tr>
<th>Cultural factors</th>
<th>Web pages characteristics</th>
<th>HCI factors</th>
</tr>
</thead>
<tbody>
<tr>
<td>Low-context country, such as Australia</td>
<td>Low visual information</td>
<td>Low information and interaction speed and frequency</td>
</tr>
<tr>
<td>High-context countries, such as China and Saudi Arabia</td>
<td>High visual information</td>
<td>High information and interaction speed and frequency</td>
</tr>
</tbody>
</table>

**Visual Representation**

For visual representation, images of young individuals, leaders, and political figure were identified as prominent design elements, and are needed to investigate the relationship with cultural factors and HCI factors.
The images of leaders vary among cultures, and were more common in Saudi Arabian than Australian websites. One possible explanation for this difference is the power-distance among countries. The Saudi Arabian culture is considered as high-power distance culture. The high-power distance demonstrates that there is greater acceptance of unequal power distribution among people (Reinecke & Bernstein, 2011). According to Al-Khalifa and Garcia (2014), high-power distance cultures use images that focus on leaders or authority, while low-power distance cultures, such as Australia, focuses on ordinary citizens (Reinecke & Bernstein, 2011).

Use of images of young individuals and political images varies among cultures. Images of young individuals in Australian websites were more common than Chinese and Saudi Arabian websites, while the political images in Chinese and Saudi Arabian websites were higher than Australian websites. Chinese and Saudi Arabian culture is said to be collectivistic (Hofstede et al., 2010), and the preferences to represent human presence on websites (Würtz, 2005), means Chinese and Saudi Arabian web pages to use images of political figures that promote characteristics of collectivistic societies. According to Würtz’s (2005) interpretation, collectivistic cultures are expected to show more frequent images of group and political figures, while individualistic cultures, such as Australia, use images of young individuals.

The culturally different use of visual representation shows that culture affects visual perceptions. Users perceive visual images in a way that they have experienced and learned (Noiwan & Norcio, 2006). By creating a sense of warmth or human contact for the user to keep a harmonious relationship with their culture, high-power and collectivistic, cultures include more images of people (Djamasbia et al., 2010). Then the visual information flow is high. It seems that, in cross-cultural website design, if more images of large group of people displayed, then the visual information speed and frequency, as well as interaction frequency speed and speed are high. Interaction frequency and information speed being high is important to users from high-power and collectivistic countries, such as China and Saudi Arabia, who are more willing to follow the tradition (Kyriakoullis & Zaphiris, 2016). On the other hand, interaction
frequency and information speed being low is important to users from low-power and individualistic countries, such as Australia, as in an individualistic society, innovation is more important than tradition (Kyriakoulis & Zaphiris, 2016). The following cross-cultural website design guidelines, in Table 5-10, are created.

Table 5-10: Visual representation cross-cultural website design guidelines

<table>
<thead>
<tr>
<th>Cultural Factors</th>
<th>Web pages characteristics</th>
<th>HCl factors</th>
</tr>
</thead>
<tbody>
<tr>
<td>Low-power and individualistic country, such as Australia</td>
<td>Low human presence images</td>
<td>Low information speed and frequency, as well as low interaction speed and frequency</td>
</tr>
<tr>
<td>High-power and collectivistic countries, such as China and Saudi Arabia</td>
<td>High human presence images</td>
<td>High information speed and frequency, as well as high interaction speed and frequency</td>
</tr>
</tbody>
</table>

**Colour**

Traditional, bright, and softer colours were identified as prominent design elements between cultures. They are used to investigate the relationship with cultural factors and HCl factors.

The use of traditional and bright colours were popular in Chinese websites, followed by Saudi Arabian websites, then Australian websites. The indirect and implicit communication pattern of high-context cultures and the high capacity visual information preferences mean Chinese web pages use traditional and bright colours in data visualization to promote their cultural values. According to Marcus and Gould (2000) and Barber and Badre (1998), high-context cultures use traditional colours and bright colours to maximize information as well as to attract user’s attention.

The high-context leads Saudi Arabian web pages to use traditional colours. However the limited information preferences of high-uncertainty avoidance cultures moderates the use of bright colours.

The direct and formal communication patterns, often by written text, of low-context cultures, and the low content preferences of high-uncertainty avoidance means Australian web pages use softer colours.
The culturally dependent preference for the use of traditional and bright colours is supported by HCI research (Heimgärtner, 2013). The cultural differences of thought pattern and browsing behaviour of users from high-context and low-uncertainty avoidance cultures, such as China, means that users scan the whole web page with non-linear scanning and browsing behaviour (Dong & Lee, 2008). Thus, the contents may be placed more freely on Chinese web pages. The high use of visual and colour embedded information displayed freely provides fast information flow. Therefore, high information speed and frequency, as well as interaction speed and frequency is important for high-context and low-uncertainty avoidance countries, such as China.

Users from western cultures, which are low-context and high-uncertainty avoidance cultures, favour abstract representation of knowledge with a functional interface structure when browsing (Choong & Salvendy, 1999; Nisbett, 2003b). For this culture, minimising attention requirements and users working area are important, to minimise error rates and information search time. Since colours impact users attention (Noiwan & Norcio, 2006), reducing bright colours helps the users, from low-context and high-uncertainty avoidance cultures, to minimise interference to their focus of attention to start browsing with less mental workload. Therefore, in cross-cultural website design, if the use of bright colours is less, then the information speed and frequency, as well as the interaction speed and frequency are low, for low-context and high-uncertainty avoidance countries, such as Australia. Some cross-cultural website design guidelines are shown in Table 5-11.

**Table 5-11: Colour cross-cultural website design guidelines**

<table>
<thead>
<tr>
<th>Cultural factors</th>
<th>Web pages characteristics</th>
<th>HCI factors</th>
</tr>
</thead>
<tbody>
<tr>
<td>Low-context and medium-uncertainty avoidance country, such as Australia</td>
<td>Less colour-embed information</td>
<td>Low information speed, and frequency, as well as low interaction speed and frequency</td>
</tr>
<tr>
<td>High-context and low-uncertainty avoidance country, such as China</td>
<td>High colour-embed information</td>
<td>High information speed, and frequency, as well as high interaction speed and frequency</td>
</tr>
<tr>
<td>High-context and high-uncertainty avoidance country</td>
<td>Medium colour-embed information</td>
<td>Medium information flow, speed, and frequency, as well as medium interaction speed and frequency</td>
</tr>
</tbody>
</table>
Text

Two prominent, text based, design elements including: number of bold and strong, and number of headings are used to investigate the relationship between cultural factors and HCI factors.

The number of bold and strong elements in Chinese websites is higher than Australian and Saudi Arabian websites. The high content preferences of high-context and less structured content preferences of long-term orientation means Chinese web pages feature more bold and strong features to emphasize important text within the content.

The number of headings in Australian websites are higher than Chinese and Saudi Arabian websites. The preference for less content and more structure of short-term orientation cultures means Australian web pages feature more formal headings to structure the content hierarchically. According to Abdulkhair’s (2004) interpretation, information presentation preferences for scanability for English users is different size headings, while the users from Saudi Arabia prefer different colours.

The culturally dependent preferences for the bold and strong, and number of headings are supported by HCI research. The emphasize text effects such as bold and strong are used to spread content important messages fast. Since high-context and long-term orientation cultures, such as China, prefer fast message speed, the use of emphasized text effects helps users to filter useful information when scanning a web page. Therefore, in cross-cultural website design, if the use of use of text emphasis is high, then the information speed, and frequency, as well as interaction speed and frequency are high, which is important for High-context, long-term orientation, and low-uncertainty avoidance countries, such as China.

Formal headings are used to structure the content hierarchically. Since the users from low-context, short-term orientation, and high-uncertainty avoidance cultures are functional (Nisbett & Miyamoto, 2005), the hierarchical arrangement of formal information creates visual cues that helps users to work as functional. This reduces mental workload for users attached to low-context, short-term orientation, and high-
uncertainty avoidance cultures, such as Australia. Therefore, in cross-cultural website design, if the use of formal headings is high, then the information flow, speed, and frequency, as well as interaction speed and frequency are low, which is important for low-context, short-term orientation, and high-uncertainty avoidance countries, such as Australia. Some cross-cultural website design guidelines are created in Table 5-12.

Table 5-12: Text cross-cultural website design guidelines

<table>
<thead>
<tr>
<th>Cultural factors</th>
<th>Web pages characteristics</th>
<th>HCI factors</th>
</tr>
</thead>
<tbody>
<tr>
<td>Low-context, short-term orientation, and high-uncertainty avoidance country, such as Australia</td>
<td>Low content and structure the content hierarchically</td>
<td>Low information speed, and frequency, as well as low interaction speed, and frequency</td>
</tr>
<tr>
<td>High-context, long-term orientation, and low-uncertainty avoidance country, such as China</td>
<td>Detailed content and less structured content hierarchically</td>
<td>High information speed, and frequency, as well as high interaction speed, and frequency</td>
</tr>
<tr>
<td>High-context, short-term orientation, and high-uncertainty avoidance country, such as Saudi Arabia</td>
<td>Low content and medium structured content hierarchically</td>
<td>Medium information speed, and frequency, as well as medium interaction speed, and frequency</td>
</tr>
</tbody>
</table>

The offered cross-cultural web design guidelines were developed by considering Australian, Chinese, and Saudi Arabian cultures. To help web designers to choose suitable web features for a specific culture, the cross-cultural web design guidelines were summarised and are given in Table 5-13 and Table 5-14. Table 5-13 shows the level of culture and HCI and Table 5-14 details the web features suitable for the target culture. Together, these tables may help web designers to choose suitable web features for a specific culture. Therefore, using these guidelines, a cross-cultural website can be constructed, for each culture. These websites will be embedded with the necessary level of cultural factors, as well as the HCI factors. Since measuring website usability is important, to measure this website usability between cultures, a usability measuring instrument is required. The next section develops a usability measuring instrument.
Table 5-13: Level of Culture and HCI for Web Design

<table>
<thead>
<tr>
<th>HCI Factors</th>
<th>Cultural factors</th>
<th>(Low) PDI</th>
<th>(Low) IDV</th>
<th>(Low) UAI</th>
<th>(Low) LTO</th>
<th>(Low) CTX</th>
<th>(Low) TPC</th>
</tr>
</thead>
<tbody>
<tr>
<td>Information speed</td>
<td>(Low)</td>
<td>(High)</td>
<td>(Low)</td>
<td>(Low)</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Information density</td>
<td>(Low)</td>
<td>(High)</td>
<td>(Low)</td>
<td>(Low)</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Information frequency</td>
<td>(Low)</td>
<td>(High)</td>
<td>(High)</td>
<td>(Low)</td>
<td>(High)</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Information redundancy</td>
<td>(High)</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Information sequentiality</td>
<td>(Low)</td>
<td>(Low)</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Interaction sequentiality</td>
<td>(Low)</td>
<td>(Low)</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Interaction exactness</td>
<td>(Low)</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Interaction speed</td>
<td>(Low)</td>
<td>(High)</td>
<td>(Low)</td>
<td>(Low)</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Interaction frequency</td>
<td>(Low)</td>
<td>(High)</td>
<td>(High)</td>
<td>(Low)</td>
<td>(Low)</td>
<td>(High)</td>
<td></td>
</tr>
</tbody>
</table>


Table 5-14: Web features for culturally specific website design

<table>
<thead>
<tr>
<th>Cultural factors</th>
<th>Web attributes</th>
<th>Web feature</th>
</tr>
</thead>
<tbody>
<tr>
<td>(Low) PDI: Power distance</td>
<td>Visual representation</td>
<td>(Low) Human presence in images</td>
</tr>
<tr>
<td>(Low) IDV: Individualism</td>
<td>Visual representation</td>
<td>(High) Human presence in images</td>
</tr>
<tr>
<td></td>
<td>Links</td>
<td>(Low) Focus on the user’s goals</td>
</tr>
<tr>
<td></td>
<td></td>
<td>(High) Focus on organisation</td>
</tr>
<tr>
<td>(Low) UAI: Uncertainty avoidance</td>
<td>Navigation</td>
<td>(Low) Guidance and navigation control</td>
</tr>
<tr>
<td></td>
<td></td>
<td>(Low) Additional support, in structured way</td>
</tr>
<tr>
<td></td>
<td></td>
<td>(High) Redundant pieces of information</td>
</tr>
<tr>
<td>(Low) LTO: Long-term orientation</td>
<td>Navigation</td>
<td>(High) Deep, to flat, hierarchical structure</td>
</tr>
<tr>
<td></td>
<td>Layout</td>
<td>(Low) Information complexity,</td>
</tr>
<tr>
<td>(Low) CTX: Context</td>
<td>Multimedia</td>
<td>(Low) Visual information</td>
</tr>
<tr>
<td></td>
<td>Colour and Text</td>
<td>(Low) Colour-embed information</td>
</tr>
<tr>
<td>(Low) TPC: Time perception</td>
<td>Links</td>
<td>(Low) Linear navigation</td>
</tr>
</tbody>
</table>

5.6 Development of a usability measuring instrument

Usability is a performance and belief based concept (Bevan et al., 2015; Ford & Kotzé, 2005), which is a crucial measure of product quality (Kyriakoullis & Zaphiris, 2016). Usability has been defined in the existing body of literature in a variety of ways. However, it is now widely accepted that usability is a socially constructed concept
made up of attributes which may not be equally valued across cultures (Reinecke & Bernstein, 2011).

Based on Lewis and Raton (2006), usability is dependent on the interactions among users, products, tasks and environments. There is no independent instrument that can provide an absolute measurement of the usability of a product (Aziz & Kamaludin, 2014).

To empirically measure website usability between cultures, a usability measuring instrument is developed, which includes objective measurement of user performance and subjective measurement of user perception.

**5.6.1 Selection of Usability Attributes**

Six usability attributes are in focus. They are effectiveness, efficiency, errors, perceived navigability, perceived classic as well as expressive aesthetics, and satisfaction. Effectiveness, efficiency, and errors are used to measure user performance and perceived navigability, perceived classic as well as expressive aesthetics, and satisfaction are used to measure user perception. User performance is measured using task-based testing, during the actual use of the website. User perception is measured using a questionnaire, after the actual use of the website. The research model for website usability is in Figure 5.1.

Prior research from Cui et al. (2015), Darem (2013), Punchoojit and Chintakovid (2012), Mountassir (2012), S. Lee and Koubek (2010), Hsieh et al. (2009), Fraternali and Tisi (2008), Seffah et al. (2006), Jeng (2005), Nielsen (2001), and Nielsen (1993) are reviewed to derive usability attributes that are suitable to measure the clarity and effectiveness of communication of the website design. Each usability attribute is described below.
Effectiveness

Effectiveness: is defined as the accuracy and completeness with which users achieve specified goals (Nielsen, 2001). Effectiveness in this study is measured by whether the user complete a task correctly in a given website.

Efficiency

Efficiency is the way users use the website in completing their task (Jeng, 2005; Yusof et al., 2010). Efficiency is measured by the amount of time participants take to complete the given task or answer the questions (Hsieh et al., 2009; Punchoojit & Chintakovid, 2012).

Errors

User performance is also measured by looking at the amount of effort required to complete a task (Darem, 2013). Errors are the number of incorrect clicks made by users during the task (Darem, 2013). According to Nielsen (1993). Counting the number of errors, to complete the given task on each website, will help in
understanding the positive and negative outcomes of interaction between users and websites. Errors in this study are measured by number of incorrect web pages viewed by users during the task.

**Perceived navigability**

Navigation is a fundamental activity users engage in to achieve their Web search activity, and information finding task (Palmer, 2002; Wang & Yen, 2007). Perceived navigability is a user’s subjective perception of how easily information is found and the website is navigated (Cui et al., 2015; Punchoojit & Chintakovid, 2012). Website usability and design researchers posit that the subjective evaluation and attitude toward the website will be effected by navigation (Nielsen, 2000; Shneiderman & Plaisant, 2004). A straightforward navigation experience allows users to complete their tasks efficiently and can heighten users’ satisfaction with the website. Measuring perceived navigability, in cross-cultural website designs that adapt “broad” vs. “deep” Web structure, will provide a deeper understanding of what navigation features may satisfaction (Cui et al., 2015).

**Perceived aesthetics: perceived classic as well as expressive aesthetics**

Website aesthetics is the look-and-feel (Yusof et al., 2010), of the page. Users have been found to judge the aesthetics of web pages, within 50 milliseconds (Lindgaard et al., 2006). Since first impressions are important for web pages (Reinecke & Bernstein, 2011), aesthetics are important. Based on the extensive analysis of existing research and the empirical investigation of people’s aesthetic perception of web pages, two levels of perceived aesthetics including: “classic” as well as “expressive” aesthetics have been proposed by Lavie and Tractinsky (2004).

**Classic aesthetics**

The classical aesthetics attribute corresponds to the “visual clarity” dimension (Nasar, 1999) of the website and express as “look” factor (De Angeli et al., 2006), which pertains to aesthetic notions emphasize clear and clean design that presided from
antiquity until the 18th century (Lavie & Tractinsky, 2004). Also, these traditional aesthetic notions emphasize orderly and clear design with perceptual design properties including clean, clean, systematic, pleasant, and aesthetic (Hartmann et al., 2008). Since, orderly and clear design are closely related to many of the design rules advocated by usability experts (Lavie & Tractinsky, 2004), measuring the level of classic aesthetics is important in visual aesthetics design.

**Expressive aesthetics**

The expressive aesthetics is the “visual richness” (Nasar, 1999) and represents qualities beyond the classical principles and stress the designer’s creativity, expressive, and originality (Lavie & Tractinsky, 2004). Expressive aesthetics includes: creativity, special effects, originality and sophistication. Measuring the level of expressive aesthetics is also important in metaphor-based design that facilitates interaction via images, animations, and scrolling objects (De Angeli et al., 2006).

**Satisfaction**

Satisfaction is the freedom from discomfort (De-Marsico & Levialdi, 2004), and overall satisfaction users have toward the system (Punchoojit & Chintakovid, 2012). End-user satisfaction is an indicator of the success of the website (Cui et al., 2015; McKinney et al., 2002; Palmer, 2002). Satisfaction is measured by the subjective satisfaction participants had toward each prototype website design (Nielsen, 1993).

### 5.7 Designing Culturally Specific Websites in HCI

The developed cross-cultural web design guidelines, which assumed relationships among prominent design elements, cultural factors, and HCI factors are based on the literature Hofstede et al. (2010), E. T. Hall and Hall (1990), and prominent design element discovered in section 5.5.2.

To design websites for a particular culture, website designers should calculate the cultural factor values of the country. Hofstede et al.’s (2010) cultural factor values can be calculated from The Hofstede centre (2017). The decimal values can be given a
range to labels: “Low,” for 0–40, “Medium,” for 41–60, and “High,” for 61–100. The E. T. Hall and Hall’s (1990) high-context vs. low-context values should be labelled: “Low” and “High,” and the monochronic vs. polychronic time perception value should be labelled: “High,” for monochronic, and “Low,” for polychronic. In the USA, the calculated cultural factor values are: “Low” (40) for Power distance, “High” (91) for Individualism, “Medium” (46) for Uncertainty avoidance, “Low” (26) for Long-term orientation, “Low” for Context, and “High” for (monochronic) Time perception.

All calculated cultural factor values should be mapped in Tables 5-13 and 5-14. So the USA’s “Low” for Power distance (PDI) can be used to identify both the HCI factors, in Table 5-13, and associated web feature, in Table 5-14. In the example of the USA, the derived HCI factors, in Table 5-13, are “Low” information speed, and frequency, as well as interaction speed and frequency. This gives the appropriate “web feature” in Table 5-14; for “Low” Power distance (PDI), and the “Low” information speed, and frequency, as well as interaction speed and frequency, a comparatively lower human presence should be used.

