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UNDERSTANDING OF SYMBOLS IN GLOBAL MULTI-CULTURAL SETTINGS

Faculty of Information Technology and Communication Sciences
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ABSTRACT

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Symbols are commonly used for visual communication, as is evident in tourism, media, technology and other areas with distinct user groups. Despite their popularity and simplicity, symbols can be easily misunderstood due to different conventions in different cultures. Cultural differences often represent a major challenge when designing for multicultural audiences. In this thesis, a quantitative research was conducted to investigate the influence of cultural differences in people's attitudes towards custom symbols used in technical documentation. In addition, the research intends to explore the potential of using animations as an alternative to custom graphic symbols. This thesis was made in collaboration with KONE and thus the research focuses on custom symbols and animations used in the company's learning and maintenance guides.

For this study, an online survey was conducted with 23 participants from Finland, China, and India. The objectives of this study were to compare participants' preferences on symbol design and analyse their impressions on animations used in technical documentation. The research findings were used to support the re-designing work of custom symbols and animations followed by an expert evaluation. Overall, the results revealed that cultural differences had no major influence on attitudes towards custom symbols. However, the research was done with participants who had a significant work experience, thus a strong familiarity with symbols used in industry. The results also confirmed the effectiveness of animations in instructional guidance and suggested that using animations can be highly beneficial, especially among Indian users.

Keywords and terms: Custom symbols, Cross-cultural design, Cultural differences, Finland, China, India, KONE, Graphics, Animations, Technical documentation.

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1 INTRODUCTION

This thesis analysed Finnish, Chinese and Indian users' attitudes towards custom symbols used in technical documentation and provided detailed information on users' preferences and impressions needed for a re-designing process of symbols. This thesis also determined the feasibility of including animations in technical documentation. For the need of this study, custom symbols and animations were re-designed following cross-cultural design principles and users' feedback. The custom symbols and animations belong to a Finnish company- KONE. For collecting data from Finland, China, and India, an online survey with 23 participants was carried out. For the purpose of validating the re-designed symbols and animations, an expert evaluation with 5 participants from KONE was conducted. Design implications for custom symbol design and animations are discussed in Chapter 7.

1.1 Background and motivation

Symbols are regularly used for visual communication in technical documentation as evident in instruction guides and user manuals. For example, Ikea uses arrow symbols in their assembly instructional guides to represent movement and direction. Despite their popularity and simplicity, symbols can be easily misunderstood due to different conventions in different cultures. Symbolic representations and their meaning making are influenced by cultural background [Callaghan, 2020].

Different studies have been carried out to determine cultural differences in the interpretation of symbols, especially among Eastern and Western cultures. Zhang [2019] analysed the cognitive differences between Chinese and American consumers on visual symbols in commercial advertising. The study focused on the consumers' attention to the graphic, colour, composition and text elements. The comparative analysis revealed interesting contrasting facts: for instance, Chinese subjects valued words more than colour, while American subjects thought colour is more important. Another interesting fact was that Chinese subjects tended to choose warm colours, while American subjects preferred harmonious colours. Not only distinctions in preferences were found, but also similarities.

Another study by Fukuoka, Kojima and Spyridakis [1999] assessed the preference and effectiveness of illustrations in user manuals between Japanese and American users. Their experimental research aimed to find out the variations in users' preference and their perception for the use of illustrations in an instruction manual. Surprisingly, the results revealed no clear differences between Japanese and American users. Both user groups agreed that the use of illustrations might ease the understanding of instructions. Also, subjects from both nationalities expressed their desire to have more graphics in their manuals.

From the perspective of documentation design, Warren [2002] highlights the importance of attitudes of a culture in preparing technical manuals after making a brief cultural analysis between two cultures and comparing their attitudes towards knowledge, education, products, etc. His study reflected how culture has implications for the style, content and organisation of technical manuals. He also mentioned that often cultural elements are ignored by communicators due to lack of time or budget difficulties.

In the field of pictorial communication, an empirical investigation on using graphics in dynamic content made by Lowe and Pramono [2006] reflected that there are situations where animations can provide more effective representation of information in comparison to static graphics. In cases where static graphics do not have direct information about their referential subject, animations can help to provide more visual awareness of the situation. Animations are able to represent different visual forms such as trajectory, orientation, continuity, speed, etc.

In summary, the studies mentioned above acknowledge the importance of culture when designing for multicultural audiences and the use of motion graphics as an alternative to static graphics. Terms such as *cross-cultural design* and *culture considerations* are often used in the requirements for designing technical documentation. However, little is known about the influence of cultural differences in users' attitudes towards custom symbols used in technical documentation, and also about the potential of animation for representing instructions in technical documentation.

The main motivation for this thesis was the opportunity to contribute to the improvement of the user-experience for technical documentation used at KONE, specifically on visual communication through symbols. Pain points were previously identified by company's specialists; issues with the understanding of custom graphical symbols among

workers in different locations around the world were recorded and acknowledged; these issues represented an excellent opportunity for research, hence, to identify potential solutions. Another motivator for this thesis was the opportunity to directly participate in the re-designing of custom graphical symbols. The author of this thesis believed this was an excellent opportunity to use his designing skills for the ideation part and for the creation of new graphical symbols.

1.2 About KONE

The author conducted this research inside KONE corporation, to which he was related by a contract as thesis worker. The aim of this study was to investigate the influence of cultural differences in people's attitudes towards custom symbols used in technical documentation. In addition, the research intends to explore the potential of using animations as an alternative to graphic symbols. This thesis was made in collaboration with KONE corporation (later referred as KONE) and thus the research focuses on custom symbols and animations used in the company's learning and maintenance guides. It is important to mention that the company contributed to the re-designing of animations specified in chapter 5.

KONE is a Finnish company focused on the elevator and escalator industry. The company provides elevators, escalators, and automatic building doors, as well as solutions for maintenance and modernisation. KONE operates in more than 60 countries around the world. It is estimated that KONE serves approximately 500, 000 customers.

The mission of KONE is to improve the flow of urban life. As a global leader in the elevator and escalator industry, KONE provides elevators, escalators and automatic building doors, as well as solutions for maintenance and modernization to add value to buildings throughout their life cycle. Through more effective People Flow®, KONE makes people's journeys safe, convenient and reliable, in taller, smarter buildings. In 2020, KONE had annual sales of EUR 9.9 billion, and at the end of the year over 60,000 employees. KONE class B shares are listed on the Nasdaq Helsinki Ltd. in Finland [KONE Corporation Finland, 2020].

1.3 Objectives and methodology

This thesis is related to the field of design, specifically to symbol design, and it includes cross-cultural design approach as it is based on a multicultural context. This thesis focuses on the current state and re-design process of custom symbols used in learning and maintenance guides at KONE.

The author aims to investigate whether cultural differences have a significant influence on users' behaviour towards custom symbols and also to justify the inclusion of animation in technical documentation. Therefore, the main focus of the thesis relies on the following research questions:

1. How does cultural differences between Finland, China and India influence in attitudes towards custom symbols?
2. Does animation enhance the understanding of instructions in technical documentation?

The study includes literature reviews, cross-cultural research, user research, symbol re-design process and evaluation. For the cross-cultural research part, Hofstede's cultural dimensions were used to analyse the cultural differences between Finland, China and India. However. Using only cultural models to analyse cultural differences is not enough, therefore, a quantitative user research was conducted for identifying more accurate and relevant information. The quantitative user research used statistical analysis to compare the preferences of each users' group on custom graphical symbols, also to measure users' acceptance on custom animated symbols.

Most relevant findings from the research results were considered in the re-designing process of both, static graphical symbols and animations. Thereafter, an expert evaluation was conducted among technical documentation experts from KONE in order to assess the re-designed symbols.

1.4 Structure of the thesis

The introduction briefly explained the background and motivation behind the topic and described the objectives and methodologies which will be explained more detailed in the following chapters.

In Chapter 2 and 3, background theoretical information about cross-cultural design and symbols are presented and explained.

Chapter 2 briefly explains the importance of cross-cultural design when designing for multicultural audiences. This chapter includes the definition of the term “culture” and presents a couple of famous cultural models. This chapter compares cultural differences between Finland, China and India based on Geert Hofstede’s Cultural Dimensions.

Chapter 3 introduces an overview on symbols and its usage. It includes the definition of the term “symbol”, the types of graphical symbols and explains what is meant by “animated symbol”. It also explains the use of custom symbols at KONE. Finally, it explains how cross-cultural design is important in symbol design.

Chapter 4 provides detailed information on the user research methodology and process. The results of the 23 online surveys investigation are presented and analysed. It also includes the main findings that are used to in the re-designing part.

Chapter 5 introduces the re-designing work and displays the outcome of the newly designed symbols based on the user research performed in chapter 4. This chapter also reports the main impressions and feedback obtained from the questionnaire given to experts at KONE.

Chapter 6 discusses the differences between previous and current symbol settings, the overall contribution of the thesis, and the impact of user research in the design process.

Chapter 7 provides a conclusion on the thesis and further suggestions are given.

2 CROSS-CULTURAL DESIGN

With the rapid increase of globalisation, businesses are required to consider culture as a major element in communication. The competitive global market has prompted companies to work across cultural barriers and focus on the importance of diversity and respect for cultural differences [Tjosvold, 2016].

Neglecting culture considerations may cause major problems in the adaptation of products or services in new markets. Chavan [2009] mentioned a cross-cultural failure case example when in the early 90's, worldwide famous cereal company, Kellogg's set up a branch in India, hoping to have a space in the Indian breakfast table. They introduced products such as cornflakes, Basmati rice flakes and wheat flakes. The outcome was surprising and disappointing for the company. The main reason for their failure was the fact that the flavour of the products was not matching the taste of Indian consumers. India is a country where eating habits vary according to the distances.

Figure 1. Kellogg's corn flakes advertising for Indian market. [1]

[1] Advertising picture Social Samosa blog: https://www.socialsamosa.com/2020/04/brand-saga-kelloggs-india-advertising-journey-part-2/

Additionally, the company did not take into account that Indians start their morning with warm milk instead of cold milk as in the U.S. or in European countries [Vignali, 2001]. The impact on the Indian market was a catastrophic as consumers considered the combination of Kellogg's cornflakes and warm milk similar to eating wet paper.

The Kellogg's case reflects the importance of knowing your audience's cultural background before initiating any important action. In the same line, cross-cultural design stands as a beneficial approach when designing for multi-cultural audiences, for instance, cross-cultural design principles have been a key factor for the success of international websites and mobile applications. Cross-cultural design focuses on comparing different cultures to identify similarities and differences that can be used later on to predict people's behaviour [Akpem, S., & Small, C., 2020]. The use of a cross-cultural approach is inevitable when creating products or services for multicultural user groups.

2.1 Definition of culture

According to Oxford Dictionary, the definition of culture is as it follows: "the customs and beliefs, art, way of life and social organization of a particular country or group" [Culture, 2021]. Although that might be, in few words, a solid definition, the definition of the term "culture" is more extensive and so far, there is not a common agreement on the exact definition of the term.

The term "culture" has gone through several changes in history and many definitions have been proposed. Initially the term *culture* was related to producing or developing something, for example, people referred to "the culture of wine" to the whole process of producing wine, also people used the term "the culture of arts" when referring to the process of creating art. In the 18th-century, the term *culture* was used in France to refer to the acquirement of training or refinement of the mind or taste. This definition was consequently used to refer to characteristics of an educated person, something that remains until now. In the 19th-century, anthropologist Edward Tylor described *culture* as a complex whole which includes knowledge, belief and any other capacities acquired by humans in society. In 1952, Kroeber & Kluckhohn published a monograph with 160 definitions for the term "culture"; they realized that there are many concepts but not a proper *theory* of culture. As literature grew around the topic of culture, its use in a global scale is common nowadays [Jahoda, 2012].

It is difficult to define culture in a single definition as it involves different perspectives, experiences and characteristics, but it certainly has a profound and important influence in people's values, actions, behaviour and reasoning. Culture is unique to each individual and it defines people as a group that can be distinguished from others.

2.2 Cultural models

There is a number of different cultural models, however, there are two popular models often used in the field of communications: The Iceberg model and Hofstede's model. Hall [1976] introduced the Iceberg model (Figure 2). According to this model, as in an iceberg in the water, only a small portion of the whole content is visible. The model proposes that there is a visible part which contains evident cultural characteristics such as behaviour, food, language, etc. Meanwhile, the major portion which relies under the surface invisibly includes characteristics such as beliefs, world views, assumptions, perceptions, attitudes, values, etc.

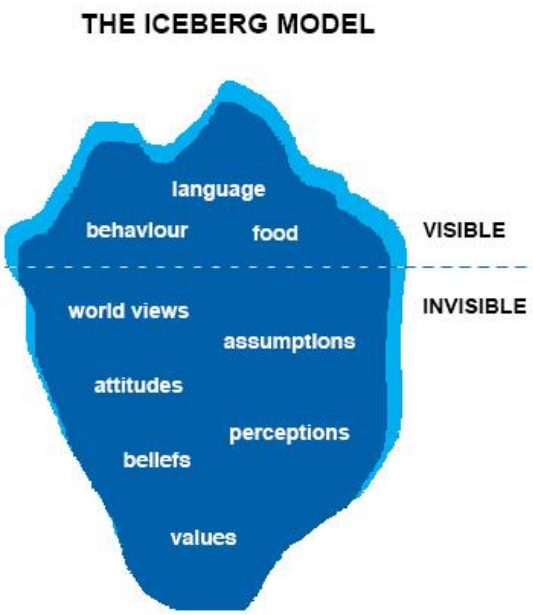

Figure 2. Iceberg model from Edward T. Hall [T. Hall, 1976].

Another cultural model frequently used in the field of cross-cultural communication is Hofstede's cultural dimensions model. Geert Hofstede, social psychologist, created a cultural model based on his research done with IBM employees focusing on cultural characteristics. According to Hofstede's cultural model, society's culture can be divided into five different cultural dimensions: Power distance, Individualism, Masculinity, Uncertainty avoidance and Long-term orientation [Hofstede, 2011].

Table 1. Hofstede's cultural dimension model [Hofstede, 2011]

Hofstede's cultural dimension model
Power distance
Individualism vs. collectivism
Masculinity vs. femininity
Uncertainty avoidance
Long-term orientation

Power Distance refers to extent which less powerful members in a group or organisation within a society accept or expect that power is distributed unequally. The inequality is approved by followers and leaders in a society. Power and inequality are, obviously, important facts in any society. When considering all the countries in the world, it is easy to notice that there are places that are more unequal than others [Hofstede, 2011].

Individualism versus its opposite, collectivism, refers to the degree on which individuals are integrated into groups. For the individualist part, we can find societies with loose ties between individuals where everyone is expected to care for themselves and for their closest relatives only. For the collective part, we can find societies with strong and cohesive integration into groups since birth, often families with a large family tree that protect their members in exchange for loyalty. The word "collectivism" does not have any political connotation and it refers mainly to a group, not to the state [Hofstede, 2011].

Masculinity versus its opposite, femininity, refers to the distribution of values between the genders in a societal context. It explains what the characteristics for masculine

or feminine societies are, for example, in a masculine society, men should be, and women may be assertive and ambitious; while in a feminine society, men and women should be modest and caring. The dimension varies according to the society. In masculine cultures there is often a taboo on this dimension [Hofstede, 2011].

Uncertainty Avoidance Index deals with society's tolerance for the uncertain and ambiguous. It refers to the search for the absolute truth and tries to minimize the possibility of uncertainty by following strict behavioural codes, laws and rules. For example, uncertainty avoiding countries are likely to be emotional and motivated by inner nervous energy. On the other hand, uncertainty accepting cultures, are more tolerant on different opinions and try to have fewer rules. People within these cultures tend to be more apathetic and contemplative [Hofstede, 2011].