If any cultural factor has value “High,” then the values should be changed vice versa for all connections in Tables 5-13 and 5-14. For example, USA’s Individualism (IDV), in Table 5-13. If the IDV value is “High,” then the information speed, and frequency, as well as interaction speed and frequency, are “Low” and can be used to inform of the appropriate “web feature” in Table 5-14. Using these design guidelines, cultural factors and HCI factors associated with a particular culture may help to inform the correct web features to be used.

Different cultures will have different cultural factors and HCI factors and the requisite web features will vary. The cultural factors, HCI factors, and web features are not bounded by the border of a nation. A cultural group is determined by the cultural characteristics of a group of users and this quantitative and qualitative data has historically been obtained from random sampling.
5.8 Discussion

This research has drawn large scale empirical results of website design preferences discovered in Chapter 4 and integrated these with design guidelines. These guidelines are appropriate for various cultural groups. The guidelines presented in this chapter describe the relationship among prominent design elements, cultural factors, and HCI factors. Prior studies from Goyal et al. (2012), Nordhoff et al. (2018), and Nizamani et al. (2018) recommended to identify cultural preferences or cultural markers, that are universally valid for web pages, to enhance web usability. The Chapter 4 investigated the use of design attributes as a starting point to determine the relationship among prominent design elements, cultural factors, and HCI factors. Cross-cultural differences, different cognitive styles, reading and scanning patterns, or colour meanings are used to consider the implications of the identified differences in designing cross-cultural websites. Hofstede et al.’s (2010), and E. T. Hall and Hall’s (1990) cultural factors are used for cross-cultural website design to explain the reason for the observed preferences. The values of cultural factors show that culture-dependent variations can be used to design websites for different cultures. Much research effort is still necessary to validate, refine, and optimize the guidelines and a large-scale user test to investigate cross-cultural website usability is an important next step. The usability measuring instrument, presented in the section 5.6, derived objective and subjective measurements that are suitable to measure the effectiveness of the website design. This chapter has designed a Cross-cultural Web Usability Model which is the model is generic enough to tailor the look, feel and aesthetics of the web page to arbitrary cultural groups.

5.9 Conclusion

A new Cross-cultural Web Usability Model has been developed. This work describes how prior work in cultural theory, and the measurement of web elements used by different cultures, can be used to design websites for different cultures. The proposed cross-cultural website design guidelines advise Web developers on design attributes including: layout, navigation, links, multimedia, visual representation, colour, and text.
Every design guideline contains cultural factors and HCI factors, which relates to the level of cultural adaptation necessary. By using these guidelines, a cross-cultural website can be constructed for each culture. In the next chapter, a user test will be carried out to investigate the cross-cultural web design guidelines. It will perform a cross-cultural usability study to evaluate the efficacy of websites from different cultures. The goal of user testing is to acquire behavioural data including: effectiveness (task success rate), efficiency (average time on task), and errors (average number of clicks for a task), and attitudinal data including perceived navigability, perceived aesthetics, and satisfaction based on completion of specified tasks. From the behavioural and attitudinal data, user performance and user perception will be measured.

Yaaqoubi and Reinecke (2018) showed that the localization teams at various global companies are used cultural factors to inform possible design interventions that might increase various success metrics. It is hoped that these advances in cross-cultural web usability will support a new generation of effective Web content. For effective communication with diverse cultural groups and a global audience, simple language translation is not sufficient. The work described in this chapter is a step toward the provision of tailored, accessible and effective communication for all cultural groups and regions.
Chapter 6. Empirical evaluation of the Cross-cultural Web Usability Model

6.1 Introduction

Chapter 5 combined the culturally specific design elements, described in Chapter 4, with a review of the literature to create a new Cross-cultural Web Usability Model. The model contains a set of cross-cultural design guidelines and a usability measuring instrument. This chapter details the testing environment for the empirical evaluation of the developed model for its validation. The evaluation will be based on the newly developed usability measuring instrument. The background is first presented, followed by a justification of the study, the existing study, and the methodology.

6.2 Background

Website users from different cultures think and behave differently (Rau et al., 2008), and these differences will influence their information processing, interaction style, and task performance with websites (Bernstein & Reinecke, 2013). On the other hand, web pages also change the way people think and behave, imposing their own information processing style on users (Rau et al., 2008). The Internet is an increasingly global market place and it is unreasonable to expect one common website design to suit everyone. To bridge this dichotomy between the need for websites that cater for different cultures, and an inexpensive method to develop them, a Cross-cultural Web Usability Model was developed and described in the previous chapter. The model contains both cross-cultural design guidelines and a usability measuring instrument.

The main aim of this study is to validate a new Cross-cultural Web Usability Model. The central hypothesis is that: if website design incorporates the cultural values of users, it may be more usable and effective.

To test the hypothesis, the developed cross-cultural design guidelines are used to create test websites, and the usability instrument is used to measure cross-cultural website usability. Website usability is measured with seven usability attributes including: effectiveness, efficiency, errors, perceived navigability, perceived classical as
well as expressive aesthetics, and satisfaction. The validated cross-cultural web design guideline will be used to provide different user interfaces for different cultural groups.

6.3 Justification of the study

Website usability involves the ease with which the user can learn to manage the website and memorise the basic functions, the efficiency of design of the site, the degree of error avoidance and the general satisfaction of the user (Nielsen, 1993). The goal of developing a usable website is to offer a satisfactory user experience (Fraternali & Tisi, 2008), which is required for website acceptance (Alghamdi et al., 2013).

The overall satisfaction of website design is influenced by cultural variables (Al-Khalifa & Garcia, 2014; Kincl et al., 2013). How web design preferences differ between countries becomes clear from research comparing web designs prepared for different cultures (Bernstein & Reinecke, 2013; Callahan, 2006; Hsieh & Hong, 2013); research has repeatedly emphasized that national culture influences the perception of good design.

Realizing the connection between web design preferences, culture, and usability, multinational companies now offer culturally adapted websites as opposed to a standardized website (Kralisch et al., 2005; Reinecke & Bernstein, 2011). This is connected to important investment decisions (Kralisch, 2005), as users can easily switch to the competition with only one click (Chau et al., 2002), and therefore a culturally adapted website can provide a significant competitive advantage (Bernstein & Reinecke, 2013). Culturally adapted websites should go beyond the language or date and time and fully translate the functionality, look, and feel of web pages, according to users’ cultural values and attitudes.

To understand the cultural values and attitudes of users, prior research relied on Hofstede et al.’s (2010) and E. T. Hall and Hall’s (1990) cultural factors, which are dominant in HCI research (Hsieh, 2014). Prior research applied these cultural factors into website design and found that websites incorporating these cultural factors are closely related with higher website quality expectations, with the design considered more acceptable by users of the target culture. Users prefer culturally adapted
websites (Nantel & Glaser, 2008), rate them with higher reliability (Chu & Yang, 2010), perceive them to be more attractive (Corbitt & Thanasankit, 2002; Reinecke & Bernstein, 2011), navigable (Cui et al., 2015), usable (Forer & Ford, 2003), and appealing (Corbitt & Thanasankit, 2002). It has also been found that culturally adapted websites improve the work efficiency of those they were intended for (Fraternali & Tisi, 2008; Hsieh, 2014; Reinecke & Bernstein, 2011).

The cross-cultural design guidelines described in Chapter 5 may be used to adapt web pages at the presentation level, so that in most cases, the web page layout, complexity, colours, and workflows will change for users from different cultural background (Cyr & Trevor-Smith, 2004; Kersten et al., 2002; Reinecke & Bernstein, 2011).

Prior research suggests that incorporating cultural factors will enhance web usability. This study evaluates the efficacy of cross-cultural websites by conducting user tests to acquire behavioural data including: effectiveness - task success rate, efficiency, average time on task, and errors - average number of clicks for a task. The study will also capture attitudinal data including perceived navigability, perceived aesthetics, and satisfaction based on completion of specified tasks. From the behavioural and attitudinal data, user performance and user perception will be measured.

6.4 Study questions and hypotheses

This study compares user performance and perception in cross-cultural websites with a comparative study comparing the efficacy of Australian and Chinese web designs using Australian and Chinese users. Usability attributes including effectiveness, efficiency, and errors were considered to measure user performance, and perceived navigability, perceived classic as well as expressive aesthetics, and satisfaction measured user perception. Cross-cultural website design offers culturally specific interaction, information processing, and communication (Reinecke & Bernstein, 2011), to provide clear and effective communication between users and web pages (Hsieh, 2015). This supports users when finding information or functionality to perform tasks in web pages (Heimgärtner, 2013), in culturally appropriate ways. Thus, usability attributes differ between cultures and culturally specific websites affect user
performance and perception. The broad research question addressed in this study was:

RQ: Do cultural factors, HCI factors, and website design interact to affect user performance and perception?

Effectiveness is the performance on a web page task (Punchoojit & Chintakovid, 2012). Fraternali and Tisi (2008) observed higher task success on culturally specific website designs. Chinese user’s effectiveness was higher on Chinese website designs that incorporate high information parallelism and density, as well as interaction parallelism. The effectiveness of Western users was higher on Western website designs incorporating low information parallelism and density, as well as low interaction parallelism. Thus, it was hypothesised that:

**H1: Cultural factors, HCI factors, and website design interact to affect effectiveness.**

*H1a: Users from Australia would have higher effectiveness on Australian culturally specific websites as opposed to Chinese culturally specific websites.*

*H1b: Users from China would have higher effectiveness on Chinese culturally specific websites as opposed to Australian culturally specific websites.*

Errors are measured by number of incorrect web pages viewed by users during the task (Nielsen, 1993). Cross-cultural research in HCI found that, culturally specific navigation structures minimise errors (Cui et al., 2015; Reinecke & Bernstein, 2011). They found that users from high-uncertainty avoidance countries, such as Australia, prefer a deeper navigation structure with a linear navigation pattern to minimise errors (Reinecke & Bernstein, 2011). However, users from low-uncertainty avoidance countries, such as China, prefer less structured design (Sang-Hun, 2007) that places contents more freely on the web page (Calabrese et al., 2012), to provide navigation freedom (Bernstein & Reinecke, 2013) and to reduce the number of page views to complete tasks (Reinecke & Bernstein, 2011). Given this cultural difference, it was proposed that:

**H2: Cultural factors, HCI factors, and website design interact to affect errors.**
H2a: Users from Australia would have fewer errors on a Australian culturally specific website design as opposed to a Chinese culturally specific website design.

H2b: Users from China would have a fewer errors on a Chinese culturally specific website design as opposed to a Australian culturally specific website design.

Time on task success was considered to measure user efficiency in cross-cultural website designs by Fraternali and Tisi (2008), who found that Chinese users’ efficiency was high in website designs with high-information density. Higher-information density offers high information speed and frequency as well as the interaction frequency and speed. This help users from long-term orientation and low-uncertainty cultures, such as China, to use many pieces of information (Reinecke & Bernstein, 2011), to accomplish tasks quickly on web pages (Heimgärtner, 2013). However, Western users’ efficiency was high in Western website designs that minimised the information presented in web pages (Cui et al., 2015; Fraternali & Tisi, 2008). The deeper hierarchical structure reduces the visible items and display density, which help the users with short-term orientation such as the US to accomplish tasks quickly (Hsieh, 2015; Reinecke & Bernstein, 2011). Given this cultural difference to efficiency, it was proposed that:

H3: Cultural factors, HCI factors, and website design interact to affect efficiency.

H3a: Users from Australia would have a higher efficiency on Australian culturally specific website designs as opposed to Chinese culturally specific website designs.

H3b: Users from China would have higher efficiency on Chinese culturally specific website designs as opposed to Australian culturally specific website designs.

User interface research in HCI showed that analytic Westerners and holistic Easterners have distinct preferences, “broad” vs “deep” navigation, for perceived navigability. Cui et al. (2015) showed that Chinese users, with a holistic cultural cognitive style, had a
higher perceived navigability with designs that adopted a “broad” navigation structure. And, US users, with an analytic cultural cognitive style, had higher perceived navigability with Western designs using a “deep” structure. Given this cultural difference to perceived navigability, it was proposed that:

**H4:** Cultural factors, HCI factors, and website design interact to affect perceived navigability.

**H4a:** Users from Australia would have higher perceived navigability on Australian culturally specific website designs as opposed to Chinese culturally specific website designs.

**H4b:** Users from China would have higher perceived navigability on Chinese culturally specific website designs as opposed to Australian culturally specific website designs.

There has been less research on user perception on aesthetics in cross-cultural website design. However, some authors suggest that two levels of aesthetics, classic as well as expressive aesthetics, are particularly important in the context of the web (Lavie & Tractinsky, 2004; Lorenzo-Romero et al., 2013). The classic aesthetics attribute corresponds to the “visual clarity” dimension, while the expressive aesthetics attribute corresponds to the “visual richness” dimension of website design (Nasar, 1999), are important to enhance user perceptions about website quality even after very short exposure (Lorenzo-Romero et al., 2013), and website usability before and after use (Tuch et al., 2012). In a study by Reinecke and Bernstein (2011), users’ perception on classic as well as expressive aesthetics were improved with culturally adaptive user interfaces. It is therefore hypothesised that the classic as well as expressive aesthetics are likely to be perceived as higher for culturally adaptive web pages than for non-adapted web pages.

**H5:** Cultural factors, HCI factors, and website design interact to affect perceived classic aesthetics.
**H5a:** Users from Australia would have higher perceived classic aesthetics on Australian culturally specific website design as opposed to Chinese culturally specific website design.

**H5b:** Users from China would have higher perceived classic aesthetics on Chinese culturally specific website design as opposed to Australian culturally specific website design.

**H6:** Cultural factors, HCI factors, and website design interact to affect perceived expressive aesthetics.

**H6a:** Users from Australia would have higher perceived expressive aesthetics on Australian culturally specific website design as opposed to Chinese culturally specific website design.

**H6b:** Users from China would have higher perceived expressive aesthetics on Chinese culturally specific website design as opposed to Australian culturally specific website design.

Satisfaction is measured by user’s subjective comfort and acceptability of use (Nielsen, 1993), which is an important indicator for website success (Cui et al., 2015). Users have long exhibited high levels of user experience and satisfaction with their culturally specific website design (Cui et al., 2015; Hsieh, 2014; Reinecke & Bernstein, 2011). For example, Chinese users had high level of satisfaction with Chinese website design, than Western design (Cui et al., 2015; Fraternali & Tisi, 2008), and users from Saudi Arabia satisfied web pages that incorporate Saudi Arabian cultural preferences (Alyahyan et al., 2016). The users’ impact on trust, satisfaction, and ultimately loyalty for culturally specific website design has been studied by (Cyr, 2008) who found that the design characteristics should be a central consideration in website design across cultures. It is therefore hypothesised that users are likely to experience a higher level of satisfaction for culturally adaptive web pages than for non-adapted web pages.
H7: Cultural factors, HCI factors, and website design interact to affect satisfaction.

H7a: Users from Australia would have higher satisfaction on Australian culturally specific website designs as opposed to Chinese culturally specific websites.

H7b: Users from China would have higher satisfaction on Chinese culturally specific website designs as opposed to Australian culturally specific websites.

6.5 Methodology

To test the hypotheses, cross-cultural websites were developed for user testing. The previously described design guidelines were used to select candidates for Australian and Chinese websites to be used in the study. Each website was professionally translated so that English speaking Australian participants could complete tasks on Australian and Chinese designed web pages. Similarly, Chinese participants completed their tasks in Mandarin (Simplified Chinese).

This study used unmoderated, remote usability testing to measure website usability for different cultures. Remote usability testing allows large scale recruitment of participants, thereby reducing travel time and cost. It also allows for testing in a setting familiar to the user (Alharbi & Mayhew, 2015).

A web-based remote usability market research tool, Loop11 (2018b), was used to record participants interaction with testing websites. Participants were recruited using Cint (2018b). Prior to undertaking the real test, a pilot test was conducted to identify and fix any procedural problems, to finalize the manipulation, and refine the experimental procedure and instructions. Before starting the real user test, training was performed to familiarise participants with Loop11.

In the real user test, Australian designed and Chinese designed web pages were given in a random order. Participants were asked to evaluate each website one after another. Each participant was asked to complete four information-seeking tasks, followed by a questionnaire. Loop11 (2018b) automatically recorded participants’
behaviour and attitudinal data which was used to inform two main aspects: user performance and perception.

The task-based testing and the questionnaires were analysed to verify if the culturally specific websites affected task completion and/or the subjective perception of the user experience. This would confirm the relevance and need for website usability design guidelines base on cultural factors and HCI factors.

6.5.1 Selection of the testing websites

Existing Australian and Chinese government websites were chosen to represent Australian and Chinese cultures. Chinese websites designed in Simplified Chinese and Australian websites designed in English were considered. Prominent design elements, and cross-cultural design guidelines, were consulted to find websites that display Hofstede et al.’s (2010) and E. T. Hall and Hall’s (1990) cultural factors and HCI factors.

The Beijing Municipal Government Portal (2016) website and the Department of Finance - Western Australia (2016) websites were selected to represent Chinese and Australian cultures, respectively. These websites provide government services, policies, and programs. Therefore, it is believed that these websites contents are relevant reliable samples from the target cultures.

6.5.2 Translation

The experiment instructions were initially created in English for Australian participants. A professional translator was engaged to translate experimental instructions and Australian English web pages to Mandarin. This translator advised on any culturally sensitive wording as well as comparability and equivalence in meaning. The translator also translated the Chinese Mandarin web pages to English. Thus, two testing websites and the experiment instructions were translated. After the translation was complete, there were four websites and images of these websites are provided in Appendix F:

1) Australian version of website design in English, for Australian participants. This will be referred to as Australian participants in Australian website design (AU-AUWeb).
2) Australian version of website design in Mandarin, for Chinese participants. This will be referred to as Chinese participants in Australian website design (CN-AUWeb).

3) Chinese version of website design in English, for Australian participants. This will be referred to as Australian participants in Chinese website design (AU-CNWeb).

4) Chinese version of website design in Mandarin, for Chinese participants. This will be referred to as Chinese participants in Chinese website design (CN-CNWeb).

6.5.3 Unmoderated, remote usability testing

Traditional in-lab usability testing has long been the standard method for evaluating and improving the usability of software or web interfaces. In-lab testing, though effective, has its drawbacks such as unavailability of representative end-users, high testing costs, and the difficulty of reproducing a user’s everyday environment. To overcome these issues, various alternative usability evaluation methods have been developed over the past two decades. One of the most commonly used is the remote usability testing method.

Unmoderated or asynchronous remote usability testing, as the name implies, occurs remotely and without a moderator. This technique can evaluate website usability or quality by testing it on many users, simultaneously, in their natural environment. Participants of unmoderated remote testing are required to have a computer with Internet connectivity and a web browser. This technique is now a common approach to conduct usability testing (Alghamdi et al., 2013; Valencia et al., 2015). Commercial market research tools such as: Loop11 (2018b), OpenHallway (2018), Try My UI (2018), Userlytics (2018), UserTesting (2018), UserZoom (2018), Validately (2018), and WhatUsersDo (2018), are available to conduct unmoderated, remote usability testing with large-scale participants (Nngroup, 2014). Loop11 (2018b) supported this research by providing access to their platform and was the method used for this study.
The Loop11 software runs as a frame around the testing website, allowing the user to interact freely, completing tasks or questions on the website. The software records data about each user’s interactions, such as the number of clicks and page views as well as the time spent on each task. Interactions are captured, processed, and made available in real-time reports. Loop11 also allows a variety of tasks and question types to be integrated into the same study, and can be used to collect both quantitative and qualitative data. The training and the final test that integrate task-based user testing and questionnaire-based user testing are discussed below.