Long-term Orientation describes how societies have to keep relations with their past while facing challenges of the present and future. Values associated to long-term orientation were perseverance, ordering relationships by status and having a sense of shame while values from short-term orientation were reciprocation of social obligations, respect for tradition, protection of their reputation and personal steadiness and stability [Hofstede, 2011].

2.3 Cultural differences between Finland, China and India

In order to have a deeper understanding of the users and their cultural context, we used Hofstede's cultural dimensions to compare cultural differences between Finland, China and India [Hofstede, 2001].

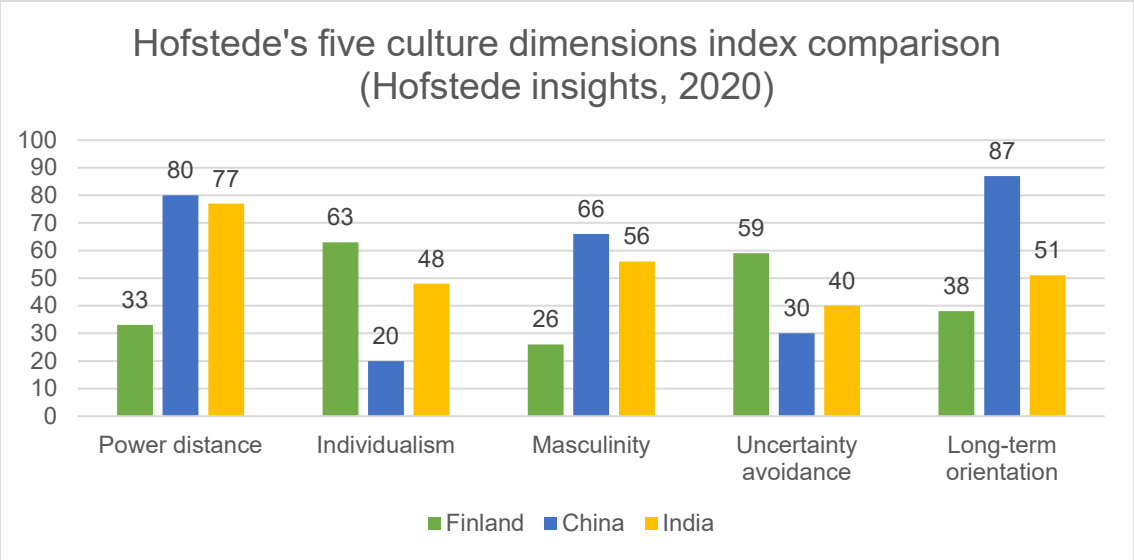

Figure 3. Differences between Finland, China and India based on Hofstede's culture dimensions [Hofstede insights, 2020].

According to figure 3, Finland scored low in Power Distance dimension index (score of 33) which means that power is decentralized, and team members' opinions or experiences are considered important. On the other hand, China (score of 80) and India (score of 77) scored very high in Power Distance which means that inequalities amongst people are acceptable; also, that relationships between subordinates and superiors are polarised and there is no resistance to power abuse.

Individualism dimension index values reveal that Finland is an individualist society (score of 63), meaning that they prefer being independent and to care for themselves and their immediate family. China scored low (score of 20) meaning that they are a collectivist culture where people act in the interests of the group and their relationships within members are cooperative for in-groups. India had an intermediate score (score of 48) which means that it is a society with both collectivistic and individualist attributes.

Masculinity dimension index values reveal that Finland is considered a feminine society as it scored low (score of 26). Finnish society focuses on solidarity and quality in their working lives. A feminine society values equality and consensus for decision making is often supported. On the other hand, China (score of 66) and India (score of 56) are considered masculine societies with success-oriented characteristics. Their need to ensure success can make them sacrifice family and leisure for work.

Uncertainty avoidance dimension index values reveal that Finns (score of 59) prefer to avoid uncertainty and follow norms that are rigid, for example having an inner urge to be busy and work hard. The Chinese scored low in this cultural dimension (score of 30) which means that they are comfortable with ambiguity. India (score of 40) has a medium low preference on avoiding uncertainty; India is traditionally a patient society with high tolerance.

Long-term orientation dimension index values reveal that Finnish society (score of 38) have a strong concern on the real truth and focus on achieving immediate results. Chinese society (score of 87) is certainly more pragmatic and believe that the truth depends on the situation, context and time. There is not an exact preference for Indians (score of 51) as they consider the truth to have many meanings.

In summary, the cultural dimensions values reflect differences and similarities between these three cultures. For example, Finnish culture, has lower power distance, low masculinity and high individualism while Chinese culture is considered to be a collectivist society with high masculinity and power distance characteristics. Indian culture has mixed values as it scores high in power distance but also has a medium score for masculinity and uncertainty avoidance. Finland index scores are similar to other western societies, especially to European societies. China and India have some cultural similarities, especially in uncertainty and power distance characteristics. Hofstede's cultural dimensions have been helpful to identify general differences between these cultures, however, in order to have an accurate understanding on the users it is necessary to conduct a user research focusing on their behaviour towards graphic symbols.

3 SYMBOLS

Humans are often exposed to symbols in their everyday life. Symbols can be found in public spaces for instance in airports, libraries, schools; they can also be found in several products, for instance in their labelling, packaging or instruction manuals. Symbols carry implicit characteristics that make them suitable as a channel of visual communication [Dreyfuss, 1970].

Figure 4. Symbol examples (from left to right): Airport, restrooms, no smoking, bar, extinguisher [AIGA symbols].

Symbols are used internationally to work across language barriers as well as in different disciplines for specific purposes. For the purposes of this thesis, we focus on graphical symbols that represent the meaning of an object or action used specifically in the elevator and escalator industry.

3.1 Definition of symbol

Charles Sanders Peirce, one of the founders of semiotics, categorized signs into three types: the symbol, the icon and the index [Crow, 2003]. In 1909, Peirce described symbols as signs that represent their objects but without a logical resemblance or real connection [Nöth, 2010, p.2].

Unlike the icon, which has a physical resemblance to the signified; and the index, which shows evidence of what is being represented; the connection between the signifier and the signified in a symbol had to be culturally learned. For example, numbers are symbols so, there is nothing implicit in the number 7 to indicate what it represents; therefore, it must be culturally learned.

3.2 Graphical symbols

Graphical symbols are able to represent objects as well as ideas. They can be divided into three subgroups: pictorial symbols, abstract symbols, and arbitrary symbols. Pictorial symbols are representational as they resemble the object they represent.

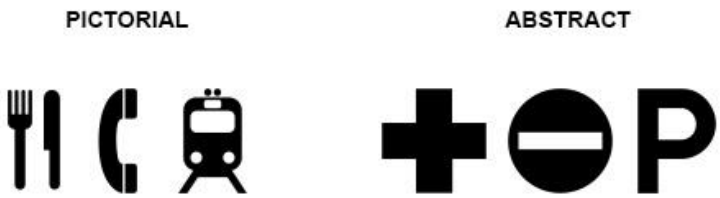

Figure 5. Pictorial symbols (from left to right): restaurant, telephone, train transportation. Abstract symbols (from left to right): first aid assistance, no entrance, parking area. Source: AIGA symbols.

The great advantage of pictorial symbols is that they easily communicate their meaning because they are easy to recognise and to remember [Detheridge & Detheridge, 2002]. Abstract symbols have little, or even none, pictorial reference with the objects that they represent but they can have a longer endurance despite changes in time [Dreyfuss, 1970]. Arbitrary symbols are created out of the designer's imagination and often have no resemblance to the object they represent. Abstract and arbitrary symbols are required to be learned [Detheridge & Detheridge, 2002].

3.3 Symbol design styles: solid and outline

Graphical signs such as symbols and icons can be used in different manners to catch the attention of the user. For example, by enhancing visual characteristics such as colour, size or even text style in an icon can cause a higher level of awareness. For this thesis, we only focus on 2 styles: solid and outline, as they are repeatedly applied in technical documentation symbols used at KONE.