6.5.4 Task-based user testing

Task-based user testing is a direct testing technique designed to assess website usability (Fraternali & Tisi, 2008), and measures the actual user performance when accomplishing a task in a certain context (Cui et al., 2015). This study conducts task-based user testing based on the traditional principles of contextual inquiry (Beyer & Holtzblatt, 1997; Fraternali & Tisi, 2008), in which a number of information-seeking tasks are assigned to users to carry out on websites (Cui et al., 2015). To complete an information seeking task, a user must successfully navigate to a web page that contains some required information. All assigned information seeking tasks, involved in this study, are listed in Table 6-1. Participants were asked to perform these tasks without distraction including viewing web pages unrelated to the study.

Before starting the real user test, each participant was required to perform a 3-minute training exercise. This training was designed to familiarise participants with the Loop11 environment and to obtain demographic data including gender, age, education, Internet experience, and website development experiences. In the start of the training, all instructions and specific tasks were explained to participants by the Loop11 system. After obtaining demographic information, a training website, shown in Appendix E, was displayed. To complete the given training information seeking task, users needed to navigate through the website to the web page that the user believes best answers or completes the task. When the user has navigated to the page that contains the information for the task, they can select “Task Complete”. If user can’t find the page or are having difficulty, then they can select “Task Abandon”. Upon clicking “Task Complete” or “Task Abandon” the task is completed.
After completing the training, the final user test starts. One of the two website designs were presented to participants for evaluation. Four information-seeking tasks were given, sequentially to participants. Loop11 automatically recorded each participant’s performance in the websites. User performance including effectiveness, efficiency, and errors were measured. Effectiveness is measured using the percentage of users who complete the task correctly, efficiency is the average task completion time and errors are the average number of incorrect clicks.

Table 6-1: Information seeking tasks involved in this study

<table>
<thead>
<tr>
<th>Task name and its’ order</th>
<th>Australian website design</th>
<th>Chinese website design</th>
</tr>
</thead>
<tbody>
<tr>
<td>Training task</td>
<td>Using the given website, find the web page containing an office email address.</td>
<td>Using the given website, find the web page containing an office email address.</td>
</tr>
<tr>
<td>Task 1:</td>
<td>Suppose you want to obtain information regarding your day to day public utilities from the Public Utilities Office, but you are not aware of the weekday opening times of the office. Using the given website, find the web page that contains information regarding weekday (Monday to Friday) opening hours of the Public Utilities Office.</td>
<td>Suppose you want to obtain information regarding your day to day public utilities from the Operation Management Centre, but you are not aware of the office’s postal address. Using the given website, find the web page that contains information regarding postal address of the Operation Management Centre.</td>
</tr>
<tr>
<td>Task 2:</td>
<td>Suppose you have purchased land in the city and need to obtain a land tax payment options. Using the given website, find out the number of available payment options to pay your private land tax.</td>
<td>Suppose, as a legal and single person, you have to obtain approval for deferred tax payment. Using the given website, find the guideline information including the “application conditions” and ‘commitment period’ for the taxpayer’s deferred tax payment approval.</td>
</tr>
<tr>
<td>Task 3:</td>
<td>Suppose you want to obtain information regarding your residential electricity. Using the given website, find the electricity prices/charges per unit for the Tariff A1 – residential electricity.</td>
<td>Suppose you want to obtain information regarding Beijing’s residential electricity tariff. Using the given website, find the electricity prices in Yuan/kWh for the Tier 1 of the Stepped Tariff Trial.</td>
</tr>
<tr>
<td>Task 4:</td>
<td>Suppose you want to obtain some information from the Department of Housing website. While, browsing the current website, get the external web page of the Department of Housing website.</td>
<td>Suppose you want to obtain some information from the “Fengtai District” website. While, browsing the current website, get the external web page of the Fengtai District</td>
</tr>
</tbody>
</table>
Following the information seeking tasks, participants were asked to complete the online questionnaire. This questionnaire, which measures quantitative perceptions, is detailed in the next section.

6.5.5 Questionnaire based user testing

Questionnaire based user testing is one of the indirect testing techniques designed to assess website usability (De-Marsico & Levialdi, 2004), and is valuable to measure a user’s subjective perception of usability attributes. Since questionnaires are well-established, it is easy to find questions, suggestions, and references used to construct new questionnaire questions (Cui et al., 2015).

A research questionnaire containing a list of evaluation questions to measure subjective assessments was developed. Subjective assessments are required to assess users’ perception of “perceived navigability”, “perceived aesthetics”, and “satisfaction.” The questionnaire consisted of 22 questions. All questions used a 7-point Likert scale, with 1 indicating “strongly disagree” and 7 indicating “strongly agree.”

A minimum of three variables per attributes, as suggested by P. Kline (1993), are required to measure each of the attributes. Perceived navigability was measured with five items adapted from Palmer (2002), and McKinney et al. (2002), and these items were also used in recent research from (Cui et al., 2015). To measure a user’s overall satisfaction, a website to use, six item scale of satisfaction was adopted from Palmer (2002) and McKinney et al. (2002). All the questionnaire item scale questionnaire components are presented in Table 6-2.

Two levels of aesthetics were identified including classic as well as expressive aesthetics, based on prior studies. Perceived classic aesthetics and perceived expressive aesthetics measured with six and five items respectively, adapted from Lavie and Tractinsky (2004). To measure a user’s overall satisfaction, a website to use, six item scale of satisfaction was adopted from Palmer (2002) and McKinney et al. (2002). All the questionnaire item scale questionnaire components are presented in Table 6-2.
During the data collection in the final study, two participants, mentioned that the questionnaire question “PN2: The website provides few clicks to locate information,” was confusing and subsequently the values are presented in the table but were not included in the statistical analysis.

Table 6-2: Items of the questionnaire

<table>
<thead>
<tr>
<th>Attributes</th>
<th>Item Scale Description</th>
<th>Source of Items</th>
</tr>
</thead>
<tbody>
<tr>
<td>Perceived</td>
<td>(1-7 Likert scale, 1=Strongly disagree, 7=Strongly agree)</td>
<td></td>
</tr>
<tr>
<td>Navigability (PN)</td>
<td>PN1: The website provides clear description for links to locate information.</td>
<td>Palmer (2002), and McKinney et al. (2002).</td>
</tr>
<tr>
<td></td>
<td>PN2: The website provides few clicks to locate information.</td>
<td></td>
</tr>
<tr>
<td></td>
<td>PN3: The website provides adequate links</td>
<td></td>
</tr>
<tr>
<td></td>
<td>PN4: The website is easy to go back and forth between pages.</td>
<td></td>
</tr>
<tr>
<td></td>
<td>PN5: In general, the website is easy to navigate.</td>
<td></td>
</tr>
<tr>
<td>Perceived</td>
<td>(1-7 Likert scale, 1=Strongly disagree, 7=Strongly agree)</td>
<td></td>
</tr>
<tr>
<td>aesthetics (PA)</td>
<td>Classic aesthetics</td>
<td></td>
</tr>
<tr>
<td></td>
<td>CA1: Overall, I am satisfied with the appearance of this website design</td>
<td></td>
</tr>
<tr>
<td></td>
<td>CA2: I feel the design of this website is aesthetic</td>
<td></td>
</tr>
<tr>
<td></td>
<td>CA3: I feel the design of this website is pleasant</td>
<td></td>
</tr>
<tr>
<td></td>
<td>CA4: I feel the design of this website is clear</td>
<td></td>
</tr>
<tr>
<td></td>
<td>CA5: I feel the design of this website is clean</td>
<td></td>
</tr>
<tr>
<td></td>
<td>CA6: I feel the design of this website is systematic</td>
<td></td>
</tr>
<tr>
<td></td>
<td>Expressive aesthetics</td>
<td></td>
</tr>
<tr>
<td></td>
<td>EA7: I feel the design of this website is creative</td>
<td></td>
</tr>
<tr>
<td></td>
<td>EA8: I feel the design of this website is fascinating</td>
<td></td>
</tr>
<tr>
<td></td>
<td>EA9: I feel the design of this website uses special effects</td>
<td></td>
</tr>
<tr>
<td></td>
<td>EA10: I feel the design of this website is original</td>
<td></td>
</tr>
<tr>
<td></td>
<td>EA11: I feel the design of this website is sophisticated</td>
<td></td>
</tr>
<tr>
<td>Satisfaction</td>
<td>(1-7 Likert scale, 1=Strongly disagree, 7=Strongly agree)</td>
<td></td>
</tr>
<tr>
<td>(SA)</td>
<td>SA1: In general, I am satisfied with the design of the website.</td>
<td></td>
</tr>
<tr>
<td></td>
<td>SA2: In general, the browsing experience that I have had with the website was satisfactory.</td>
<td></td>
</tr>
<tr>
<td></td>
<td>SA3: Using the website made me frustrated. (Reverse coding)</td>
<td></td>
</tr>
<tr>
<td></td>
<td>SA4: I feel terrible when using the website. (Reverse coding)</td>
<td></td>
</tr>
<tr>
<td></td>
<td>SA5: After using the design, I will never recommend it to my friends. (Reverse coding)</td>
<td></td>
</tr>
<tr>
<td></td>
<td>SA6: After using the website, I never to use this website again. (Reverse coding)</td>
<td></td>
</tr>
</tbody>
</table>

S. Lee and Koubek (2010), and Lavie and Tractinsky (2004).
6.5.6 Participants

The study obtained large-scale quantitative data, through remote usability testing with Australian and Chinese participants. All Australian participants were native English speakers living in Australia. Similarly, the Chinese participants were native Mandarin speakers living in China. Prior work was reviewed to find a suitable sampling approach and the number of required participants.

Prior work, comparing two website designs, used either “within subjects” or “between subjects” techniques, in traditional laboratory settings. Studies that used the same participants on both designs, within subjects, recruited smaller numbers of 15 or 10 participants per culture, Hsieh (2014) and Fraternali and Tisi (2008), respectively. Using different participants on each design, a between subjects technique, Cui et al. (2015) recruited 63 participants per culture. The current study used a between subject approach. This aimed to reduce the overall survey time compared to a within-subjects design to reduce participant fatigue and minimise the dropout rate (Liana, 2013).

Prior work was also reviewed to determine the number of participants. Between subject, unmoderated usability testing is likely to find statistical significance with comparisons of two website designs requires how big of a difference wants to detect (Sauro, 2014). The size of the difference will give a better idea about the practical significance and impact of the statistical result. Usually with sample sizes less than about 30 (15 in each group), they are limited to seeing big effects - big differences in usability attributes; it doesn’t expect to detect small effects. The ability to detect a difference is like the confidence level for detecting a difference if one exists. This is usually set to 80% (Sauro, 2015), with this, the minimum number of participants to see small, medium, and large effects are 226, 36, and 14, per culture, respectively. This study expected to see more than the medium effects and obtained usable responses from 212 participants, 6 for pilot and 100 for final study, per culture.

To recruit participants from their natural locations and to obtain large-scale data, Cint (2018b) was used as a recruitment platform to recruit Australian and Chinese participants, from Australian and China, respectively. Cint (2018b) is a panel company specializing in providing participants for survey, based on basic demographic criteria,
such as Language, Country, Region, Gender, Age Range, Education Level, and Occupation. Cint (2018b) currently has access to 50,000,000 registered respondents recruited from over 1500 unique panels, from more than 80 countries (Cint, 2018a).

Cint (2018b) is also technically integrated with Loop11 (2018b) and can validate whether participants were using desktop computers (Loop11, 2018a). Cint also ensures data quality by using various data control measures. Researchers can provide participant IDs of those who have not made a serious attempt for any reason. Those participants, flagged in Cint’s system, are not recorded as a complete and more data is gathered until the desired target number of useful responses is obtained.

### 6.5.7 Participant recruiting process

Participants were recruited by email from the Cint survey panels. The email contained a survey link with the survey instructions as well as consent form. Participants were paid upon successful submission of the final survey.

Prior to commencement of the recruiting process, ethics approval was sought and obtained from the Murdoch University Human Research Ethics Committee. The current study was reviewed and approved with permit number 2016/140. A copy of the permit renewal letter is provided in Appendix B. The next chapter details the results and analysis of the empirical evaluation of the cross-cultural web usability.
Chapter 7. Results and data analysis of the cross-cultural web usability test

7.1 Overview

Chapter 6 detailed the testing environment for the empirical evaluation and developed a model for its validation. This chapter describes the data analysis for the empirical evaluation of the developed model. The data preparation is first presented, followed by results, analysis, discussion, and conclusion.

7.2 Data preparation and analysis

The pilot test was conducted over two days from 3/07/17 to 5/07/17. Minor changes, suggested by the survey panel, were made to the survey instructions. The final test was conducted for two weeks from 7/07/17 to 21/7/17. Initially, quotas were set for each of the user tests, three for pilot, and 50 for final test. When the quota reached the target for a batch, data screening was undertaken to filter completions; this is to ensure that participants had made a reasonable attempt to complete all tasks and ensure data quality. The data screening process was discussed below.

When the results were ready in Loop11’s reporting dashboard, it was possible to note the success, failure, or abandon rate of each task. Loop11’s session videos and real-time reports were used to monitor participants’ active cursor movements and clicks on each task to filter useful responses. It was identified that participants who made a reasonable attempt to complete all tasks, spent greater than 130 seconds and less than 1500 seconds on each task. Therefore, this condition was set and referred as “condition to filter useful responses” for both pilot and final tests. The following data screening rules were applied in sequential order to filter useful responses from the recorded responses.

Partially completed surveys were considered incomplete and removed. Of the complete responses, the above mentioned “condition to filter useful responses” was applied to filter useful responses. After filtering useful responses from a batch, Survey’s quotas were readjusted, iteratively, to obtain sufficient complete responses. The numbers involved in the data screening process are detailed in Table 7-1.
Table 7-1: Data screening process to filter useful completes

<table>
<thead>
<tr>
<th>Responses</th>
<th>Australian participants</th>
<th>Chinese participants</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Australian website design</td>
<td>Chinese website design</td>
</tr>
<tr>
<td>Total responses recorded in Loop11</td>
<td>219</td>
<td>210</td>
</tr>
<tr>
<td>Incompletes</td>
<td>82</td>
<td>71</td>
</tr>
<tr>
<td>Completes</td>
<td>137</td>
<td>139</td>
</tr>
<tr>
<td>Useful completes for Pilot and Final test</td>
<td>53</td>
<td>53</td>
</tr>
<tr>
<td>Final test sample size</td>
<td>50</td>
<td>50</td>
</tr>
</tbody>
</table>

Among the four user tests, three of the user tests reached the target within a week. The user test “Chinese participants in Australian website: CN-AUWeb” required another week to reach the target. As can be seen in Table 7-1, the dropout rate was much larger: of the 513 total responses, 317 were incomplete. The reason was that Chinese participants often left the survey with partial involvement in one or two of the tasks. Perhaps Chinese participants faced difficulties finding information for tasks in the Australian design and this may have been the first indication of the cultural effect on website use.

7.3 Results and analysis

A total of 200 valid responses, 100 from Australia and 100 from China, were obtained. The demographic profile of the respondent pool is presented in Table 7-2. The Chinese participants were relatively young, male, and had degrees, which was roughly consistent with the Chinese Internet user population reported by China Internet Network Information Center (2017). Most Chinese participants, 76%, were aged between 18 and 34. The male-to-female ratio was 59:41, and 90% were educated with at least a Bachelor's, Master's, or higher degree. Also, 96% of Chinese participants had been using the Internet for more than 5 years, and 83% were not professional web developers.

Most Australian participants were middle aged, female, and their level of education were high school graduate or trade/technical/vocational training. Over 56% were aged 45-65, the female-to-male ratio was 65:35, and 68% were high school graduate or had trade/technical/vocational training. Also, 98% of Australian participants had been
using the Internet for more than 5 years, and 97% were not professional web developers.

Table 7-2: Demographic profile of survey respondents

<table>
<thead>
<tr>
<th>Category</th>
<th>Frequency for user tests (n=50)</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Australian participants</td>
</tr>
<tr>
<td></td>
<td>Australian website design</td>
</tr>
<tr>
<td>Gender</td>
<td>Australian website design</td>
</tr>
<tr>
<td>Male</td>
<td>15</td>
</tr>
<tr>
<td>Female</td>
<td>35</td>
</tr>
<tr>
<td>Age</td>
<td>18-24</td>
</tr>
<tr>
<td></td>
<td>25-34</td>
</tr>
<tr>
<td></td>
<td>35-44</td>
</tr>
<tr>
<td></td>
<td>45-54</td>
</tr>
<tr>
<td></td>
<td>55+</td>
</tr>
<tr>
<td>Internet usage</td>
<td>1-5 years</td>
</tr>
<tr>
<td></td>
<td>5-10 years</td>
</tr>
<tr>
<td></td>
<td>10 years or more</td>
</tr>
<tr>
<td>Level of school</td>
<td>No schooling completed</td>
</tr>
<tr>
<td></td>
<td>High school graduate</td>
</tr>
<tr>
<td></td>
<td>Trade/ technical/</td>
</tr>
<tr>
<td></td>
<td>vocational training</td>
</tr>
<tr>
<td></td>
<td>Bachelor's degree</td>
</tr>
<tr>
<td></td>
<td>Master's degree or</td>
</tr>
<tr>
<td></td>
<td>higher</td>
</tr>
<tr>
<td>Professional web developer</td>
<td>Yes</td>
</tr>
<tr>
<td></td>
<td>No</td>
</tr>
<tr>
<td>Completion of training task</td>
<td>Success</td>
</tr>
<tr>
<td></td>
<td>Fail</td>
</tr>
<tr>
<td></td>
<td>Abandon</td>
</tr>
<tr>
<td></td>
<td>Average page views</td>
</tr>
<tr>
<td></td>
<td>Average time</td>
</tr>
</tbody>
</table>

The training helped familiarise participants with the test environment and the results are rather interesting. Australian participants’ success rate, number of page views, and time spent to complete the “training task” was higher than Chinese participants. In this training task, on average, 42% of Australian participants viewed an average of 2.85 pages, as well as clocking in at 64.1 seconds. Chinese participants had a lower success rate, 13%, viewing an average of 2.7 pages and completing in 50.7 seconds. Some of the participants may have previously used a test environment similar to Loop11 and therefore this training data is not used to explore differences between cultures.
The data was divided between performance attributes and perception attributes. Data on the performance attributes were numerically, graphically, and statistically analysed. Loop11’s included metrics, heatmaps, and clickstream reports were used for numerical and graphical analysis. Statistical tests were conducted to identify whether differences in the performance attributes were significant, to evaluate hypotheses H1a, H1b, H2a, H2b, H3a, and H3b. For statistical tests on performance attributes, Australian participants in the Australian website (AU-AUWeb) were compared with Chinese participants in the Australian website (CN-AUWeb), and Australian participants in the Chinese website (AU-CNWeb) were compared with Chinese participants in the Chinese website (CN-CNWeb). The performance analysis is detailed in section 7.3.1.

Hypotheses H4a, H4b, H5a, H5b, H6a, and H6b investigated user perception. Australian user perceptions were compared between Australian website and Chinese design. Similarly, Chinese user perceptions were compared between Australian website and Chinese design. The perception analysis is detailed in section 7.3.2. All statistical analysis was conducted using SPSS Version 22, and an alpha level of 0.05 was used for all statistical tests.

7.3.1 Performance attributes

The performance attributes in this study were effectiveness, errors, and efficiency. They were numerically, graphically, and statistically analysed. Metrics such as task completion rate, average page views per task, and average time on task were used to numerically analyse effectiveness, errors, and efficiency, respectively. Heatmaps were analysed task by task to identify attempts to click on elements such as links, images, text, or dead space on the homepage.

Clickstream reports were used to graphically analyse participants’ journeys through the website, as well as the path they took before abandoning or failing a task. Each task’s clickstream report was obtained for all connections with 5 web pages. Task navigation paths were analysed for up to 7 web pages from the homepage. This included more than 75% task completion rates.
To conduct statistical tests to evaluate the H1a, H1b, H2a, H2b, H3a, and H3b, data regarding successful tasks was considered. This is because for failed or abandoned tasks, the number of page view and time on task may be lower than those that were successful. Therefore, user performance measures will be more valid, if the successful tasks values were considered (Darem, 2013). Dependent variables including success-on-task, page-view-on-task-success, and time-on-task-success were defined, to evaluate effectiveness, efficiency, and errors, respectively.

To test the hypothesis H1a and H1b, a series of Chi-square tests for association was conducted between culture and website design for each success-on-task of the task.

Chi-square tests for association are used to determine whether there is a relationship between two categorical variables, by examining deviations of observed frequencies from expected frequencies in categories (S. M. Lynch, 2013). Since, page-view-on-task-success and time-on-task-success were continuous variables and the data did not meet the assumption of normality, associated to culture and website design as assessed by Shapiro-Wilk's test (p > .05), the use of independent sample t-tests was not appropriate to test hypotheses H2a, H2b, and H3a, H3b. Therefore, the alternative rank-based non-parametric Mann-Whitney U test (Mann & Whitney, 1947) was used. The Mann-Whitney U test evaluates whether two independent samples are likely to derive from the same population and does not require the assumption of normal distributions.

**Effectiveness**

Effectiveness refers to user success rate (Nielsen, 2001). Therefore, task completion rate and clickstream reports were employed to numerically and graphically analyse successful, failed and abandoned task rates between cultures. This was first discussed, followed by a statistical test that evaluates the H1a and H1b.

Task success rate was higher in the culturally specific website design. Average task completion rate reports, in Figure 7-1 and 7-2, were employed to analyse task completion rates between cultures. The success rates of Australian participants was higher in the Australian website (53%) than the Chinese websites (47%). The success
rates of Chinese participants was higher in the Chinese website (57%) than the Australian website (31%).

![Australian participants in Australian design (AU-AUWeb)](image1)

![Chinese participants in Australian design (CN-AUWeb)](image2)

**Figure 7-1: Average task completion rate in Australian website design, between cultures**

![Australian participants in Chinese design (AU-CNWeb)](image3)

![Chinese participants in Chinese design (CN-CNWeb)](image4)

**Figure 7-2: Average task completion rate in Chinese website design, between cultures**

Among the four tasks, the number of successful completed tasks, for any three tasks, was compared. Table 7-3 shows the number of task successes between cultures. Australian participants’ task success rate, for any three tasks rose from 13 in the Chinese website to 21 in Australian website. Similarly, Chinese participants task success rate, for any three tasks, rose from 9 in Australian websites to 20 in Chinese websites.

Importantly, all Australian participants successfully completed at least one task in both Australian and Chinese websites. All Chinese participants successfully completed at least one task in the Chinese website; however, 32% of Chinese participants did not successfully complete any of the tasks in the Australian website. Perhaps the
Australian website design was confusing for Chinese participants in their information search, increasing the number of failed tasks (58%) and abandoned tasks (11%) in the Australian website, as noted previously.

Table 7-3: Number of task success for user test

<table>
<thead>
<tr>
<th>Source</th>
<th>Participants N = 50 for each user test</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Australian participants</td>
</tr>
<tr>
<td>Australian website design</td>
<td>Australian website Design</td>
</tr>
<tr>
<td>Number of participants who success in all 4 tasks</td>
<td>3</td>
</tr>
<tr>
<td>Number of participants who success in any 3 tasks</td>
<td>18</td>
</tr>
<tr>
<td>Number of participants who success in any 2 tasks</td>
<td>12</td>
</tr>
<tr>
<td>Number of participants who success in any 1 task</td>
<td>17</td>
</tr>
<tr>
<td>Number of participants who do not success in any of the 4 tasks</td>
<td>0</td>
</tr>
<tr>
<td>Total number of task success</td>
<td>107</td>
</tr>
</tbody>
</table>

The fail and abandoned task rates dropped in the culturally specific website design. As can be seen in Figure 7.2, Chinese participants, that failed all tasks, was higher in the Australian website design (58%) than the Chinese design (40%). Furthermore, 25% of Australian participants believed they had successfully completed a task in the Chinese website when they had failed. This number dropped to 16% in the Australian website, as can be seen in Figure 7.1.

For the participants that abandoned all tasks, the differences were small, 28% in the Chinese website and 31% in the Australian website. The Chinese participants who abandoned all tasks displayed differences between the websites. A higher percentage, 11%, of Chinese participants gave up and abandoned tasks in the Australian website compared with only 3% abandoning tasks on the Chinese website. These results also suggest that there may be some differences in the performance of the groups, associated with website design.

Task result overviews, shown in Figure 7-3 to 7-6, show the average page views and average time taken to reach a resolution for each task. They were employed to analyse individual tasks to identify any similar pattern that exists within or between cultures.
Figure 7-3: Task results for Australian participants in Australian website design

Figure 7-4 and 7-6 show that three tasks performed by Chinese participants had similar patterns, in which the abandon task rate was 0%. These tasks were: Task 2 in Australian design; Tasks 1 and 4 in Chinese website. Clickstream reports were analysed for the Chinese and Australian participants’ success and abandon task rates. It was revealed that, an average of 32% and 39% of Australian and Chinese participants, respectively, went directly to the success page from the homepage. Australian participants have an average of 11% abandon task rate, while Chinese participants had 0% abandon task rate. Results suggest that displaying hyperlink(s) in homepage provide clear direction to finish task with fewer clicks. This navigation freedom helps Chinese participants not to get confuse to finish task (Heimgärtner, 2013). The raw clickstream reports are available in Appendix G.
The deep hierarchies of Australian websites may be less intuitive for Chinese participants. Tasks 3 and 4 evaluated the effect of culture on deep hierarchy of content, in which the successful content was placed at lower levels, 3 levels down, of the site hierarchy. As can be seen in Figure 7-3 and 7-4, an average of only 19% of Chinese participants successfully completed a task, while an average of 67% of Chinese participants believed they had successfully completed a task in the Australian website when they had failed. However, an average of 36% of Australian participants successfully completed a task, with only a 19% task fail rate.

In the deep navigation structure, displaying intermediate category hyperlinks in the homepage of the Australian website appeared to be helpful for Australians and
Chinese participants. To evaluate Task 2 in the Australian design, three similar labelled hyperlinks were placed. They were in the main menu, “Popular Page” section, and the Fat Footer, of the homepage. These hyperlinks act as shortcuts that lead directly to lower level of the same page. Given that Task 2 had higher success rates with both Australian and Chinese participants, 80% of Australian and 50% of Chinese participants successfully completed Task 2 in the Australian website design, displaying intermediate category pages, this may be a useful cross-cultural feature.

The navigation to external websites was evaluated with the Task 3 in the Chinese website. As can be seen in Figure 7-5 and 7-6, Chinese participants had greater success with 46% completing the task correctly and a lower, 8%, abandon rate. However, Australian participants had only 24% success rate, with a higher (54%) abandon rate. Results suggest that Australian participants had difficulty finding links to external web pages and they missed content.

Chi-square tests for association were employed to test the hypotheses H1a that predicts Australian participants would have a higher effectiveness on Australian websites than Chinese website, and H1b that predicts Chinese participants would have a higher effectiveness on Chinese website than Australian website. The binary dependent variable “success-on-task” was assigned a value either 1, for success, or 0, for fail or abandon.

All tasks expected cell frequencies were greater than five. As can be seen from Table 7-4, the majority of tasks had a statistically significant association between the culture and website design in terms of success-on-task. They are discussed below.

It was proposed that Australian participants would have a higher task success in Australian website design as opposed to Chinese website design, and this was found to be true. In the Australian website, Task 4 did not provide a statistically significant association between the culture and website design in terms of success-on-task ($\chi^2(1) = 3.409, p = .065$). However, all other tasks including Task 1 ($\chi^2(1) = 5.760, p = .016$), Task 2 ($\chi^2(1) = 9.890, p = .002$), and Task 3 ($\chi^2(1) = 4.937, p = .026$) demonstrated a statistically significant association between culture and website design in terms of
success-on-task. These results suggest that Australian websites favour Australian users to successfully complete most tasks. H1a was, therefore, supported.

Table 7-4: Chi-square comparisons for success-on-tasks

<table>
<thead>
<tr>
<th>Task</th>
<th>Australian participants</th>
<th>Chinese participants</th>
<th>Deg. of freedom</th>
<th>Chi-square</th>
<th>Sig.level</th>
</tr>
</thead>
<tbody>
<tr>
<td>Task 1</td>
<td>31</td>
<td>19</td>
<td>1</td>
<td>5.760</td>
<td>.016</td>
</tr>
<tr>
<td>Task 2</td>
<td>40</td>
<td>25</td>
<td>1</td>
<td>9.890</td>
<td>.002</td>
</tr>
<tr>
<td>Task 3</td>
<td>27</td>
<td>16</td>
<td>1</td>
<td>4.937</td>
<td>.026</td>
</tr>
<tr>
<td>Task 4</td>
<td>9</td>
<td>3</td>
<td>1</td>
<td>3.409</td>
<td>.065</td>
</tr>
</tbody>
</table>

It was also proposed that Chinese participants would have a higher task success in Chinese website design as opposed to Australian website design. In the Chinese website, Task 1 provided a statistically significant association between culture and website design in terms of success-on-task ($\chi^2(1) = 5.844, p = .016$) favour to Australian participants, and Task 2 did not provide a statistically significant association between culture and website design in terms of success-on-task ($\chi^2(1) = 2.627, p = .105$); however, Task 3 ($\chi^2(1) = 5.319, p = .021$) and Task 4 ($\chi^2(1) = 9.013, p = .003$) demonstrated a statistically significant association between culture and website design in terms of success-on-task. These results suggest that Chinese websites favour Chinese participants to successfully complete the majority of tasks. H1b was, therefore, supported.

Errors

The amount of web pages viewed to succeed in a task was used to measure errors. Viewing fewer web pages, prior to successful completion, gives fewer errors. The Loop11’s included metric average page views per task, heatmaps, and clickstream reports were used to numerically and graphically analyse page views between cultures. This was first discussed, followed by statistical test that evaluates H2a and H2b.
As can be seen from Figure 7-3 and 7-6, Australian participants viewed an average of 3.5 pages, to complete a task in the Chinese website, which increased slightly to 3.9 pages per task in the Australian website. Chinese website’s flatter hierarchy with more categories at each level led to Australian participants viewing slightly fewer pages to complete tasks in the Chinese website. Chinese participants viewed 4.3 pages per task in the Australian website; this dropped to 4.1 pages per task in the Chinese website. These results suggest that maximising information strategy will reduce number of page views to complete tasks.

Deep content, requiring participants to click through many levels to get to specific content, was evaluated in Task 3 in the Australian website. To succeed in a task, participants were required to navigate through a minimum of 3 pages to reach the successful URL. Clickstream reports revealed that, 40% of Australian participants and only 10% of Chinese participants successfully completed the task by viewing 5 or fewer pages pages less than or equal to 5. Also, with the page views less than or equal to 5, abandon task rate of Chinese participants (52%) was higher than Australian participants (14%). Results suggest that during deep navigation tasks, Chinese participants were more likely to abandon the task.

Evident in the heatmaps for each task, in Figure 7-7 and Figure 7-8, the majority of Australian participants’ clicks were on text hyperlinks located in main menu or Fat Footer, where major categories are located. However, the Chinese participants’ clicks were found all around the homepages and included clicks on different elements including blank space, images, text, and links. Since, mouse and eye movement follow very similar rhythms and focus in on the same page content (Chen et al., 2001; Clicktale, 2010), Chinese participants may scan the whole page to gain an overall picture of the website and process information as partial “imagers” by partially thinking in images. However, Australians participant’s attention may be directed to the main menu to gain an overall picture of the website (Dong & Lee, 2008) and react as “verbalizers” by processing information by thinking in words.
Figure 7-7: Heatmap of Task 1 for Australians in Australian website design
Figure 7-8: Heatmap of Task 1 for Chinese in Australian website design
Density of the clicks were analysed between cultures, using the heatmaps and the clickstream reports. As can be seen from heatmaps, Australian participants’ click density was high in Australian website, while Chinese participants’ click density was high in Chinese website. For all tasks, clickstream reports for Australian websites were further analysed for connection thickness between homepage and the first web page view. In all tasks, the connection thickness for “other” web pages was thicker for Chinese participants. These results suggest that Chinese participants followed a non-linear navigation pattern and Australian participants followed a linear navigation pattern in Australian websites.

Clickstream reports for Chinese website were also analysed. The first task’s (Task 1) connection thickness for “other” web pages was thinner for Australian participants than Chinese. Results suggest that Australian participants had a linear navigation pattern, for the first task; after with a moderately linear navigation pattern, for the rest of the tasks. Chinese participants had non-linear navigation patterns for Chinese website as well as for the previously described Australian website.

The number of clicks were analysed between cultures, using heatmaps. The numbers of clicks recorded in the heatmaps were presented in Table 7-5 and it was revealed that, Australian participants made fewer total clicks in both homepages. Chinese participants made fewer total clicks in the Australian homepage than the Chinese homepage. Results suggest that the low information density used in Australian homepage reduced the number of clicks from Australian and Chinese participants.

H2a hypothesised that Australian users would have fewer errors on the Australian website than the Chinese website. H2b predicted that the Chinese users would have fewer errors on Chinese website than the Australian website. Task success values were transformed to dependent variable “page-view-on-task-success,” and the Table 7-6 provides descriptive information about page-view-on-task-success.

Visual inspection was conducted on a population pyramid histogram, shown in Figure 7-9 to 7-16, to determine whether the distribution of each task’s page-view-on-task-success scores were similar or dissimilar. The Australian website Task 2’s distributions for Australian and Chinese participants were dissimilar; therefore, mean range of each
distribution of scores were used to report the results. For all other tasks’, median was used to report the results.

**Table 7-5: Number of clicks between cultures and website design**

<table>
<thead>
<tr>
<th>Tasks</th>
<th>Number of clicks made by Australian participants</th>
<th>Number of clicks made by Chinese participants</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Clicks on visible elements</td>
<td>Clicks on non-visible elements</td>
</tr>
<tr>
<td>In Australian website design</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Task 1</td>
<td>49</td>
<td>16</td>
</tr>
<tr>
<td>Task 2</td>
<td>50</td>
<td>13</td>
</tr>
<tr>
<td>Task 3</td>
<td>44</td>
<td>20</td>
</tr>
<tr>
<td>Task 4</td>
<td>47</td>
<td>16</td>
</tr>
<tr>
<td>Total</td>
<td>190</td>
<td>65</td>
</tr>
<tr>
<td>In Chinese website design</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Task 1</td>
<td>101</td>
<td>0</td>
</tr>
<tr>
<td>Task 2</td>
<td>107</td>
<td>0</td>
</tr>
<tr>
<td>Task 3</td>
<td>142</td>
<td>1</td>
</tr>
<tr>
<td>Task 4</td>
<td>103</td>
<td>33</td>
</tr>
<tr>
<td>Total</td>
<td>453</td>
<td>34</td>
</tr>
</tbody>
</table>

**Table 7-6: Descriptive table for page-view-on-task-success**

<table>
<thead>
<tr>
<th>Task</th>
<th>User Test</th>
<th>Mean</th>
<th>Median</th>
<th>Std. Deviation</th>
<th>Skewness</th>
<th>Kurtosis</th>
</tr>
</thead>
<tbody>
<tr>
<td>Task 1</td>
<td>AU-AU Web</td>
<td>3.48</td>
<td>3.00</td>
<td>1.546</td>
<td>1.246</td>
<td>0.621</td>
</tr>
<tr>
<td></td>
<td>AU-CN Web</td>
<td>2.76</td>
<td>2.00</td>
<td>1.986</td>
<td>4.442</td>
<td>22.467</td>
</tr>
<tr>
<td></td>
<td>CN-AU Web</td>
<td>5.11</td>
<td>4.00</td>
<td>4.162</td>
<td>2.682</td>
<td>9.361</td>
</tr>
<tr>
<td></td>
<td>CN-CN Web</td>
<td>3.18</td>
<td>2.00</td>
<td>2.519</td>
<td>2.605</td>
<td>7.037</td>
</tr>
<tr>
<td>Task 2</td>
<td>AU-AU Web</td>
<td>3.60</td>
<td>3.00</td>
<td>0.982</td>
<td>1.074</td>
<td>2.391</td>
</tr>
<tr>
<td></td>
<td>AU-CN Web</td>
<td>5.00</td>
<td>4.00</td>
<td>2.525</td>
<td>1.320</td>
<td>.659</td>
</tr>
<tr>
<td></td>
<td>CN-AU Web</td>
<td>3.32</td>
<td>3.00</td>
<td>1.796</td>
<td>1.726</td>
<td>2.947</td>
</tr>
<tr>
<td></td>
<td>CN-CN Web</td>
<td>5.12</td>
<td>4.00</td>
<td>2.403</td>
<td>0.630</td>
<td>-1.204</td>
</tr>
<tr>
<td>Task 3</td>
<td>AU-AU Web</td>
<td>5.15</td>
<td>5.00</td>
<td>1.379</td>
<td>0.380</td>
<td>-0.249</td>
</tr>
<tr>
<td></td>
<td>AU-CN Web</td>
<td>8.17</td>
<td>6.50</td>
<td>5.781</td>
<td>1.042</td>
<td>0.511</td>
</tr>
<tr>
<td></td>
<td>CN-AU Web</td>
<td>6.75</td>
<td>5.50</td>
<td>4.640</td>
<td>1.724</td>
<td>3.594</td>
</tr>
<tr>
<td></td>
<td>CN-CN Web</td>
<td>8.26</td>
<td>6.00</td>
<td>8.142</td>
<td>3.529</td>
<td>14.304</td>
</tr>
<tr>
<td>Task 4</td>
<td>AU-AU Web</td>
<td>4.78</td>
<td>4.00</td>
<td>2.279</td>
<td>1.165</td>
<td>0.054</td>
</tr>
<tr>
<td></td>
<td>AU-CN Web</td>
<td>2.61</td>
<td>2.00</td>
<td>1.383</td>
<td>3.672</td>
<td>15.654</td>
</tr>
<tr>
<td></td>
<td>CN-AU Web</td>
<td>5.33</td>
<td>4.00</td>
<td>2.309</td>
<td>1.732</td>
<td>Nil</td>
</tr>
<tr>
<td></td>
<td>CN-CN Web</td>
<td>2.39</td>
<td>2.00</td>
<td>0.754</td>
<td>2.284</td>
<td>5.235</td>
</tr>
</tbody>
</table>
Figure 7-9: Task 1 successes page views in Australian website design between cultures

Figure 7-10: Task 2 successes page views in Australian website design between cultures

Figure 7-11: Task 3 successes page views in Australian website design between cultures

Figure 7-12: Task 4 successes page views in Australian website design between cultures
Task 1, 3, and 4’s median page-view-on-task-success scores for Australian participants (3, 5, and 4) and Chinese participants (4, 5, and 4) in Australian website were not
statistically significantly different, \((U = 364, z = 1.432, p = .152, U = 246, z = 0.765, p = .444, \) and \(U = 16.5, z = 0.571, p = .568\), respectively. Task 2’s page-view-on-task-success scores for Australian participants (mean rank = 37.22) was statistically significantly higher than Chinese participants (mean rank = 26.24), \(U = 331, z = -2.390, p = .017\). This data is summarised in Table 7.7. Displaying a “one-click web link” that leads directly to lower level hierarchy minimised the number of page views for Chinese participants. Since none of the tasks in the Australian website provided a statistically significant result to favour Australian users, H2a, which proposed that Australian participants would have fewer errors on the Australian website than the Chinese website, was not supported.