Solid style, also known as fill or filled-in, is represented by the color, gradient, or pattern the occupies the inside of a drawn object. Outline style, also known as hollow, is the color, gradient, or pattern that borders the drawn object (see figure 6). Both styles are easily recognizable across design systems.

Figure 6. Solid and outline styles examples.

3.4 Animation and graphical symbols

With the development of media, animation has been progressively integrated into learning materials. Several studies have been done to determine the potential of using animation for educational purposes, for example, Kim et al. [2007] analysed the effect of animation in learning and motivation within elementary school students in Korea; as a result, they discovered that there is no clear prove that animated graphics are more beneficial than static graphics, but some claimed that animated graphics are more enjoyable and motivating.

In the field of semiotics, Schlosser et al. [2012] investigated the effects of animation on graphic symbols among pre-schoolers; the study revealed that animations made it easier for pre-schoolers to guess the meaning of graphic symbols.

3.5 Use of symbols at KONE

For this thesis, we focused on the usage of symbols in learning guides and maintenance guidelines at KONE. Most of the signs and symbols used at KONE come from standard sources such as ISO standard (ISO 7010), European Lift Association (ELA) and GHS labelling of chemicals.

Figure 7. Safety signs used at KONE [ISO 7010, 2019].

In addition to the standard symbols, there is a fair number of custom symbols used to represent specific tasks or actions. Custom symbols are mainly used to represent maintenance or installation tasks. Hence, they need to be carefully planned and designed in order to guarantee their understanding. The custom symbols used at KONE's technical documentation can be divided into two types of graphics: static graphical symbols and animations. Static graphical symbols are 2D type images while animations are provided in GIF images (Graphics Interchange Format).

3.6 Cross-cultural design for symbols

According to Callaghan [2020], humans are exposed to symbols already in infancy and they acquire the symbolic ways of their cultural groups. As symbol understanding is inherited from each human's cultural environment, it may represent a disadvantage when it comes to understanding symbol systems outside their cultural group.

There is no formula to create universal symbols, but cross-cultural design principles can be applied in order to reach a better result, especially when designing for multicultural audiences. Some of the main cross-cultural design principles focus on specific actions such as embracing with the culture, getting information from experts, avoiding biases and assumptions, and being flexible and understanding [Akpem & Small, 2020].

4 USER RESEARCH

In earlier chapters, cross-cultural principles and cultural differences between Finland, China, and India using Hofstede's cultural dimensions were introduced. Additionally, the use of animation for supporting learning was briefly explained. However, in order to determine whether cultural differences have a relevant influence on users' attitudes towards custom symbols, and to explore the potential of animation in technical documentation, a user research targeted to a specific group was conducted. This user research focuses on the usage of custom symbols and animation used in technical documentation at KONE.

4.1 Research objectives

In order to understand the users' attitudes and impressions on custom symbols in a comprehensive manner, the user research focuses onto the following objectives:

1. To compare users' preferences on custom static symbols.
2. To assess users' impressions on the usage of symbols and animation in technical documentation.

This research also collected opinions and suggestions from users in order to identify potential clues to be utilised in the re-design process of symbols.

4.2 Research method and process

This user research has a quantitative approach. The reason for choosing this approach was to provide a concrete explanation of users' attitudes based on measurable data. Therefore, an online survey with 23 respondents was conducted. The participants used for the survey were employees at KONE. The survey was distributed in Finland, China, and India.

4.2.1 Survey

The survey consisted of a semi-structured questionnaire with 25 questions including closed-ended questions, multiple choice questions, image choice questions, rank questions and open-ended questions. The questions can be divided into five groups:

1. General questions focused on collecting basic information from participants such as demographical data, for example: age, gender, nationality. It also included work-related questions such as work experience and area of expertise.

2. Questions about technical documentation usage. This group contained 3 questions focused on:

    a. The type of channel from which the participant access to technical documentation.

    b. Frequency of negative experiences with understanding symbols displayed in the technical documentation.

    c. Action taken by the participant when symbol is not understood.

3. Questions about graphical symbols. These group contained 7 multiple choice questions with a single answer option. Each choice contained a graphical sample which represented an action or task. These questions aimed to identify the participants' preferences on symbol type and symbol style. For example, in figure 8 there is a question which displays 4 graphic samples from which 2 are solid styles and the other 2 are outline styles.

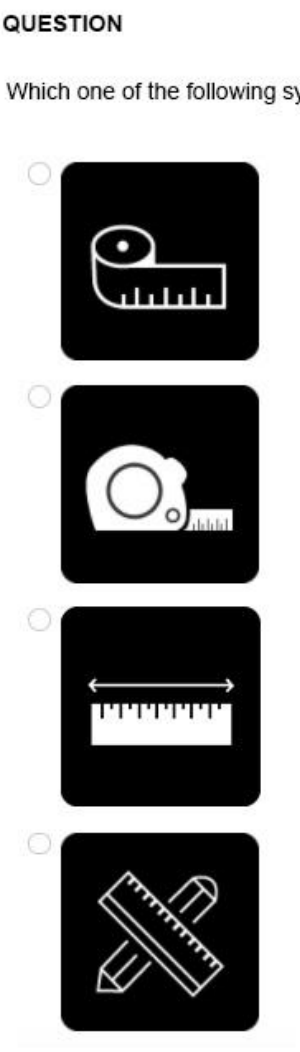

Figure 8. Survey question for symbol styles (solid and outline).

4. Questions about animated graphics in technical documentation. These group contained 7 questions. The first 3 questions used a Likert scale to measure how well animated graphics are understood by the participants. The following 3 questions used unipolar rater scales to measure the effectiveness of animated graphics in their working environment. The last question focused on the importance of using text to explain the animations.

5. Open questions. These questions aimed to collect opinions and suggestions on the use of animated graphics and symbols. Anonymous feedback was enabled to obtain critical feedback.

4.2.2 Research focus

The research work focused on the following aspects:

1. Preference on symbol type: pictorial versus abstract
2. Preference on symbol style: solid versus outline
3. Action taken by user to find out the meaning of an unknown symbol
4. Comparison between animated and static graphic symbols
5. Efficiency of animation to describe instructions in technical documentation.

The first two aspects focus on aesthetical preferences for static custom symbols. The third aspect focuses on the source used by participants when searching for information on symbols. The fourth and fifth aspects focus on impressions toward animation used in technical documentation.

4.3 Research results

Demographic data indicated that from the 23 participants, 14 were from Finland, 5 from China, and 4 from India. The gender distribution was 83% males and 17% females. Participants were distributed in three age groups: 18-24 years old: 9%; 25-39 years old: 48%; 40-59 years old: 43%.

Regarding distribution of participants by area of expertise, results indicated that majority of participants worked in maintenance (48%) followed by documentation (39%); other areas such as installation and, learning and development, only represented a 13% of the total. Regarding work experience, majority of the participants had between 10 to 20 years' experience (48%) followed by those with less than 5 years (26%); finally, participants with 5 to 10 years (13%) as well as those with more than 20 years' experience (13%).

Regarding the main aspects of the research, the following results were found:

Aspect 1: Preference on symbol type: Pictorial versus Abstract

The research data indicated that majority of Finnish (57%) and Indian (63%) participants preferred pictorial symbols over abstract symbols. In contrast, a slight majority of Chinese participants (60%) preferred abstract symbols over pictorial symbols. Abstract symbols were the least preferred by Indian participants (37%).