Table 7.7: Mann-Whitney U test table for page-view-on-task-success

<table>
<thead>
<tr>
<th>Task</th>
<th>Australian participants</th>
<th>Chinese participants</th>
<th>Mann-Whitney’s U</th>
<th>z-score</th>
<th>p-value*</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Median</td>
<td>Mean rank</td>
<td>Median</td>
<td>Mean rank</td>
<td></td>
</tr>
<tr>
<td>Task 1</td>
<td>3.00</td>
<td>23.26</td>
<td>4.00</td>
<td>29.16</td>
<td>364,000</td>
</tr>
<tr>
<td>Task 2</td>
<td>3.00</td>
<td>37.22</td>
<td>3.00</td>
<td>26.24</td>
<td>331,000</td>
</tr>
<tr>
<td>Task 3</td>
<td>5.00</td>
<td>20.89</td>
<td>5.50</td>
<td>23.88</td>
<td>246,000</td>
</tr>
<tr>
<td>Task 4</td>
<td>4.00</td>
<td>6.17</td>
<td>4.00</td>
<td>7.50</td>
<td>16,500</td>
</tr>
</tbody>
</table>

In Chinese website
| Task 1 | 2.00 | 28.29 | 2.00 | 28.82 | 381,000 | 0.148 | .883 |
| Task 2 | 4.00 | 21.68 | 4.00 | 21.38 | 209,500 | -0.080 | .936 |
| Task 3 | 6.50 | 17.92 | 6.00 | 18.04 | 139,000 | 0.035 | .972 |
| Task 4 | 2.00 | 39.23 | 2.00 | 37.14 | 644,000 | -0.512 | .609 |

*Asymptotic-derived p-values were used

As can be seen from Table 7.7, median page-view-on-task-success scores for Task 1, 2, 3, and 4 in the Chinese website were not statistically significantly different, for Australian participants (2, 4, 6.5, and 2), and Chinese participants (2, 4, 6, and 2), \((U = 381, z = 0.148, p = .883, U = 209.5, z = -0.080, p = .936, U = 139, z = 0.035, p = .972, \) and \(U = 644, z = -0.512, p = .609\), respectively. Since none of the tasks in the Chinese website provided a statistically significant result to favour to Chinese participants, H2b, which proposed that Chinese participants would have fewer errors on the Chinese website than the Australian website, was not supported.
Efficiency

Efficiency refers to time on task (Tullis & Albert, 2008), which is the time elapsed between the start and end of a task, expressed in seconds (Darem, 2013); less time spent to succeed in a task increases efficiency. Average time on task was employed to numerically analyse task completion between cultures. This is first discussed, followed by statistical test that evaluates the H3a and H3b.

Figure 7-3 and 7-6, showed that the average time on task for Australian participants between websites, was small; 124 and 117 seconds per task in the Australian website and Chinese website respectively. The Chinese website’s broad navigation structure would reduce the time Australian participants spent in the Chinese website.

As shown in Figure 7-4 and 7-6, Chinese participants’ time on task dropped from 137 seconds in Australian websites to 114 seconds in the Chinese website. These results suggest that Chinese websites reduced task completion time to Australian and Chinese participants.

The time spent for task success was considered to test the hypotheses H3a that predicts Australian participants would have a higher efficiency in the Australian website than the Chinese website and H3b that predicts Chinese participants would have a higher efficiency in the Chinese website than in the Australian website. The task success values were transformed to dependent variable “time-on-task-success” and the Table 7-8 provides descriptive information about time-on-task-success.

Mann-Whitney U tests were run to determine any differences in task time-on-task-success score between culture and website design. As assessed by visual inspection of population pyramid histogram shown in Figure 7-17 to 7-24, all tasks distributions of the time-on-task-success scores associate to user tests were similar. Therefore, median was used to report the results.

Table 7-9 shows that the differences in median time-on-task-success scores for Task 3 and Task 4 in the Australian website were not statistically significant for Australian participants (104 and 148) and Chinese participants (96.5 and 225), \(U = 254, z = 0.955\),
\( p = .340 \) and \( U = 16, z = -0.462, p = .644 \), respectively. However, median time-on-task success scores for Task 1 and 2 in Australian websites were statistically significantly lower for Australian participants (86 and 53) than Chinese participants (145 and 80), \( (U = 403, z = 2.169, p = .030 \) and \( U = 658, z = 2.131, p = .033) \), respectively. Results suggest that Australian participants’ efficiency is higher in the Australian website, than the Chinese website. H3a was therefore supported.

Table 7-8: Descriptive information for time-on-task-success

<table>
<thead>
<tr>
<th>Task</th>
<th>User Test</th>
<th>Mean</th>
<th>Median</th>
<th>Std. Deviation</th>
<th>Skewness</th>
<th>Kurtosis</th>
</tr>
</thead>
<tbody>
<tr>
<td>Task 1</td>
<td>AU-AU Web</td>
<td>3.48</td>
<td>3.00</td>
<td>1.546</td>
<td>1.246</td>
<td>0.621</td>
</tr>
<tr>
<td></td>
<td>AU-CN Web</td>
<td>2.76</td>
<td>2.00</td>
<td>1.986</td>
<td>4.442</td>
<td>22.467</td>
</tr>
<tr>
<td></td>
<td>CN-AU Web</td>
<td>5.11</td>
<td>4.00</td>
<td>4.162</td>
<td>2.682</td>
<td>9.361</td>
</tr>
<tr>
<td></td>
<td>CN-CN Web</td>
<td>3.18</td>
<td>2.00</td>
<td>2.519</td>
<td>2.605</td>
<td>7.037</td>
</tr>
<tr>
<td>Task 2</td>
<td>AU-AU Web</td>
<td>3.60</td>
<td>3.00</td>
<td>0.982</td>
<td>1.074</td>
<td>2.391</td>
</tr>
<tr>
<td></td>
<td>AU-CN Web</td>
<td>5.00</td>
<td>4.00</td>
<td>2.525</td>
<td>1.320</td>
<td>.659</td>
</tr>
<tr>
<td></td>
<td>CN-AU Web</td>
<td>3.32</td>
<td>3.00</td>
<td>1.796</td>
<td>1.726</td>
<td>2.947</td>
</tr>
<tr>
<td></td>
<td>CN-CN Web</td>
<td>5.12</td>
<td>4.00</td>
<td>2.403</td>
<td>0.630</td>
<td>-1.204</td>
</tr>
<tr>
<td>Task 3</td>
<td>AU-AU Web</td>
<td>5.15</td>
<td>5.00</td>
<td>1.379</td>
<td>0.380</td>
<td>-0.249</td>
</tr>
<tr>
<td></td>
<td>AU-CN Web</td>
<td>8.17</td>
<td>6.50</td>
<td>5.781</td>
<td>1.042</td>
<td>0.511</td>
</tr>
<tr>
<td></td>
<td>CN-AU Web</td>
<td>6.75</td>
<td>5.50</td>
<td>4.640</td>
<td>1.724</td>
<td>3.594</td>
</tr>
<tr>
<td></td>
<td>CN-CN Web</td>
<td>8.26</td>
<td>6.00</td>
<td>8.142</td>
<td>3.529</td>
<td>14.304</td>
</tr>
<tr>
<td>Task 4</td>
<td>AU-AU Web</td>
<td>4.78</td>
<td>4.00</td>
<td>2.279</td>
<td>1.165</td>
<td>0.054</td>
</tr>
<tr>
<td></td>
<td>AU-CN Web</td>
<td>2.61</td>
<td>2.00</td>
<td>1.383</td>
<td>3.672</td>
<td>15.654</td>
</tr>
<tr>
<td></td>
<td>CN-AU Web</td>
<td>5.33</td>
<td>4.00</td>
<td>2.309</td>
<td>1.732</td>
<td>Nil</td>
</tr>
<tr>
<td></td>
<td>CN-CN Web</td>
<td>2.39</td>
<td>2.00</td>
<td>0.754</td>
<td>2.284</td>
<td>5.235</td>
</tr>
</tbody>
</table>

Figure 7-17: Task 1 successes time spent in Australian website between cultures

Figure 7-18: Task 2 successes time spent in Australian website design between cultures
Figure 7-19: Task 3 successes time spent in Australian website design between cultures

Figure 7-20: Task 4 successes time spent in Australian website design between cultures

Figure 7-21: Task 1 successes time spent in Chinese website design between cultures

Figure 7-22: Task 2 successes time spent in Chinese website design between cultures
Table 7-9: Mann-Whitney U test table for time spent to success tasks

<table>
<thead>
<tr>
<th>Task</th>
<th>Australian participants</th>
<th>Chinese participants</th>
<th>Mann-Whitney’s U</th>
<th>z-score</th>
<th>p-value*</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Median</td>
<td>Mean rank</td>
<td>Median</td>
<td>Mean rank</td>
<td></td>
</tr>
<tr>
<td>In Australian website design</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Task 1</td>
<td>86.00</td>
<td>22.00</td>
<td>145.00</td>
<td>31.21</td>
<td>403.000</td>
</tr>
<tr>
<td>Task 2</td>
<td>53.00</td>
<td>29.05</td>
<td>80.00</td>
<td>39.32</td>
<td>658.000</td>
</tr>
<tr>
<td>Task 3</td>
<td>104.00</td>
<td>20.59</td>
<td>96.50</td>
<td>24.38</td>
<td>254.000</td>
</tr>
<tr>
<td>Task 4</td>
<td>148.00</td>
<td>6.22</td>
<td>225.00</td>
<td>7.33</td>
<td>16.000</td>
</tr>
<tr>
<td>In Chinese website design</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Task 1</td>
<td>73.50</td>
<td>27.43</td>
<td>91.00</td>
<td>30.16</td>
<td>410.500</td>
</tr>
<tr>
<td>Task 2</td>
<td>104.00</td>
<td>20.21</td>
<td>126.00</td>
<td>22.38</td>
<td>234.500</td>
</tr>
<tr>
<td>Task 3</td>
<td>131.50</td>
<td>18.25</td>
<td>115.00</td>
<td>17.87</td>
<td>135.000</td>
</tr>
<tr>
<td>Task 4</td>
<td>53.00</td>
<td>46.15</td>
<td>37.00</td>
<td>32.26</td>
<td>429.500</td>
</tr>
</tbody>
</table>

Note: * Asymptotic-derived p-values were used

Table 7-9 shows that the median time-on-task-success scores for Task 1, Task 2 and Task 3 in the Chinese website were not statistically significant for Australian participants (73.5, 104, and 131.5) and Chinese participants (91, 126, and 115), \( (U = 410, z = 0.612, p = .540, U = 234, z = 0.564, p = .573, \) and \( U = 135, z = -0.104, p = .917) \); respectively. However, the median time-on-task-success score for Task 4 in the Chinese website was statistically significant, lower for Chinese participants (37) than
Australians participants (53), \( (U = 429.5, z = -2.718, p = .007) \). These results suggest that Chinese participants’ efficiency is higher in the Chinese website, than the Australian website. H3b was therefore supported.

### 7.3.2 Perception attributes

Perception attributes were perceived navigability, classic aesthetics, expressive aesthetics, and satisfaction. Measurement validation was conducted. The internal consistency of attributes, a measure of reliability, was measured by Cronbach’s alpha (Nunnally & Bernstein, 1994), which was used to determine how much the items on a scale are measuring the same underlying perception attribute. Each perception attribute had a high level of internal consistency, as determined by Cronbach's alpha.

The reliability coefficient of perceived navigability was 0.884, classic aesthetics was 0.969, expressive aesthetics was 0.874, and satisfaction was 0.942. Since the recommended Cronbach's alpha value is 0.7 or higher (DeVellis, 2003; R. B. Kline, 2005), all coefficients were acceptable (Nunnally & Bernstein, 1994). Thus, perception attribute validity was established.

The perception attribute data did not meet the assumption of normality. Therefore, the alternative non-parametric Mann-Whitney \( U \) test was used to test hypotheses H4a, H4b, H5a, H5b, and H6a, H6b.

### Results and analysis on perception attributes

After measurement validation, items of each perception attribute were averaged as a measure of the target attribute. Descriptive information for user perception attributes were in Table 7-10.

Mann-Whitney \( U \) tests were run to determine differences in the perception attribute score between culture and website design. Visual inspection was conducted on the population pyramid histogram, shown in Figure 7-25 to 7-32, to determine two distributions of the perception attribute scores were similar or dissimilar. The classic and expressive aesthetics distributions for Chinese participants in the Chinese website, and the satisfaction distribution for Australian participants in the Australian website were dissimilar; therefore, mean range of each distribution of scores were used to
compare the results. Since the perceived navigability distribution for both groups were similar, the median score for two groups were used to compare the results.

Table 7-10: Descriptive information for user perception attributes

<table>
<thead>
<tr>
<th>Usability Attribute</th>
<th>User Test</th>
<th>Mean</th>
<th>Median</th>
<th>Std. Deviation</th>
<th>Skewness</th>
<th>Kurtosis</th>
</tr>
</thead>
<tbody>
<tr>
<td>Perceived Navigability (PN1, PN3, PN4, PN5)</td>
<td>AU-AU Web</td>
<td>3.91</td>
<td>4.00</td>
<td>1.41</td>
<td>-.286</td>
<td>-.423</td>
</tr>
<tr>
<td></td>
<td>AU-CN Web</td>
<td>3.29</td>
<td>3.00</td>
<td>1.44</td>
<td>.680</td>
<td>-1.33</td>
</tr>
<tr>
<td></td>
<td>CN-AU Web</td>
<td>4.61</td>
<td>4.75</td>
<td>1.29</td>
<td>-.236</td>
<td>-.002</td>
</tr>
<tr>
<td></td>
<td>CN-CN Web</td>
<td>5.12</td>
<td>5.00</td>
<td>1.08</td>
<td>-.431</td>
<td>.071</td>
</tr>
<tr>
<td>Classic Aesthetics (CA1, CA2, CA3, CA4, CA5, CA6)</td>
<td>AU-AU Web</td>
<td>3.86</td>
<td>3.58</td>
<td>1.39</td>
<td>.378</td>
<td>- .636</td>
</tr>
<tr>
<td></td>
<td>AU-CN Web</td>
<td>2.75</td>
<td>2.33</td>
<td>1.64</td>
<td>.890</td>
<td>.216</td>
</tr>
<tr>
<td></td>
<td>CN-AU Web</td>
<td>4.77</td>
<td>4.92</td>
<td>1.24</td>
<td>-.394</td>
<td>- .165</td>
</tr>
<tr>
<td></td>
<td>CN-CN Web</td>
<td>4.52</td>
<td>4.58</td>
<td>1.24</td>
<td>-.056</td>
<td>- .716</td>
</tr>
<tr>
<td>Expressive Aesthetics (EA7, EA8, EA9, EA10, EA11)</td>
<td>AU-AU Web</td>
<td>3.04</td>
<td>3.00</td>
<td>1.23</td>
<td>.744</td>
<td>.241</td>
</tr>
<tr>
<td></td>
<td>AU-CN Web</td>
<td>2.95</td>
<td>2.70</td>
<td>1.55</td>
<td>.407</td>
<td>- .980</td>
</tr>
<tr>
<td></td>
<td>CN-AU Web</td>
<td>3.98</td>
<td>4.00</td>
<td>1.06</td>
<td>.357</td>
<td>-.045</td>
</tr>
<tr>
<td></td>
<td>CN-CN Web</td>
<td>3.99</td>
<td>4.10</td>
<td>0.95</td>
<td>-.038</td>
<td>-.763</td>
</tr>
<tr>
<td>Satisfaction (SA1, SA2, SA3, SA4, SA5, SA6)</td>
<td>AU-AU Web</td>
<td>3.67</td>
<td>3.33</td>
<td>1.67</td>
<td>.547</td>
<td>-.572</td>
</tr>
<tr>
<td></td>
<td>AU-CN Web</td>
<td>2.85</td>
<td>2.50</td>
<td>1.53</td>
<td>.592</td>
<td>-.446</td>
</tr>
<tr>
<td></td>
<td>CN-AU Web</td>
<td>4.46</td>
<td>4.42</td>
<td>1.27</td>
<td>-.244</td>
<td>-.113</td>
</tr>
<tr>
<td></td>
<td>CN-CN Web</td>
<td>4.51</td>
<td>4.42</td>
<td>1.32</td>
<td>-.007</td>
<td>-.877</td>
</tr>
</tbody>
</table>

People with holistic and analytic cultural cognitive styles displayed different perceived navigability on “broad” and “deep” website structures (Cui et al., 2015). Given the culturally specific navigation structure, it was proposed that Australian participants would have a higher perceived navigability in Australian website design as opposed to the Chinese website design. Consistent with this, as can be seen from Table 7-11, Australian participants perceived navigability median scores for Australian website (4) was statistically significantly higher than for Chinese website (3), (Mean rank Australian website = 57.48 vs. Mean rank Chinese website = 43.52; U = 901, z = -2.410, p = .016). H4a was therefore supported. It was also hypothesised that Chinese participants would have a higher perceived navigability in Chinese website design as opposed to the Australian website design. Consistent to expectations, Chinese respondents perceived navigability median scores for the Chinese website (5) was statistically significantly higher than for the Australian website (4.75), (Mean rank Chinese website = 56.57 vs. Mean rank Australian website = 44.43; U = 1553.5, z = -2.098, p = .036). Chinese participants perceived navigability was higher in the Chinese culturally specific website design. H4b was therefore supported.
Table 7-11: Mann-Whitney U test table for perception attributes

<table>
<thead>
<tr>
<th>Task</th>
<th>Australian website design</th>
<th>Chinese website design</th>
<th>Mann-Whitney's U</th>
<th>z-score</th>
<th>p-value*</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Median</td>
<td>Mean rank</td>
<td>Median</td>
<td>Mean rank</td>
<td></td>
</tr>
<tr>
<td>PN</td>
<td>4.00</td>
<td>57.48</td>
<td>3.00</td>
<td>43.52</td>
<td>901.000</td>
</tr>
<tr>
<td>CA</td>
<td>3.58</td>
<td>60.80</td>
<td>2.33</td>
<td>40.20</td>
<td>735.000</td>
</tr>
<tr>
<td>EA</td>
<td>3.00</td>
<td>52.16</td>
<td>2.70</td>
<td>48.84</td>
<td>1167.000</td>
</tr>
<tr>
<td>SA</td>
<td>3.33</td>
<td>57.62</td>
<td>2.50</td>
<td>43.38</td>
<td>894.000</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>AU-AU Web</td>
<td>N = 50</td>
<td>Mean Rank = 57.48</td>
<td>N = 50</td>
<td>Mean Rank = 43.52</td>
<td></td>
</tr>
<tr>
<td>AU-CN Web</td>
<td>N = 50</td>
<td>Mean Rank = 57.48</td>
<td>N = 50</td>
<td>Mean Rank = 43.52</td>
<td></td>
</tr>
</tbody>
</table>

Note: * Asymptotic-derived p-values were used.
Where: PN – Perceive Navigability; CA – Classic Aesthetics; EA – Expressive Aesthetics; and SA – Satisfaction.

Figure 7-25: Perceived navigability for Australian participants

Figure 7-26: Perceived navigability for Chinese participants
Figure 7-27: Classic aesthetics for Australian participants

Figure 7-28: Classic aesthetics for Chinese participants

Figure 7-29: Expressive aesthetics for Australian participants

Figure 7-30: Expressive aesthetics for Chinese participants
It was proposed that Australian participants would have a higher perceived classic aesthetics in Australian website design as opposed to Chinese website design. Consistent with this, as can be seen from Table 7-11, Australian participants perceived classic aesthetics mean rank was 60.80 for Australian website and 40.20 for Chinese website and this difference was significant (Median Australian participants = 3.58 vs. Median Chinese participants = 2.33; $U = 735, Z = -3.555, p < .000$). H5a was therefore accepted. It was also hypothesised that Chinese participants would have a higher perceived classic aesthetics in the Chinese website design as opposed to Australian website design. Contrary to expectations, there was no significant difference for Chinese participants in perceived classic aesthetics for Australian and Chinese websites (Median Australian participants = 4.92 vs. Median Chinese participants = 4.58, Mean rank Australian participants = 53.71 vs. Mean rank Chinese participants = 47.29; $U = 1089.5, Z = -1.108, p = .268$), respectively, and H5b was therefore not supported.

It was hypothesised that Australian participants would have a higher perceived expressive aesthetics in Australian website design as opposed to Chinese website design. Contrary to expectations, there was no significant difference for Australian participants in perceived expressive aesthetics for Australian and Chinese websites

**Figure 7-31: Satisfaction for Australian participants**

**Figure 7-32: Satisfaction for Chinese participants**
(Median Australian Website = 3.00 vs. 2.70, Mean rank Chinese Website 52.16 vs. 48.84; U = 1167, Z = -0.573, p = .566), and H6a was therefore not supported. It was also proposed that Chinese participants would have a higher perceived expressive aesthetics in Chinese website design as opposed to Australian website design. Contrary to expectations, there was no significant difference for Chinese participants in perceived expressive aesthetics for Australian and Chinese websites (Median 4.00 vs. 4.10, Mean rank 49.99 vs. 51.01; U = 1275.5, Z = 0.176, p = .860), and H6b was therefore not supported.

Finally, H7a and H7b were related to satisfaction of website designs. H7a was hypothesised that Australian participants would have a higher satisfaction with regards to Australian website design, as oppose to Chinese website design. Table 7-11 shows that Australian participants satisfaction mean rank was 57.62 for Australian website design and 43.38 for Chinese website design and this difference was significant (Median Australian website = 3.33 vs. Median Chinese website = 2.50; U = 894, Z= -2.457, p < .014). H7a was therefore accepted. H7b hypothesised that Chinese participants would have a higher satisfaction with regards to Chinese website design, as opposed to Australian website design. Contrary to expectations, there was no significant difference for Chinese participants in satisfaction for Australian and Chinese website designs (Median Australian website = 4.42 vs. Median Chinese website = 4.42, Mean rank Australian website 50.16 vs. Mean rank Chinese website 50.84; U = 1267, Z = 0.117, p = .907), and H7b was therefore not supported.

A summary of hypotheses testing results is displayed in Table 7-12.

7.4 Discussion

This study investigated the cultural effects on user performance and perception to cross-cultural websites with different information presentation and interaction styles, by validating a new Cross-cultural Web Usability Model. The results of the study provide statistically significant evidence to support the hypotheses that cultural factors, HCl factors, and website design interact to affect user performance and perception. Most of the hypotheses were supported.
Table 7-12: Hypotheses testing results

<table>
<thead>
<tr>
<th>Usability attribute</th>
<th>Hypotheses</th>
<th>Result</th>
</tr>
</thead>
<tbody>
<tr>
<td>Effectiveness</td>
<td>H1a: Users from Australia would have a higher effectiveness on Australian culturally specific website design as opposed to Chinese culturally specific website design.</td>
<td>Supported</td>
</tr>
<tr>
<td></td>
<td>H1b: Users from China would have a higher effectiveness on Chinese culturally specific website design as opposed to Australian culturally specific website design.</td>
<td>Supported</td>
</tr>
<tr>
<td>Errors</td>
<td>H2a: Users from Australia would have a fewer errors on Australian culturally specific website design as opposed to Chinese culturally specific website design.</td>
<td>Not supported</td>
</tr>
<tr>
<td></td>
<td>H2b: Users from China would have a fewer errors on Chinese culturally specific website design as opposed to Australian culturally specific website design.</td>
<td>Not supported</td>
</tr>
<tr>
<td>Efficiency</td>
<td>H3a: Users from Australia would have a higher efficiency on Australian culturally specific website design as opposed to Chinese culturally specific website design.</td>
<td>Supported</td>
</tr>
<tr>
<td></td>
<td>H3b: Users from China would have a higher efficiency on Chinese culturally specific website design as opposed to Australian culturally specific website design.</td>
<td>Supported</td>
</tr>
<tr>
<td>Perceived navigability</td>
<td>H4a: Users from Australia would have a higher perceived navigability on Australian culturally specific website design as opposed to Chinese culturally specific website design.</td>
<td>Supported</td>
</tr>
<tr>
<td></td>
<td>H4b: Users from China would have a higher perceived navigability on Chinese culturally specific website design as opposed to Australian culturally specific website design.</td>
<td>Supported</td>
</tr>
<tr>
<td>Perceived classic aesthetics</td>
<td>H5a: Users from Australia would have a higher perceived classic aesthetics on Australian culturally specific website design as opposed to Chinese culturally specific website design.</td>
<td>Supported</td>
</tr>
<tr>
<td></td>
<td>H5b: Users from China would have a higher perceived classic aesthetics on Chinese culturally specific website design as opposed to Australian culturally specific website design.</td>
<td>Not supported</td>
</tr>
<tr>
<td>Perceived expressive aesthetics</td>
<td>H6a: Users from Australia would have a higher perceived expressive aesthetics on Australian culturally specific website design as opposed to Chinese culturally specific website design.</td>
<td>Not supported</td>
</tr>
<tr>
<td></td>
<td>H6b: Users from China would have a higher perceived expressive aesthetics on Chinese culturally specific website design as opposed to Australian culturally specific website design.</td>
<td>Not supported</td>
</tr>
<tr>
<td>Satisfaction</td>
<td>H7a: Users from Australia would have a higher satisfaction on Australian culturally specific website design as opposed to Chinese culturally specific website design.</td>
<td>Supported</td>
</tr>
<tr>
<td></td>
<td>H7b: Users from China would have a higher satisfaction on Chinese culturally specific website design as opposed to Australian culturally specific website design.</td>
<td>Not supported</td>
</tr>
</tbody>
</table>
Differences were identified in each of the usability attributes. These differences suggest that incorporating cultural factors and HCI factors into website design provides culturally specific functionality, look, and feel will improve user engagement, performance, and perception. These differences further suggest that cultural adaptation will enable clear and effective communication between users and web pages (Heimgärtner, 2017; Rau et al., 2008).

User performance was measured using effectiveness, errors, and efficacy. Effectiveness was associated with success on task. This differed between cultures. Consistent with Fraternali and Tisi (2008), Chinese participants had higher task success in the Chinese website designed with high information: speed, frequency, parallelism, and density. In the Chinese parallel information and interaction design, Australian participants missed content and felt frustrated and isolated. Due to the high use of external websites used in the Chinese website, Australian participants were met with confusing navigation systems, an array of visual images and multimedia objects, and inconsistent interaction patterns. Australian participants achieved higher task success rates in the Australian website that was designed with low information: speed, frequency, parallelism, and density, and as well as low interaction speed, frequency, and parallelism.

Errors were associated with increased number of web page views required to succeed at a task. Although Australian participants viewed equal a number of web pages in both websites, they viewed fewer web pages for tasks requiring participants to click through many levels. The results of this study and Reinecke and Bernstein’s (2011) study show that users from high-uncertainty avoidance countries, such as Australia, use a linear navigation pattern to minimise errors. Therefore, designing web pages that carry high information as well as interaction sequentially and a deep navigation structure provides greater control to Australian users (Reinecke & Bernstein, 2011). However, in deep navigation structures, past research Cui et al. (2015), Fraternali and Tisi (2008), and the results of this research shows that Chinese are less effective or slower to complete the task than in flatter navigation structures. Therefore, for Chinese users less structured design and placing contents more freely on web pages is important; this provides navigation freedom to users from low-uncertainty avoidance
countries, such as China, to tolerate less control in navigation to reduce number of page views to complete tasks (Reinecke & Bernstein, 2011). This finding was consistent with Bernstein and Reinecke (2013) and Sang-Hun (2007), who found that users in many Asian countries prefer less structured web pages.

Efficiency was associated with time on task success. It has been suggested that Chinese users efficiently filter dense information (Heimgärtner, 2013; Nisbett, 2003; Reinecke & Bernstein, 2011), and perform well with parallel information (Fraternali & Tisi, 2008). Consistent with expectations, Chinese users’ efficiency was high in the Chinese website that contained high-information density and parallel information and interaction style pages. If information density was high, then the information speed and frequency as well as the interaction frequency and speed are also high. Users from long-term orientation and low-uncertainty, such as China, will use many pieces of information to accomplish tasks quickly (Heimgärtner, 2013). However, Australian users’ efficiency was higher in the Australian website that minimised the amount of information presented in a web page. The deeper hierarchical structure reduces the visible items and display density, which help the users from short-term orientation such as Australian to accomplish tasks quickly (Hsieh, 2015; Reinecke & Bernstein, 2011).

Beside the objective user performance, culture and culturally specific website design can interact to affect user perception on perceived navigability. As suggested by prior user interface research, websites can either be designed as a “broad” or “deep” navigation structure (Galletta et al., 2006). These results extend previous understanding by demonstrating that analytic Westerners, including Australian users, and holistic Easterners, including Chinese users, have distinct perceptions and preferences for “broad” vs “deep” navigation designs. Chinese participants, with a holistic cultural cognitive style, had a higher perceived navigability with the Chinese design that adopted a “broad” navigation structure. Australian participants, with an analytic cultural cognitive style, would have a higher perceived navigability with the Australian design that adapts a “deep” structure. These findings were consistent with Cui et al. (2015) who found that Chinese participants had a higher perceived navigability with a “broad” navigation structure design and Australian participants had higher perceived navigability with a “deep” structure design.
Classical aesthetics is the “visual clarity” dimension (Nasar, 1999) of the website (De Angeli et al., 2006). This attribute is characterised by order (regular or harmonious arrangement) and familiarity, increases understanding and sense making, and reduces ambiguity (van Schaik & Ling, 2009). This notion emphasises orderly and clear design and are closely related to many of the design rules advocated by usability experts (Lavie & Tractinsky, 2004). The results suggest that Australian users would have a high perceived classic aesthetic in Australian website design as opposed to the Chinese website design. However, there was no significant difference for Chinese users in the Chinese website design. According to van Schaik and Ling (2009), classical aesthetics attribute is an appropriate attribute for judging information-oriented pages that reduces ambiguity. So Chinese users judge that the Australian web pages are more information-oriented pages, than Chinese pages. This may have resulted in Chinese users not perceiving significantly higher classic aesthetics on Chinese websites. However, the Chinese website design did not lead to significantly worse classic aesthetics perception for Chinese users as it did for Australian users. This supporting the expectation that Chinese website design would enable Chinese users to perceive classic aesthetics higher than Australian users.

Expressive aesthetics is the “visual richness” dimension (Nasar, 1999) of the website which goes beyond the classical principles and tests the designer’s creativity and expressive power (Lavie & Tractinsky, 2004). This attribute is characterised by complexity, and increases arousal and involvement (van Schaik & Ling, 2009). This attribute captured users’ perceptions of design properties including: creative, special effects, originality, sophistication. Reinecke and Bernstein (2011) found that expressive aesthetics was rated significantly higher for the culturally adapted version. However, no differences in the levels of perceived expressive aesthetics were found in both cultures. Nevertheless, with little rating differences in median scores, Chinese users had a higher perceived expressive aesthetics belief in Chinese design (4.1), than in the Australian website (4). Similarly, Australian users had a higher perceived expressive aesthetics belief in the Australian design (3), than in the Chinese design (2.7). This suggests that users have a better “feel-good factor,” typically expressed as expressive aesthetics (De Angeli et al., 2006) in their culturally specific website design.
From the evidence of the above two levels of aesthetics including classic and expressive aesthetics, it was speculated that the concept of interaction via images, animations, and scrolling objects did not make the expressive aesthetics - a concept strongly related to engagement and fun (De Angeli et al., 2006), outweigh the classic aesthetics. This suggests the classic aesthetics was as important than expressive aesthetics, in overall web aesthetic judgments. A potential explanation would be to understand the classic aesthetics as a form of “visual” usability (Hassenzahl & Monk, 2010), complementing the usability of interaction (Tuch et al., 2012), which is important to engage the users in fulfilling interaction and generating affective responses (Lorenzo-Romero et al., 2013), than the engagement and fun. These findings were consistent with van Schaik et al.’s (2009), who found that after brief exposure of website use, classically aesthetic pages that are information oriented are rated as more attractive than expressively aesthetic pages.

It has been suggested that users will be satisfied with their culturally specific website design (Hsieh, 2014; Reinecke & Bernstein, 2011). Consistent with expectations, Australian users have a high satisfaction in Australian website design as opposed to Chinese website design. However, there was no significant difference for Chinese users, no matter which website design is shown. However Chinese participants’ average satisfaction associated with Chinese website design (Mean = 4.51) was generally higher than Australian website (Mean = 4.46). This means that Chinese website design favour to Chinese users, thus supporting the expectation that Chinese users would be more satisfied with a Chinese website design.

Finally, support for the concurrent validity of the proposed model was provided by the positive correlations with the user performance and perception of the cross-cultural websites. This suggests that the aesthetics in cross-cultural websites may improve user performance and perceived usability (Reinecke & Bernstein, 2011). Cui et al. (2015), Bernstein and Reinecke (2013), Reinecke and Bernstein (2011), Hassenzahl (2008), Lavie and Tractinsky (2004), revealed that user performance, perceptions of navigability as well as aesthetics, and satisfaction are highly correlated. The overall results of this study not only confirms those findings, but sheds new light on usability-aesthetics relations. Since the term “aesthetics” is often used to describe a beautiful or
pleasing appearance of an interactive system (Lavie & Tractinsky, 2004), the notion of “what is beautiful is usable” (Hassenzahl & Monk, 2010; Tractinsky, Shoval-Katz, & Ikar, 2000; Tuch et al., 2012) as well as “what is usable is beautiful” (De Angeli et al., 2006; Hamborg et al., 2014) should be considered in cultural context.

7.5 Limitations

There are certain limitations and concerns that may be addressed by future work. First, like other behavioural research, this study has limitations such as representativeness of the samples. Prior research showed that unsupervised online participants are less likely to pay attention to instructions (Oppenheimer et al., 2009); they may skim instructions, missing key elements of the task or manipulation, or respond in a haphazard fashion (Goodman et al., 2013). Although this study reduces the noise and increases the validity of data by filtering useful responses from users’ behavioural data, to further reduce noise in attitudinal data, future research could conduct a prescreening qualification test that have a series of questions, to determine participant language competencies and cultural exposure, and a modified Instructional Manipulation Check (IMC) (Oppenheimer et al., 2009), in which the screening questions gauge attention and comprehension.

Second, cross-cultural research revealed that participants from different cultures may differ in their interpretation of survey questions (Cui et al., 2015; Schneider & De Meyer, 1991). Although this study included objective measurement of user experience - user performance - to reduce this limitation, future research could try other methods to eliminate this issue. Furthermore, demographic differences, such as age and gender between Australian and Chinese users may account for their varying performance and perception on cross-cultural websites. To address these limitations, future research could adopt the psychological priming method (Oyserman & Lee, 2007), by manipulating cognitive style on users from the same culture and then study user performance and perception on cross-cultural websites; it is also possible to test the created model on content and process cognition. It is expected that this approach may help to eliminate the effect of language or other unrelated cultural distinctions.
Finally, so far it is unclear whether there are any attributes that increase user satisfaction on culturally specific website design. It is reasonable to expect that companies and organisations might want to find the most effective subset of website cultural adaptation steps, so that the functional, look, and feel aspects of their website, would help to increase user satisfaction. Thus further studies should investigate which attributes are most important for increasing the user satisfaction.

7.6 Conclusion

The new Cross-cultural Web Usability Model was evaluated. The model contained design guidelines used to design culturally specific websites between cultures; these websites incorporated the necessary level of information processing and interaction style, according to a user’s culture. The usability measuring instrument was used to measure website usability between cultures. The results demonstrate that usability attributes differ between cultures and that culturally specific websites increase user performance and perception.

Among the user performance attributes including effectiveness, errors, and efficiency, effectiveness and efficiency differed between cultures with users performing better in their culturally specific websites. The result on perception and perceived navigability showed that users from both cultures considered the culturally adapted version to be preferable. The results on attribute perception including: classic and expressive aesthetics showed that Australian users perceived the culturally adapted version have better classic aesthetics and were more satisfied. The proposed model has confirmed the central hypothesis that localised website designs improve user experience. Thus, it is expected that the proposed model has the potential to increase usability.
Chapter 8. Conclusion

8.1 Introduction

This chapter concludes the research into cross-cultural web usability described in this thesis. This work on cross-cultural web usability addresses some of the shortcomings of the predominant human-computer interaction paradigm by recognizing the role of culture in website use.

Users from different cultures think and behave differently, and these differences will influence how they perceive and interact with websites (Rau et al., 2008; Reinecke & Bernstein, 2011). Cultural website adaptation is required to provide culturally specific web pages, to offer clear and effective communication between the web page and user (Hsieh, 2015; Mushtaha & Troyer, 2016). However, the current state of the art in website adaptation generally only considers language translation, such as that provided by automated online services. Even if performed accurately, this only addresses one aspect of the overall communication. Furthermore, this approach may send mixed or inconsistent messages as the translated language of one culture may be paired alongside the culturally specific layout and interface of another culture. Further work such as the work described in this thesis also considers the complex interaction between different cultural factors and HCI factors, the strength of association between specific adaptations and the overall website usability.

The thesis has made progress towards this ambitious goal by looking beyond the confines of a specific language or content to consider broader design attributes such as layout, navigation, colour choices, or imagery. As the body of knowledge describing the role of culture in everyday activities grows, so do the technological capabilities to build better, more natural, life-like and usable web pages. The work described in this thesis aspires to incorporate cultural factors and HCI factors into website design, to offer clear and effective communication between users and web pages. Several contributions are made to the field of cross-cultural web usability as well as user experience design in areas including: cultural preferences, a new Cross-cultural Web Usability Model, and the subsequent empirical evaluation and validation of the developed model.
The following sections summarize the main research contributions. This is followed by a discussion of the limitations of the research. Finally, the theoretical and practical implications of the findings are covered.