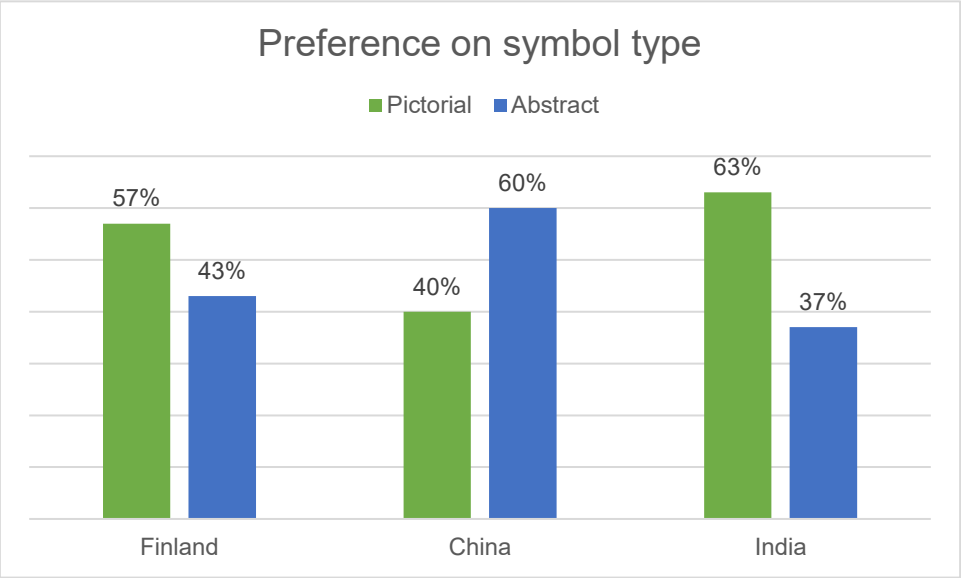

Figure 9. Preferences on symbol type by country.

Results revealed that pictorial symbols were more popular among Finns and Indian participants while abstract symbols were slightly more popular on Chinese participants.

Aspect 2: Preferences on symbol style: Solid versus Outline

Research data indicated that Finnish and Indian participants' preference was distributed equally (50% for solid style and 50% for outline style). Only a slight difference was perceived on Chinese participants (60% preference for outline style). According to results shown in this aspect, it is clear that no significant differences were found in participants' preferences.

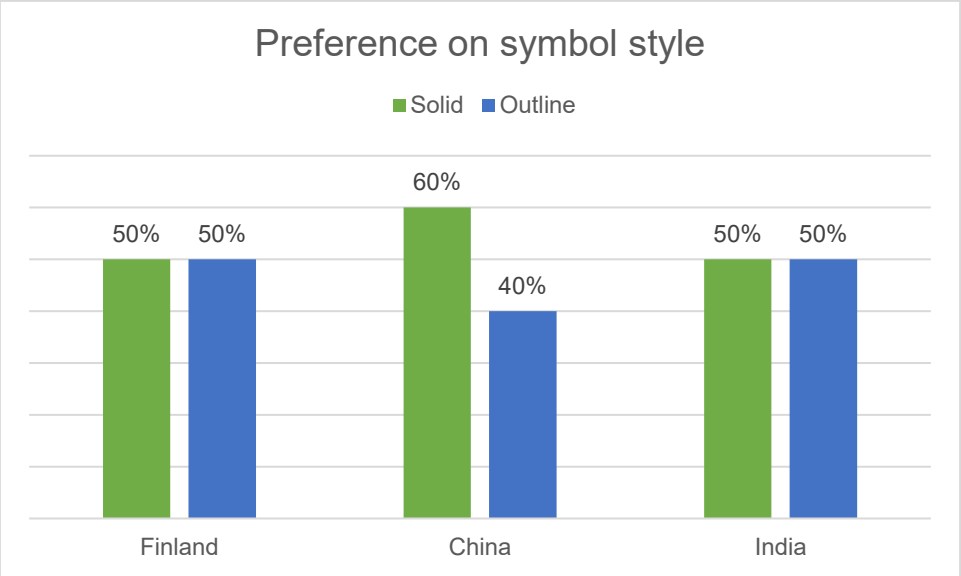

Figure 10. Preference on symbol style by country.

Aspect 3: Action taken by user to find out the meaning of an unknown symbol

This aspect focused on the action performed when experiencing problems to understand a symbol. The aim is to investigate the source of information used by the user. Research results indicated the following preferences: From Finnish participants, 37% preferred using the reference documentation, 23% preferred guessing the meaning, 22% would ask a colleague while only 19% preferred searching online. From Chinese participants, 31% preferred searching online, 31% would ask a colleague, 23% preferred using the reference guide while only 15% would guess the meaning of the symbol. From Indian participants, 33% preferred using the reference guide, 33% would perform an online search, 17% would ask a colleague and 17% preferred to guess the meaning of the symbol.

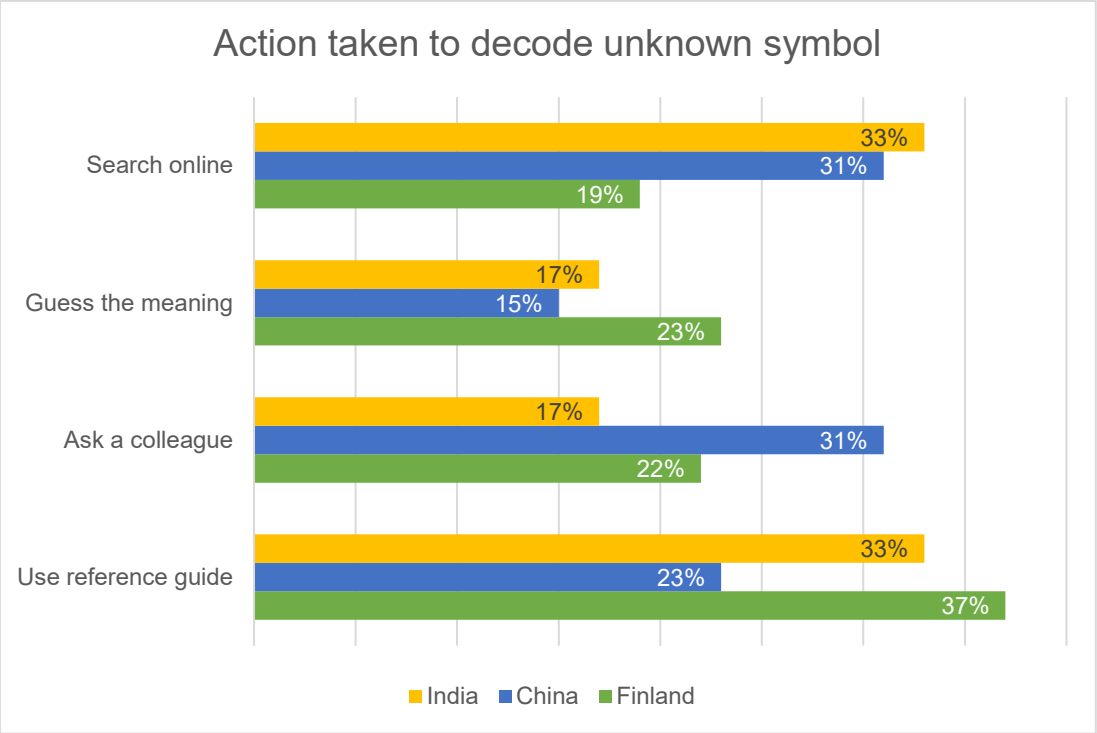

Figure 11. Action taken to decode unknown symbol by country.

Aspect 4: Efficiency of animation to describe instructions in technical documentation

Research data indicates that the majority of participants (Finland 79%, China 80%, and India 100%) agreed and strongly agreed that using animated symbols improves the description of instructions in technical documentation. A smaller number of participants partly agreed that animations were effective in this kind of situations (Finland 21%, China 20%).