8.2 Evaluation of the use of website design elements

Prior research suggests that to operate in the global market, website designers and developers should accommodate cultural preferences in websites (Cyr & Trevor-Smith, 2004; Hsieh, 2015; Reinecke & Bernstein, 2011). There is increasing research interest in culturally preferred design elements (Kincl & Štrach, 2013; Steve et al., 2013). However, systematically investigating design preferences for broad design attributes, on a large scale international website remains an active area of research. The first contribution of this research was a manual and automated website audit. This evaluated the similarities and differences in cultural preferences for broad design attributes including layout, navigation, links, multimedia, visual representation, colours, and text, between Australian, Chinese, and Saudi Arabian cultures with a large sample of 460 websites. This data provided an up to date view of design preferences in websites and further justifies the concept of cultural translation of web content.

User performance in applications such as Internet shopping stems largely from the characteristics of the web pages (J. Lee et al., 2000). Prior research suggests that there are important design attributes including layout, navigation, links, multimedia, visual representation, colours, and text that enable effective communication between the user and the web page (Calabrese et al., 2012; Hsieh, 2014; Mushtaha & Troyer, 2014). These design elements were identified based on the literature, and merit attention in a cultural context as they relate to general web design and localization issues.

The website audit revealed that many website design elements are indeed culturally specific. For instance, statistically significant differences were found for layout, colour usage, navigation, information density and others. These observed differences can be linked back to aspects of Hofstede et al. (2010) and E. T. Hall and Hall (1990) cultural factors, including power distance, individualism, uncertainty avoidance, long-term
orientation, context, and time perception. It has previously been noted that different interfaces may be needed for successful communication with different cultural groups and that since cultures have differing needs (Hsieh et al., 2013; Hsieh & Hong, 2013; Nordhoff et al., 2018). Thus it has been proposed that web designers should align web pages to help users to think in culturally natural ways (Nasrul, Masrom, et al., 2012; Nasrul, Nor, et al., 2012). The empirical findings of this website audit support these propositions by providing evidence of culturally specific preferences across a large sample of real-world websites.

8.3 A Cross-cultural Web Usability Model

The second major contribution of this thesis is a Cross-cultural Web Usability Model as a solution for website cultural adaptation. This model provides both cross-cultural web design guidelines and a usability measuring instrument. The cross-cultural web design guidelines help to incorporate culturally specific functionality, look, and feel to offer clear and effective communication between the user and web page. The usability measuring instrument enables website designers and developers to measure the level of usability between cultures. This model aims to provide practical benefit by simplifying the creation of cross-cultural websites, while enabling developers to create cross-cultural web pages and later evaluate their page usability for different cultures.

The model was created through the integration of prior work in cultural theory, and the new audit data of web design elements used by different cultures to facilitate website design for different cultures. To adapt cultural values into website design, most previous research directly applied theoretical cultural factors into website development. The research described in this thesis extended prior work by also incorporating design elements, cultural factors, and HCI factors. The study, described in Chapter 4, provided the empirical baseline to create the cross-cultural web design guidelines by collecting and interpreting a significantly larger data set than those used in prior work – thus ensuring that the proposed guidelines are reliable and based on actual web data rather than theory. Every web design guideline contains web design characteristics, cultural factors, and HCI factors, which relate to the level of website cultural adaptation necessary. Web design elements and cultural factors are already
the subject of cross-cultural investigation of website design (Fraternali & Tisi, 2008; Hsieh, 2015; Yaaqoubi & Reinecke, 2018), therefore more comprehensive cross-cultural web design guidelines were developed in this research by incorporating HCI factors such as time, context and mental aspects. The guidelines advise web developers on broad design attributes including layout, navigation, links, multimedia, visual representation, colour, and text. The design guidelines also showed that a modular approach to website cultural adaptation composed of different design elements, is more time-efficient and less expensive. By using these guidelines, a cross-cultural website can be easily constructed for each culture.

The usability measuring instrument consists of a variety of usability attributes including: effectiveness, efficiency, errors, perceived navigability, aesthetics, and satisfaction. These usability attributes may be used to measure the overall effect of website functionality, look, and feel, and enables website designers to compare the level of usability between cultures. Compared to conventional cultural adaptation where pages were designed for specific target countries, website cultural adaptation based on this new model does not rely on time-consuming and costly ethnographic analyses. The potential exists to provide personalized user interfaces for users from any country and the model proposed helps to achieve this.

8.4 Empirical evaluation of the developed model

The final major contribution of this thesis is an evaluation of the new Cross-cultural Web Usability Model. The model proposed a relationship between cultural factors, HCI factors, and design elements in website design, which help to incorporate a necessary level of cultural adaptation. This model has the potential to improve user performance including: effectiveness, efficiency, and errors, and user perception including: perceived navigability, perceived classic as well as expressive aesthetics, and satisfaction. These aspects also influence overall user experience.

The Cross-cultural Web Usability Model was subjected to an empirical evaluation to investigate the efficacy of cross-cultural web pages, for a culturally adapted version of a website. Whilst prior research had generally been conducted with small sample sizes of university students in a laboratory setting, this research aimed for a more
representative and generalizable study. Thus to understand the effect of culture in website usability, a novel large scale remote cross-cultural web usability study, described in Chapter 6, recruited participants from their natural locations, and obtained large scale usable responses. The findings demonstrated that user performance (e.g. efficiency or error rate) and perception (e.g. user experience) is improved in the culturally adapted website version. This indicates that the guidelines offered in the proposed model are capable of website cultural adaptation, and are suitable to measure the level of usability between cultures. Web designers often find it difficult to decide when to adapt and how to adapt the designs, mainly because there are currently no guidelines that describe common website designs in various countries (Nordhoff et al., 2018). The proposed model will help web designers to incorporate social and cultural components into web pages to design and evaluate usable websites, in new paradigms of human-computer interaction in today’s and tomorrow’s market (Rau et al., 2008).

8.5 Future research

The effects of national cultures on web design attributes were evaluated from website categories including “Government” and “News and Media” in three countries: Australia, China, and Saudi Arabia. It is possible that in other website categories, the prominence of certain design elements may differ (Mushtaha & Troyer, 2012). A valuable area of future research is to evaluate other types of websites and different cultures to improve the understanding of website localization and the appropriate design elements. It is possible that cultural adaptation of web content needs to also take into account the subject matter or content of the site. Also, as the original data was collected from actual published websites. It is difficult to determine, whether the data was a partial product of the cultural and value system of web designers (Goyal et al., 2012). A valuable future area of research is to conduct user studies with designers from each culture and derive from interviews to identify how and why the website design attributes might vary. Progress in this area will contribute to the future goal of being able to integrate design elements into broad design attributes, identified early in this thesis.
During the development of the Cross-cultural Web Usability Model, the prominent design elements were mapped with cultural factors, to design cross-cultural web design guidelines. It was strongly believed that different cultural values and beliefs exist. Hofstede et al. (2010) and researchers such as Díaz et al. (2017) noted that some cultural belief is necessary, in the day to day life, because all people develop cultural values based on their environment and early learning and training as children. Hofstede et al. (2010) also noted that cultural differences are hundreds or even thousands of years old, and believed that the cultural differences will not disappear quickly from traditional cultures, even with pervasive global telecommunication systems. Recent research has shown that the dimensions have remained quite stable for the last twenty years (Díaz et al., 2017; Steve et al., 2013). Although, not everyone in a society fits the same cultural pattern, there is enough statistical regularity to identify trends and tendencies (Díaz et al., 2017). These trends and tendencies should not be used to create negative assumptions but recognized as different patterns of values and thought that exists in the multi-cultural world. Since the web is not a culturally neutral or value-free space in which culturally diverse individuals communicate with equal ease (Reeder et al., 2004) it is necessary to cooperate to achieve practical goals without requiring everyone to think, act, and believe identically (Diaz et al., 2013). As the web continues to develop globally, considering the relevance of cultural factors to improve usability, user experience, and related areas to improve service is required. Much research effort is still required to develop cross-cultural web usability guidelines.

The scope of the Cross-cultural Web Usability Model is constrained to Hofstede et al.’s (2010) and E. T. Hall and Hall’s (1990) cultural factors, HCI factors suggested by Heimgärtner (2013), and the mapping which includes time, context, and mental aspects. The current mapping of context, time, and mental aspects is convenient as it provides an important point of user’s style of information processing and interaction characteristics (Heimgärtner, 2013), but the possibility should be acknowledged that some additional level of detail may be brought through when considering other human factors that stress human capabilities and behaviours. One potential area of research may be to consider other human factors and psychology, such as linguistics or
philosophy as these refer to a representational system responsible for behaviour, language, and thoughts. By considering these human and psychology factors, some additional cultural preferences or expression patterns can be brought through into a template, so that the outcomes may be generalized further.

As future work, the developed model requires further validation and refinement. When validating, international evaluators should apply the model to other contexts and platforms, such as educational or transactional websites.

Finally, the evaluation of the Cross-cultural Web Usability Model highlighted areas for further research. The model met all the research goals and a significant increase in user performance and perception were observed when using the model on the appropriate audience. These positive findings justify the need for future work in evaluating further usability attributes in this model. Two possible usability attributes are: “memorability” the retention over time, making it possible for casual users to return to the website after some period of disuse, without having to learn everything all over again (Folmer & Bosch, 2004; Nielsen, 1993); and “learnability”, the speed at which new users learn to accurately execute the process of a task (Nielsen, 1993). Future research of these usability attributes will provide additional insight into the user experience. There is also no definitive information on how gender, age, education level or years of Internet experience effect website design and usability perceptions. The Cross-cultural Web Usability Model developed in this thesis only used these demographic factors controls. Future research could evaluate the interaction effect of such demographic factors in cross-cultural web usability.

It is important to question whether the existing formal tools serve to generate quality websites. If the awareness of considering cultural factors and HCI factors becomes an essential element of web page design, then it needs to change the current practices to develop new website development tools. Future research needs to make it feasible to develop multiple versions of websites in a cost-effective manner, perhaps through templates or through specific versioning website designing tools.
8.6 Implications

The importance of studying culture has been highlighted in many areas of technology design. Knowledge of the target culture is vital to cater for design attributes including layout, navigation, links, visual representation of images, colour, and text (Mushtaha & Troyer, 2016). The use of culturally preferred website design attributes may thus have substantial implications. The findings that different interfaces are needed for successful communication with different cultural groups provides evidence of influence of culture on web design preferences and web usability. The resulting quantitative data may subsequently be abstracted into culture-aware design templates to encapsulate the significant characteristics of a culturally specific website. The creation of these templates may improve website design for different cultures with differing preferences (Fraternali & Tisi, 2008; Hsieh, 2014; Nordhoff et al., 2018). Websites aligned with cultures will help users to interact with a website in a natural and intuitive manner (Nasrul, Nor, et al., 2012) with the potential for commercial advantage (Cyr & Trevor-Smith, 2004).

The Cross-cultural Web Usability Model contributed a framework to build usable websites between cultures. The developed design guidelines may help to build an optimal website to fulfil the needs of a number of related cultural groups. From a theoretical perspective, this model encourages a mapping between design elements, cultural factors, and HCI factors that describe the information processing and interaction style between user and a website. These design elements and cultural as well as HCI factors may be refined and developed independently of one another. The use of the model described will provide comprehensive insight into socio-cultural factors in the target market that affect the HCI. It will also provide information about the methods to be used in cross-cultural web usability evaluation. The model can also be used across the broad range of interface design for a global market, which could be adapted by a range of media interfaces including e-commerce sites, digital libraries, online banks, travel agents and kiosks. Also, this model permits future website designers and researchers to concentrate on their own area of expertise, and share best practices for cross-cultural web usability. Web designers may also consider this model and realize the potential future design of website for a culture to ensure web
usability. The inclusion of a usability measuring instrument into this model allows cross-cultural web usability to be measured between cultures, and is a step toward making websites that are usable to all.

The evaluation of the Cross-cultural Web Usability Model has also demonstrated that real-world evaluation of website use, in unmoderated, remote web usability testing techniques is cost effective and able to capture the majority of user behaviour on web pages. By performing tasks upon existing cross-cultural websites that incorporate the necessary level of cultural factors and HCI factors, the developed Cross-cultural Web Usability Model was subject to empirical evaluation. The findings demonstrated that web pages that incorporate the necessary level of cultural factors and HCI factors enhance user performance and perception, as well as highlighting areas for further cross-cultural web development in the future.

In conclusion, the research described in this thesis represents significant progress towards making websites usable between cultures, by bridging the divide between cultural theory, sociology, HCI factors, and web page design. In cross-cultural studies it is imperative that individual cultures be studied to build rich repositories which, will in turn make it less expensive and time consuming for designers, companies and researchers to gather information about different cultures around the world (Jagne et al., 2004; Yaaqoubi & Reinecke, 2018). The next generation of websites built considering cultural values may address this communication gap and foster users’ natural information processing and interaction style to become an intuitive, and productive user experience to the benefit of all website users.
APPENDICES

Appendix A. Questionnaire for the Evaluation of Website Design Attributes

Website Design Elements Evaluation Survey - Version 1.0, April 1, 2015

* 1. What is the type of banner? Tick all that apply.
   - Contain single colour
   - Contain multi colours
   - Contain image
   - Animated

* 2. What is the type of main navigation?
   - Horizontal
   - Vertical
   - Other

* 3. Where is the main navigation located?
   - Before the banner
   - With in the banner
   - After the banner
   - Left-hand
   - Right-hand
   - Other

* 4. What is the type of main menu?
   - Simple
   - All-visible multi-level
   - Tab
   - Drop-line tab
   - Regular drop-down
   - Mega
   - Accordion
   - No menu

* 5. How many visible links are available in the main menu, when the web page loads?
* 6. What is the maximum level of choices in the main menu?
   ○ 0
   ○ 1
   ○ 2
   ○ 3

* 7. Are the Quicklinks used?
   ○ Yes
   ○ No

* 8. How many clickable Banners are available?
   Directs to internal pages
   Directs to external pages

* 9. How many clickable Banners are animated?

10. If there is a clickable Banner, where is it located? Tick all that apply.
   □ Top left
   □ Top middle
   □ Top right
   □ Middle left
   □ Centre of the web page
   □ Middle right
   □ Bottom left
   □ Bottom middle
   □ Bottom right

* 11. Are the Fat footers used?
   ○ Yes
   ○ No

12. If there is a Fat footer, how is it presented?
   ○ Multi-row structure
   ○ Multi-column structure
13. If the Fat footer is Multi-row/ Multi-column, how many rows/columns are available?
   - 1
   - 2
   - 3
   - 4
   - 5
   - 6

14. If there is a Fat footer, which of the following are present?
   - Internal text links
   - External text links
   - Icons for internal navigation
   - Icons from social media
   - Images for internal navigation
   - Images for external navigation
   - Clickable banners for internal navigation
   - Clickable banners for external navigation

* 15. How columns are present, excluding the header and footer? Tick all that apply.
   - 1-column
   - 2-column
   - 3-column
   - 4-column

* 16. Does any pop-ups appear/ move across/ around the web page?
   - Yes
   - No

17. Are any multimedia elements used in the page body? Tick all that apply.
   - Slideshow
   - Image/ text animation
   - Text scrolling
   - Image scrolling
18. Does the user have the ability to control multimedia capabilities with ‘Pause’ or ‘Play’ button?
- Yes
- No
- Not applicable

19. Images/ pictures. Tick all that apply.
- Image of leader/ authority
- Image of young individuals
- Image of elderly/ experienced individuals
- Image of smaller groups (with maximum 5 persons)
- Image of larger groups (with more than 3 persons)
- Image of people in daily action/ life
- Image of political/ religious
- Image of personal achievements/success
- Image of group achievements/ success
- Image of state building/ city scape
- Image of nature

20. How many unique icons are used?
Note: Omit all icons from social media, and RSS.
Standard icons (e.g., home, print, search, email, call, chat, video, play, stop, pause, +, left-arrow, right-arrow, up-arrow, and down-arrow)

Local or culturally specific icons

21. Do the local or culturally specific icons have text captions?
- Yes
- No
- Not applicable

22. Are cartoons used?
- Yes
- No
23. How many logos are used?

24. Are following features used? Tick all that apply.

- [ ] Skip to content
- [ ] Skip to navigation
- [ ] Back to top
Appendix B. Ethics Approval for the Empirical Evaluation of the Cross-cultural Web Usability Model

Thursday, 25 August 2016

Dr David Murray
School of Engineering and IT
Murdoch University

Dear David,

Project No. 2016/140
Project Title Usability themes in high and low context cultures: a comparative study

Thank you for addressing the conditions placed on the above application to the Murdoch University Human Research Ethics Committee. On behalf of the Committee, I am pleased to advise the application now has:

OUTRIGHT APPROVAL

Approval is granted on the understanding that research will be conducted according the standards of the National Statement on Ethical Conduct in Human Research (2007), the Australian Code for the Responsible Conduct of Research (2007) and Murdoch University policies at all times. You must also abide by the Human Research Ethics Committee's standard conditions of approval (see attached). All reporting forms are available on the Research Ethics and Integrity web-site.

I wish you every success for your research.

Please quote your ethics project number in all correspondence.

Kind Regards,

Dr. Erich von Dietze
Manager
Research Ethics and Integrity

cc: Dr Nik Thompson and Rikshan Alexander
Appendix C. Survey Invitation Email to Participants, Sent by Cint

Survey instructions:

The survey you are being asked to complete is about Website Usability:

- You should read the Information letter (http://ceto.murdoch.edu.au/~32347959/information_letter/a/a.html) and provide your consent in the external final survey page.
- The final survey page link is given in the Survey Link section.
- In the final survey, a compulsory ‘training test’ followed by a ‘final survey test’ will be conducted. A web-based remote usability market research tool called Loop11 will record your interaction with web pages.
- The training test helps to familiarise you with the Loop11 environment and the training test will consume less than 3 minutes.
- After finishing your training test, you will be given a cross-cultural website design. You will be asked to perform information-seeking tasks in a given website design, followed by a questionnaire. You are asked to perform the information-seeking tasks as they would normally perform them.
- Your activity on the training and cross-cultural websites will be monitored by Loop11. If we believe that you have not made a reasonable attempt to complete each task then your payment may be withheld.
- You are asked to perform this task without distraction including viewing other web pages that are not related to this study.
- Do not use the browser’s Back or Forward button during the training or final survey user tests.

Survey Link

Take Your Survey Now
Appendix D. Information Letter and Participant Consent for the Empirical Evaluation of the Cross-cultural Web Usability Model

Information letter

Information letter about the nature and scope of this survey

Title of research study: Usability themes in high and low context cultures: a comparative study

The main aim of this research is to conduct a usability test, with users from relevant cultural backgrounds, to validate a new cross-cultural website usability model. This research seeks to fill a gap by exploring the influential role of culture on website usability. The findings of the research may help to tailor website design to target users’ specific needs and preferences. This will improve aesthetics and functionality for users from diverse cultures and make their online presence more effective. We invite you to participate in a research study examining the usability of websites designed for users in particular cultural groups.

What the project will involve?

If you decide to participate in this study, you will complete an online survey that will take less than 20 minutes.

You will be asked to conduct 3 minutes of compulsory training before the actual tasks are presented. Your actions on training and cross-cultural website will be monitored. The study will use a web-based remote usability market research tool called Loop11 to record your interactions with some web pages.

The survey is completely anonymous and we will not identify individuals in any way. The data collected will be only used by the approved researchers at Murdoch University.

How the reimbursement/payment will occur

After completing the study, we will review your work. If your work is deemed valid, we will accept your work and approve your payment for participating.

Voluntary participation and withdrawal from the study

Your participation in this research is entirely voluntary and you can decide not to participate simply by not taking this Survey. By completing this survey, you will be consenting to the use of your data in this research project.
Benefits of the study

Participating in this evaluation will encourage you to reflect on your experiences with internationalized web content. The outcomes of this study should help to provide greater understanding of the usability requirements and factors that influence how well websites can be navigated and comprehended. This understanding will be translated into guidelines that will hopefully be used to improve user experience across the web.

A summary of the results of the study will be posted at the link here (http://ceto.murdoch.edu.au/~32347959/sf/index.htm) in around 6 months. We request you to copy and keep the link somewhere to view the results of the study later. Alternatively, you can email us and request a copy of the results.

Possible risks

There are no specific risks anticipated with participation in this study. If you have any questions, or comments about this project please feel free to contact: Dr. Nik Thompson (N.Thompson@murdoch.edu.au), Dr. David Murray (D. Murray@murdoch.edu.au) or Mr. Rukshan Alexander (R.Alexander@murdoch.edu.au).

Thank you in advance to those you who will participate in the project, and those of you who decide not to participate, thank you for your consideration.

Kind regards

Mr. Rukshan Alexander
r.alexander@murdoch.edu.au

This study has been approved by the Murdoch University Human Research Ethics Committee (Approval No. 2016/140). If you have any reservation or complaint about the ethical conduct of this research, and wish to talk with an independent person, you may contact Murdoch University’s Research Ethics Office (Tel.+61 8 9360 6677 or e-mail ethics@murdoch.edu.au). Any issues you raise will be treated in confidence and investigated fully, and you will be informed of the outcome.

Participant consent

I have read the Information letter about the nature and scope of this survey. Any questions I have about the research process have been answered to my satisfaction. I am aware that this survey is anonymous and no personal details are being collected or used. I agree that by submitting the survey I give my consent for the results to be used in this research study and in future studies by the researchers.

I know that I may change my mind, withdraw my consent, and stop but I acknowledge that once the data has been submitted it will not be possible to withdraw my data.
I understand that the findings of this study may be published and that no information which can specifically identify me will be published.

Please give your consent in the external final survey page to participate in the project if you accept the above terms.

Copyright Dr. David Murray, Dr. Nik Thompson, and Mr. Alexander Rukshan © 2016. All Rights Reserved.

External final survey page that get participant consent
Appendix E. Screen Shots of the Training Website for the Empirical Evaluation of the Cross-cultural Web Usability Model

Training website for Australian participants

Accessible at: http://ceto.murdoch.edu.au/~32347959/training_a/
Training website for Chinese participants

Accessible at: http://ceto.murdoch.edu.au/~32347959/training_c/
Appendix F. Screen Shots of the Cross-Cultural Websites for the Empirical Evaluation of the Cross-cultural Web Usability Model

Australian version of website design in English, for Australian participants (AU-AUWeb)

Australian version of website design in Mandarin, for Chinese participants (CN-AUWeb)

Accessible at: http://ceto.murdoch.edu.au/~32347959/ccac/cms/
Chinese version of website design in English, for Australian participants (AU-CNWeb)

Accessible at: http://ceto.murdoch.edu.au/~32347959/ccca/
Chinese version of website design in Mandarin, for Chinese participants (CN-CNWeb)

Accessible at: http://ceto.murdoch.edu.au/~32347959/ccca/
Appendix G. Clickstream reports for the Empirical Evaluation of the Cross-cultural Web Usability Model

Figure G-1: Task 1 for Australian participants in Australian website design

Figure G-2: Task 1 for Chinese participants in Australian website design
Figure G-3: Task 2 for Australian participants in Australian website design

Figure G-4: Task 2 for Chinese participants in Australian website design
Figure G-5: Task 3 for Australian participants in Australian website design

Figure G-6: Task 3 for Chinese participants in Australian website design
Figure G-7: Task 4 for Australian participants in Australian website design

Figure G-8: Task 4 for Chinese participants in Australian website design
Figure G-9: Task 1 for Australian participants in Chinese website design

Figure G-10: Task 1 for Chinese participants in Chinese website design
Figure G-11: Task 2 for Australian participants in Chinese website design

Figure G-12: Task 2 for Chinese participants in Chinese website design
Figure G-13: Task 3 for Australian participants in Chinese website design

Figure G-14: Task 3 for Chinese participants in Chinese website design
Figure G-15: Task 4 for Australian participants in Chinese website design

Figure G-16: Task 4 for Chinese participants in Chinese website design
Appendix H. Heatmaps from the Empirical Evaluation of the Cross-cultural Web Usability Model

Heatmap for task 2: 50 clicks displayed. 13 clicks were on 4 non-visible elements

Figure H-1: Task 2 by Australian participants in Australian website design
Figure H-2: Task 2 by Chinese participants in Australian website design
Figure H-3: Task 3 by Australian participants in Australian website design
Figure H-4: Task 3 by Chinese participants in Australian website design
Figure H-5: Task 4 by Australian participants in Australian website design
Figure H-6: Task 4 by Chinese participants in Australian website design
Figure H-7: Task 1 by Australian participants in Chinese website design
Figure H-8: Task 1 by Chinese participants in Chinese website design
Figure H-9: Task 2 by Australian participants in Chinese website design
Figure H-10: Task 2 by Chinese participants in Chinese website design
Figure H-11: Task 3 by Australian participants in Chinese website design
Figure H-12: Task 3 by Chinese participants in Chinese website design
Figure H-13: Task 4 by Australian participants in Chinese website design
Figure H-14: Task 4 by Chinese participants in Chinese website design
Appendix I. Participants comments for the Empirical Evaluation of the Cross-cultural Web Usability Model

Comments from Australian participants for the Australian version of website design in English (AU-AUWeb)

<table>
<thead>
<tr>
<th>S. No</th>
<th>Australian Participants comments</th>
</tr>
</thead>
<tbody>
<tr>
<td>Pilot 1</td>
<td>none</td>
</tr>
<tr>
<td>Pilot 2</td>
<td>Nil</td>
</tr>
<tr>
<td>Pilot 3</td>
<td></td>
</tr>
<tr>
<td>1</td>
<td>na</td>
</tr>
<tr>
<td>2</td>
<td></td>
</tr>
<tr>
<td>3</td>
<td></td>
</tr>
<tr>
<td>4</td>
<td>none I could discover</td>
</tr>
<tr>
<td>5</td>
<td></td>
</tr>
<tr>
<td>6</td>
<td>Was very difficult to complete tasks and locate relevant information and links, I felt the website was very cluttered with too much information and links on every page making it difficult to locate relevant information. A question related to the website providing few clicks, made me confusing.</td>
</tr>
<tr>
<td>7</td>
<td></td>
</tr>
<tr>
<td>8</td>
<td>none</td>
</tr>
<tr>
<td>9</td>
<td>I could not find any links to Dept. of Housing</td>
</tr>
<tr>
<td>10</td>
<td></td>
</tr>
<tr>
<td>11</td>
<td>Didn't understand last question, &quot;key&quot; what?</td>
</tr>
<tr>
<td>12</td>
<td>nil</td>
</tr>
<tr>
<td>13</td>
<td>department of housing was confusing to find.</td>
</tr>
<tr>
<td>14</td>
<td>I think this study was great, I didn't have any problems navigating the pages</td>
</tr>
<tr>
<td>15</td>
<td></td>
</tr>
<tr>
<td>16</td>
<td>The question related to this website providing few clicks to locate information is not clear.</td>
</tr>
<tr>
<td>17</td>
<td></td>
</tr>
<tr>
<td>18</td>
<td>Some info is just hard to find. there needs to be fewer links on the first page.</td>
</tr>
<tr>
<td>19</td>
<td>I think there needs to be a search engine, nowhere could I find a place to search for terms</td>
</tr>
<tr>
<td>20</td>
<td>a site map would have been helpful</td>
</tr>
<tr>
<td>21</td>
<td>TOO DIFFICULT TO NAVIGATE</td>
</tr>
<tr>
<td>22</td>
<td>Some labels need to be highlighted, or the Frequently Asked Questions section needs to be more detailed. I have long experience with internet searches and I could not complete some of the tasks because there was no place to ask a specific question, or headings that I could see clearly directing me.</td>
</tr>
<tr>
<td>23</td>
<td>they need a search bar.</td>
</tr>
<tr>
<td>24</td>
<td>this website wasn't easy to navigate</td>
</tr>
<tr>
<td>25</td>
<td></td>
</tr>
<tr>
<td>26</td>
<td>I find the website too crowded. Too many options to choose from. I'd prefer broader categories and then narrow it down. I spent too much time reading all the options, which wasn't pleasant because the categories are kind of crammed together in rather small letters and my vision is very good. I missed a 'search' field. I like the 'popular pages' on the right hand side and the speed of the website. In general it's very annoying if a website is too slow to load a new page. I find the bottom half of the 'home' website page too</td>
</tr>
</tbody>
</table>
much; it’s a repetition of the categories from above. I’d rather use that space for something else, for extra information/links or leave it and make the rest of the page less crowded.

27 took a while two find the first two things. but after that finding things you were looking for was way too confusing

28

29 Couldn’t find Dept of Housing link, nor electricity pricing

30 I found it cluttered and had great difficulty finding some of the information. I didn’t find it user friendly or intuitive at all.

31 It seems relatively easy to find information so the information architecture seems good but the overall look and feel of the website feels a bit dated. Can’t pinpoint exactly what is wrong but it doesn’t seem “new”.

32 Just found very difficult to navigate & find what I needed to. Could definitely use “search” facility

33

34

35 There are so many links that looking for your specific information is extremely difficult. The amount of links should be reduced and the website should be simplified

36 The only real issue I had was finding the public housing link.

37 I could NOT locate ANY information on the Department of Housing on the Dept of Finance website AT ALL.

38

39 useless website

40 Hard to find info unless you are an experienced web user.

41 there were no links to other websites that I could find

42 I was unsure about office opening hours - the page I found listed office opening hours at the top then contact details for various departments underneath - I assumed that the opening hours applied to all departments but I think it would be good to make this clear. I also think it would be helpful to have a search box at the top of the website.

43 Terminology used for this webpage may impede certain social groups from using it particularly relating to the housing question

44 the last question did not leave many options and was frustrating trying to find information

45

46 just put more faster website, put few options more, maybe free rewards

47 I the question regarding recommending the website to a friend it was difficult to answer. The website in question holds essential information, so therefore must be recommended for the purpose of obtaining information, however it wasn’t user-friendly. A search box at the top of the page would greatly simplify searching for specific information.

48 It was hard to work out exactly where to go

49

50 It is so hard to navigate this page. So improving the functionality would be really great. Thank you for asking my opinion.

Comments from Chinese participants for the Australian version of website design in Mandarin (CN-AUWeb)

<table>
<thead>
<tr>
<th>S. No</th>
<th>Chinese Participants comments that were translated to English</th>
</tr>
</thead>
<tbody>
<tr>
<td>Pilot 1</td>
<td>no search key, structure is not clear</td>
</tr>
<tr>
<td>Pilot 2</td>
<td></td>
</tr>
<tr>
<td>Pilot 3</td>
<td></td>
</tr>
</tbody>
</table>

230
better to provide a search portal, search files, etc.
too many words
allow users to post comments, increase transparency, monitoring, and interaction
cannot find some content
the site is well designed
links have no issue, but feel confused some time. Not quite easy to find certain content
menu is too complex, structure is confusing
need to add search function
classification does not make sense
I feel it is convenient to search questions
navigation structure does not make sense
cannot find some content
need better layout
overall good, but suggestion is to add common function windows to support search
links are not clear.
cannot find some content
not clear, cannot find links
classification and naming are confusing for Chinese
well-designed
words of the last link is a bit small; elder people may have some difficulty to recognize the words
links are not clear; not easy to find
need clearer classification, to make better sense
not clear
classification is not clear
none
too difficult to use
(do not understand this)
add more classification search and buttons, to allow users to find content more easily
take quite a long time to find where to click
objectives need clear, can add work time
add links that are commonly used

none
structure is not clear, function is not convenient, not easy for Chinese to use
can better design search options
well-designed, easy to understand
classification is too complex, not convenient, take too much time to find something; looking is well-designed
sites do not provide in-site search  
a bit slow to load the site  
searching is not convenient  
need better layout  
not very well-designed

Comments from Australian participants for the Chinese version of website design in English (AU-CNWeb)

<table>
<thead>
<tr>
<th>S.No</th>
<th>Chinese Participants comments that were translated to English</th>
</tr>
</thead>
<tbody>
<tr>
<td>Pilot 1</td>
<td>n/a</td>
</tr>
<tr>
<td>Pilot 2</td>
<td></td>
</tr>
<tr>
<td>Pilot 3</td>
<td>1</td>
</tr>
<tr>
<td></td>
<td>2</td>
</tr>
<tr>
<td></td>
<td>3 links were not broken</td>
</tr>
<tr>
<td></td>
<td>4 The website is completely flooded with links. It is very confusing and difficult to locate the information that is wanted.</td>
</tr>
<tr>
<td></td>
<td>5</td>
</tr>
<tr>
<td></td>
<td>6 whole website is confusing/unfriendly</td>
</tr>
<tr>
<td></td>
<td>7</td>
</tr>
<tr>
<td></td>
<td>8</td>
</tr>
<tr>
<td></td>
<td>9</td>
</tr>
<tr>
<td></td>
<td>10 N/A</td>
</tr>
<tr>
<td></td>
<td>11</td>
</tr>
<tr>
<td></td>
<td>12</td>
</tr>
<tr>
<td></td>
<td>13 There are too many words on this website, it is extremely hard to navigate and therefore extremely hard to complete the navigation tasks.</td>
</tr>
<tr>
<td></td>
<td>14 na</td>
</tr>
<tr>
<td></td>
<td>15 Clear idea</td>
</tr>
<tr>
<td></td>
<td>16 this website was very hard to understand and complete, didn’t make much sense, I think it was designed for someone that would actually be required to use it.</td>
</tr>
<tr>
<td></td>
<td>17</td>
</tr>
<tr>
<td></td>
<td>18</td>
</tr>
<tr>
<td></td>
<td>19 I couldn't find the electricity tariff answer on this website anywhere</td>
</tr>
<tr>
<td></td>
<td>20</td>
</tr>
<tr>
<td></td>
<td>21</td>
</tr>
<tr>
<td></td>
<td>22 Why were certain pages intentionally blocked.</td>
</tr>
<tr>
<td></td>
<td>23 A few of the links I clicked to find information said &quot;this page was left intentionally blank&quot; and it seemed like the &quot;ctrl&quot; key was disabled stopping me from searching for key word</td>
</tr>
<tr>
<td></td>
<td>24</td>
</tr>
<tr>
<td></td>
<td>25 No broken links noticed.</td>
</tr>
<tr>
<td></td>
<td>26</td>
</tr>
<tr>
<td></td>
<td>27</td>
</tr>
<tr>
<td></td>
<td>28 New tabs opening when you click a link, that is not a good thing. Hard to find information, small tabs and unreadable links</td>
</tr>
<tr>
<td></td>
<td>29</td>
</tr>
<tr>
<td></td>
<td>30 the website is terrible. Far too many links and they are small and not in order</td>
</tr>
</tbody>
</table>

232
31 nothing
32
33 everything fine
34 How confusing....much more work needed on this website.
35
36
37 all good
38
39 i think it was clear to use and maybe use larger text it was a bit small to read
40
41
42
43
44 This is a very busy website, lots going on, lots of information.. all pretty good..
45 I only had problem with 1 task. The rest I had no trouble.
46
47 none
48
49
50 I think the website is very clear and informative

Comments from Chinese participants for the Chinese version of website design in Mandarin (CN-CNWeb)

<table>
<thead>
<tr>
<th>S.No</th>
<th>Chinese Participants comments that are translated to English</th>
</tr>
</thead>
<tbody>
<tr>
<td>Pilot 1</td>
<td>classification is not clear; not sure where to find relevant information</td>
</tr>
<tr>
<td>Pilot 2</td>
<td>reduce the number of links</td>
</tr>
<tr>
<td>Pilot 3</td>
<td>too messy</td>
</tr>
<tr>
<td>1</td>
<td>well-designed; wish to take more surveys like this!</td>
</tr>
<tr>
<td>2</td>
<td>information is a bit messy; need better classification</td>
</tr>
<tr>
<td>3</td>
<td>increase the relevance of information</td>
</tr>
<tr>
<td>4</td>
<td>can better utilize the left and right part of the site</td>
</tr>
<tr>
<td>5</td>
<td>information structure is not clear</td>
</tr>
<tr>
<td>6</td>
<td>interface does not look good</td>
</tr>
<tr>
<td>7</td>
<td>need search function</td>
</tr>
<tr>
<td>8</td>
<td>no search function, cannot find content</td>
</tr>
<tr>
<td>9</td>
<td>no search function, not very convinient; cannot locate relevant information for tasks</td>
</tr>
<tr>
<td>10</td>
<td>site design is too complex</td>
</tr>
<tr>
<td>11</td>
<td>navigation should be clearer</td>
</tr>
<tr>
<td>12</td>
<td>none</td>
</tr>
<tr>
<td>13</td>
<td>links function well, easy to use, and good sites</td>
</tr>
<tr>
<td>14</td>
<td></td>
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<tr>
<td>15</td>
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<td>16</td>
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<tr>
<td>---</td>
<td>---</td>
</tr>
<tr>
<td>20</td>
<td>not quite different from common sites, easy to use, can find information quickly</td>
</tr>
<tr>
<td>21</td>
<td></td>
</tr>
<tr>
<td>22</td>
<td>the second (find?) management operation center is not easy to find</td>
</tr>
<tr>
<td>23</td>
<td></td>
</tr>
<tr>
<td>24</td>
<td></td>
</tr>
<tr>
<td>25</td>
<td>link works</td>
</tr>
<tr>
<td>26</td>
<td>a bit slow to load the site</td>
</tr>
<tr>
<td>27</td>
<td>function classification is not clear, not easy to find content</td>
</tr>
<tr>
<td>28</td>
<td>none</td>
</tr>
<tr>
<td>29</td>
<td></td>
</tr>
<tr>
<td>30</td>
<td></td>
</tr>
<tr>
<td>31</td>
<td>not convenient to find the needed content, some necessary information is put on the second-level pages</td>
</tr>
<tr>
<td>32</td>
<td>information is too much and too messy, cannot find the needed information directly</td>
</tr>
<tr>
<td>33</td>
<td>not easy to find information</td>
</tr>
<tr>
<td>34</td>
<td>none</td>
</tr>
<tr>
<td>35</td>
<td>none</td>
</tr>
<tr>
<td>36</td>
<td></td>
</tr>
<tr>
<td>37</td>
<td>no search function, not easy to find information</td>
</tr>
<tr>
<td>38</td>
<td>too much information, cannot filter those needed</td>
</tr>
<tr>
<td>39</td>
<td>the interface is too messy, not search function</td>
</tr>
<tr>
<td>40</td>
<td>none</td>
</tr>
<tr>
<td>41</td>
<td>navigation is not clear</td>
</tr>
<tr>
<td>42</td>
<td>structure is clear, but too much information, need cleaner content and pages</td>
</tr>
<tr>
<td>43</td>
<td>the meaning of menu is not clear</td>
</tr>
<tr>
<td>44</td>
<td>the design of web does not look good</td>
</tr>
<tr>
<td>45</td>
<td>the site is too complex, need simple search function, can use classification to list functions that can be searched</td>
</tr>
<tr>
<td>46</td>
<td></td>
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<tr>
<td>47</td>
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<tr>
<td>48</td>
<td></td>
</tr>
<tr>
<td>49</td>
<td>need to add search function</td>
</tr>
<tr>
<td>50</td>
<td>information layout is too complex</td>
</tr>
</tbody>
</table>
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