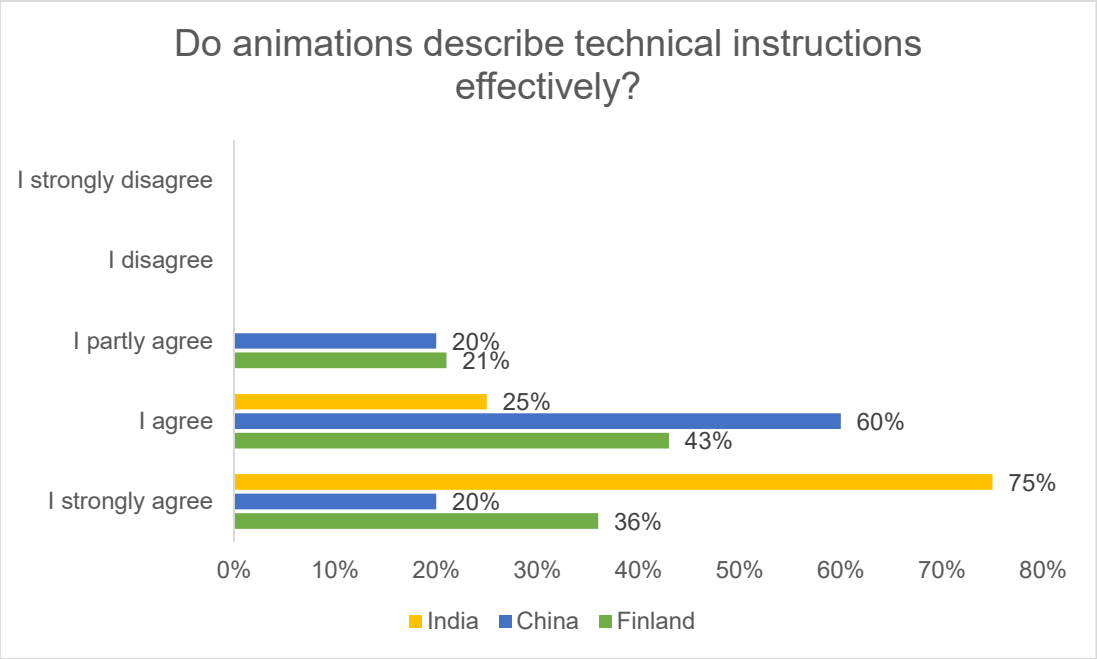

Figure 12. Efficiency of animation to describe instructions in technical information.

Aspect 5: Comparison between animation and static graphic symbols

Research data indicates that the majority of participants (Finnish 72%, Chinese 80%, Indian 100%) agreed that animations are much easier and slightly easier to understand in comparison to static symbols. However, a minor number of participants (Finnish 28% and Chinese 20%) agreed that animated and static symbols have about the same level of difficulty.

According to data, no participant found using animations difficult. It is also important to mention that animations were totally accepted by Indian participants.

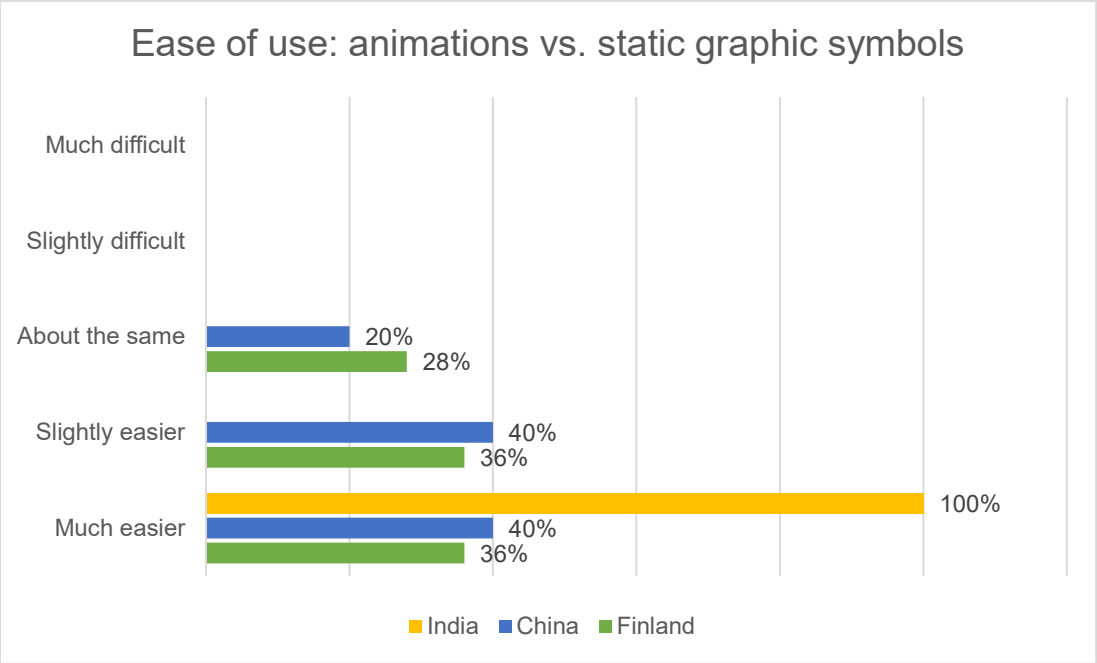

Figure 13. Comparison difficulty between animations and static graphic symbols.

4.4 Summary

The user research was performed with 23 participants, where majority were male. There was a higher number of participants from Finland (14 out of 23). Regarding to age, 91% of participants were between 25 and 59 years old. Most participants were actively working in maintenance (48%) and documentation (39%) tasks. Regarding to work experience, 61% of participants had more than 10 years' work experience.

Results on preferences for symbol type and style reflected that majority of Finnish and Indian participants preferred pictorial symbols while a slight majority of Chinese participants preferred abstract symbols. There was no significant difference among participants on symbol style (solid and outline).

Regarding the source of information used to decode an unknown symbol: for Finnish participants, the most preferred source was the technical guide and the least preferred was online search; for Chinese participants, the most preferred source was searching online or asking a colleague while the least preferred was to guess the meaning of the symbol; for Indian participants, the most preferred source was searching online or using the reference guide while the least preferred was guessing the meaning or asking a colleague.

Regarding the efficiency of aminations, majority of participants agreed and strongly agreed that animations can describe effectively technical instructions (Finland 79%, China 80%, and India 100%).

Regarding the easiness of using animations compared to static graphic symbols, Indian participants' preference for animations was unanimous; Chinese (72%) and Finnish (80%) participants agreed and strongly agreed that animations are easier to understand than static graphic symbols. Results on the use of animations reveal that there is a great potential for using animations in technical documentation. It may be an advantage to use animation in places like India where clearly there is a predominant preference for animations.

5 RE-DESIGN WORK AND EVALUATION

According to user research, a certain number of custom static symbols and animations used at KONE's technical documentation required design improvement in order to achieve an optimal user experience. In addition to that, there was a need for creating new symbols for specific actions that are recurrent in the field. The re-designing process focused on preliminary assumptions from the user research and on suggestions provided by the participants in the research part. The design process followed basic design principles and cross-cultural design principles as well. The still images (SVG format) for the static graphic symbols and the animations (GIFs) were created and modified using Adobe Illustrator.

5.1 Re-design work

The newly designed graphics were divided into two groups: static symbols and animations.

5.1.1 Static symbols

5.1.1.1 MEASURE

Measuring is a one of the most common actions performed at the work field. Inside the instructional guides, the action of measuring has been represented by several symbols, for example: ruler, measuring tape, roller tape, etc. In order to simplify this particular action, a unique but familiar symbol was required.

Figure 14. *Measure* graphic symbol (new version).

The main approach for the creation of this graphic symbol for such an important action was to rely on the users' preferences that were reflected in the user research. Strong preferences such as the use of pictorial symbols and outline styling were used in this graphic symbol. The aim of the new graphic symbol was to resemble the tool used by the technicians at the field.

5.1.1.2 ENTER THE ELEVATOR CAR ROOF

Another common action in the work field is accessing the elevator car roof to perform work duties. Previous attempts to represent this action failed to describe the action clearly. The previous version of the symbol for this action was largely abstract and confusing for most users (See figure 15).

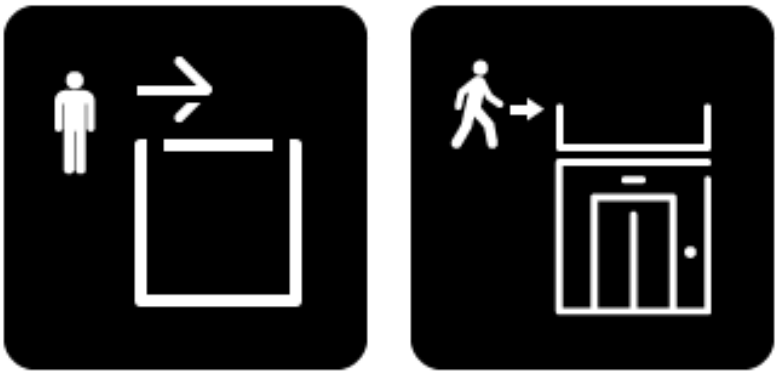

Figure 15. *Enter the elevator roof* graphic symbol. Left (old version), right (new version).

The re-designing of this symbol focused on providing a more intuitive graphical representation of the action. The new symbol used a pictorial approach including visual details to resemble the elevator and the roof area on top. It also aimed to simplify the visual element for the direction of the user by using a more generic arrow. The new symbol uses a side perspective for the user character which is often used for specifying a walking direction.

5.1.1.3 SWITCH ON SHAFT LIGHTS

Illumination of the working spaces is essential during any maintenance or installation activity. For this situation, a symbol that represents the action of switching-on the shaft lights was required. Although there are different ways to represent a *light-switch* or

simply *light*, it was a challenging task to create a symbol that can successfully represent the action inside a specific environment.

The new symbol required to represent the action effectively and in a simple manner. After different attempts, an abstract approach was used in the creation of the new symbol. The criterion for applying this approach was that abstract symbols can express more complex meanings which may include more than one element. The symbol intends to represent the action of switching on the lights inside the shaft environment.

Figure 16. *Switch on shaft lights* graphic symbol (new version).

The final version of the new symbol proposed a simple and minimalist solution using a graphical representation through a bulb. A light bulb is often associated with source of light and it is used in different cultures. Symmetrical vertical lines on the sides were used to resemble the shaft. Overall, minimal number of details were applied in the new symbols as, according to user feedback, excessive use of details inside a symbol is unnecessary and may cause confusion. Another reason for avoiding adding many details inside the symbols was the fact that these are visualized from small screens.

5.1.2 Animations

Although animations were strongly accepted among participants during the user research, few suggestions for design improvement were mentioned. According to feedback, animations required modifications in the design, specifically on graphical elements inside the animation sequences. The animations presented some problems with continuity and symmetry. For example, the arrow element which represents the direction, movement, or trajectory of a specific object inside the sequence was discontinued (See figure 17). Participants mentioned that discontinuation of the arrow inside the animation was confusing and

misleading. Also, a problem with the size of an element representing a bolt was noticed by the participants (See figure 18).

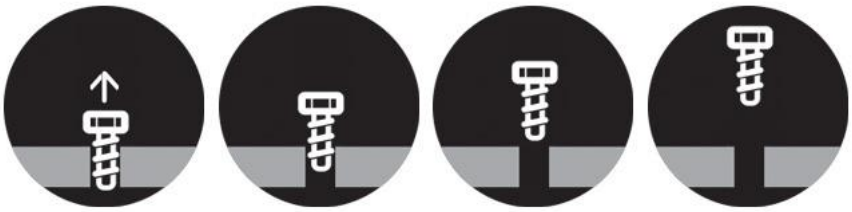

Figure 17. *Screw out* animation sequence (before re-design).

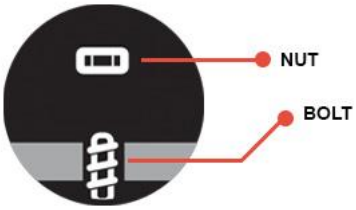

Figure 18. Design issue: Bolt size too short.

In order to enhance the sense of direction within the animations, arrow elements were included in the second and in the third frame of the animation sequence. This approach aimed to provide a more comprehensive clue to the user on how the action must be performed. The GIF animation can be displayed in a loop using a logical continuity. Additionally, modifications in appearance, specifically in size, were applied for some elements to match with the rest of the animation elements.

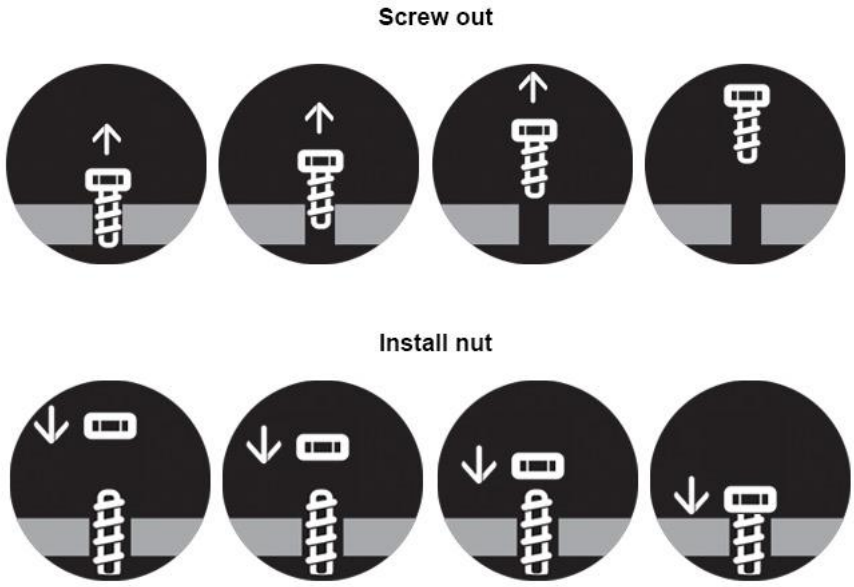

Figure 19. Re-designed GIF animation sequence.

5.2 Expert evaluation

After the re-design work, an expert evaluation was conducted in order to assess whether the new symbols and animations were suitable for technical documentation. Five experts from KONE were participated in the evaluation. The experts were given a short questionnaire with five open questions focusing on general impressions and suggestions on the new graphic symbols and animations. All the answers were collected anonymously in order to guarantee an objective feedback.

Table 2. Background information of participants

Participants	Field of expertise
Participant #1	Content writing
Participant #2	Content writing
Participant #3	Maintenance method development
Participant #4	Content writing
Participant #5	Maintenance method developer

The experts expressed a high satisfaction on the new graphic symbols and animations. "*I really like the usage of symbols and animations especially in task topics. These symbols help the readers to understand the actual task more easily and quickly"* (Participant #1). "*They look more clear and easier to read, less stress to the eye than our current symbols with mostly white fill colour"* (Participant #2). "*Signs looks informative they are representing the information's clearly"* (Participant #4).

Majority of the experts acknowledged an important design improvement in the new symbols and animations in comparison to previous versions. However, a minority (2 out of 5 participants) suggested that some improvement could be done on a specific graphic symbol: *go to elevator car roof* symbol. "*All those symbols and animations looks good but that car roof symbol. That is unclear for me if I see only that symbol"* (Participant #3). "*These symbol actions are straight forward and clear" (Participant #4).*

All experts agreed that the new set of symbols and animations can be easily blended into the technical documentation at KONE. "*These symbols will be really handy and reader-friendly"* (Participant #1). "*Yes, after harmonizing the style of existing KONE symbols with the new ones"* (Participant #2).

The participants expressed their optimism on the implementing the new graphic symbols and using GIFs in their documentation. They also provided interesting suggestions, for instance, testing the new graphic symbols and animations in devices such VR/AR glasses in order to test their responsivity in different screen sizes. They also suggested to harmonize the new custom symbols with the existing set of symbols used in technical documentation.

5.3 Summary

The expert evaluation provided an objective and accurate feedback on the re-designing of symbols and animations. All observations and suggestions were carefully collected and analysed. The results reflected a strong approval on the new designs. Participants considered the new set of symbols and animations as clear, user-friendly and effective graphics that can be used in their company's technical documentation. However, the evaluation also brought criticism and suggestions on specific designs.

In general, the feedback from KONE experts was extremely important to identify new options for improvement which can be considered in future re-designing processes. The positive outcome of the evaluation was used to validate the re-design of custom symbols and animations.

6 DISCUSSION

Results on preferences for symbol type revealed that pictorial symbols were more popular among Finns and Indian participants while abstract symbols were for Chinese participants. The explicit nature of pictorial symbols to represent an object or an action seemed to be a relevant factor to obtain a higher acceptance than abstract symbols. The implicit nature of abstract symbols certainly requires learning for being understood, thus a higher commitment from the user.

Regarding graphic styles, no significant differences were found in participants' preferences, neither for outline nor solid styles. According to participants, outline styles were helpful in describing details while solid styles were helpful in catching attention. These results on graphic styles are also reflected in a similar study made for icon recognition presented by interface designer, Alla Kholmatova [2013]. According to Kholmatova's informal study, not important difference was found in the response times in participants when selecting between filled-in or outline icons [Kholmatova, 2013].

The study also revealed that majority of participants had more than a decade work experience in their field of expertise which implicates that most users are familiar with symbols used in industry. The constant exposure to graphical symbols may explain why most participants were able to provide constructive and precise criticism in their feedback for abstract custom symbols.

Within the research, some interesting facts about users' behaviour were found, for instance, a considerable number of Chinese participants would trust work colleagues to decode a symbol they do not understand. This could be interpreted as a cultural fact. According to Hofstede's cultural dimensions, China is a highly collectivist culture; In collectivist societies, relationships with colleagues are cooperative for in-groups. Another relevant discovery was that a significant amount of Chinese and Indian participants preferred online searching for decoding unknown symbols while Finnish participants preferred using the reference guide. Although participants did not specify the reason to opt for such a choice, we can present two possible reasons for that: English language proficiency and the increasing usage of internet to access information. English proficiency in China and India is often lower in comparison to Western countries. Even though KONE

does localization for their technical documentation, instruction guides are often written in English language.

Research results on impressions towards using animations provide implications for documentation designers. Majority of participants, especially Indian and Chinese, expressed their approval on using animations in technical documentation. Participants agreed that animations are descriptive and easy-to-follow. Certainly, animations provide movement and direction which may represent an advantage for guiding people. When comparing animations and static graphic symbols, most participants mentioned that animations were more efficient, specifically among Indian participants. The high preference for animated graphics among Indian participants was a revealing discovery.

The re-designing of symbols and animations was validated by the experts' evaluation outcome. Experts' feedback reflected the importance of design principles in order to create efficient symbols and also emphasized the use of animations in documentation. Experts at KONE supported the inclusion of the new set of graphic symbols and animations into the current technical documentation.

7 CONCLUSION

According to study results, no significant differences were found between Finnish, Chinese and Indian participants on their preferences for symbol type and style used in technical documentation. However, cultural differences were identified on their behaviour which can be aligned with Hofstede's cultural dimensions such as *collectivism* in Chinese participants and *uncertainty avoidance* in Finnish participants. Cultural characteristics provided design implications for the localization of custom symbols in instructional documentation in China and India. Providing explanatory text in the local language might ensure the correct understanding of custom symbols.

The investigation revealed a slight preference for pictorial symbols due to their simplicity to describe objects or ideas. On the other hand, abstract symbols were appointed to be helpful in actions with complex meanings. Prioritizing the use of pictorial symbols over abstract symbols for representing simple meanings could be considered in future custom symbols' designs, especially when designing for multicultural audiences. Further studies on graphic styles focusing on custom symbols might be necessary to understand the advantages of each kind.

Participants' impressions on the use of animations in technical documentation confirmed that there is a great potential for the implementation of animated graphics in instructional documentation, especially in India. The increasing usage of screen devices such as laptops, mobile phones and tablets provide an optimal scenario for the inclusion of animations in technical documentation.

Overall, this study suggests that there is no strong evidence to assume that cultural differences influence on attitudes towards custom symbols. However, the research was done with participants who had a significant work experience, thus a strong familiarity with symbols used in industry; their impressions might differ from those who are novice in the field. The importance of design evaluation was highlighted during the re-design of custom symbols and animations. Design evaluation in early stages of any design process is essential to avoid potential design constrains in later stages.

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APPENDIX

A1: ONLINE SURVEY

1. Please, select your gender:

- Male
- Female
- Other / I prefer not to tell

2. Please, select your group age:

- 18 to 24 years old
- 25-39 years old
- 40-60 years old
- Over 60 years old

3. What is your nationality?

- Select (from list of countries)

4. Which KONE branch are you currently working at?

- China
- Finland
- Germany
- India
- United States
- Other:

5. What's your profession or area of expertise?

- Maintenance
- Installation
- Documentation
- Other:

6. How long have you been working in your profession?

- Less than 5 years
- 5-10 years
- 10-20 years
- More than 20 years

7. Where do you usually read technical instructions/information from?

- From paper (for instance: Guidance book, Printed documents)
- From a laptop
- From a tablet
- From a mobile phone
- Other:

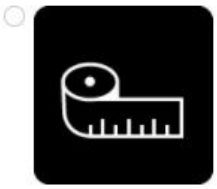
8. How often do you experience problems to understand symbols that are in the instruction guide?

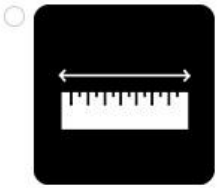
- Always
- Often
- Ocassionally
- Rarely
- Never

9. While you are performing a task, what do you do when you don’t understand a symbol from the guide?

- Search for the meaning of the symbol in the guide
- Ask a friend or co-worker
- Try to guess what is the meaning
- Use an online search tool (for instance: Google, Bing, Baidu, Yahoo, etc)
- Other:

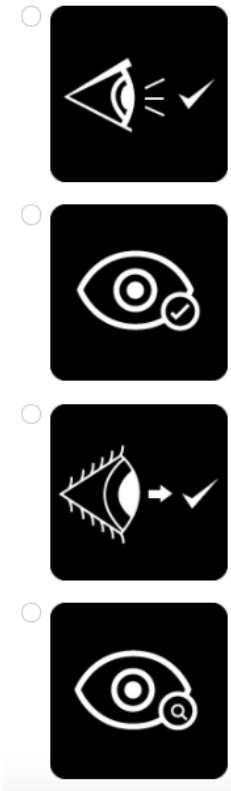
10. Which one of the following symbols is the best description for "MEASURE"?





11. Which one of the following symbols is the best description for "ADJUST"?

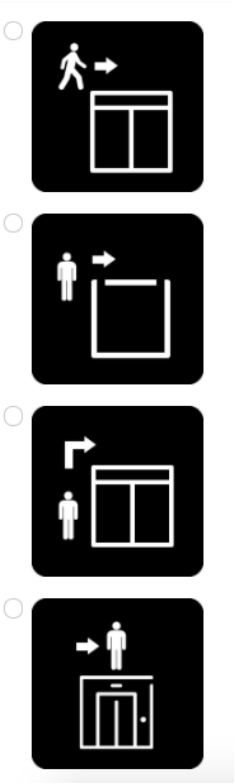
12. Which one of the following symbols is the best description for "VISUAL CHECK"?



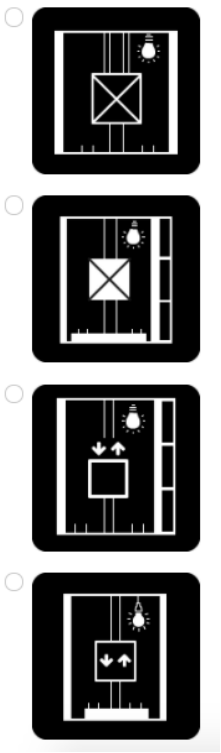
13. Which one of the following symbols is the best description for "CLEAN THE SITE"?

14. Which one of the following symbols is the best description for "INHIBIT DOORS OPENING"?

15. Which one of the following symbols is the best description for "ENTER THE ELEVATOR CAR ROOF"?



16. Which one of the following symbols is the best description for "SWITCH ON SHAFT LIGHTS"?



17. How well does the animated symbol below describes the action "DISCONNECT PLUG"?

[animation]

- Extremely well
- Very well
- Moderately well
- Slightly well
- Not at all well

18. How well does the animated symbol below describes the action "SCREW OUT"?

[animation]

- Extremely well
- Very well
- Moderately well
- Slightly well
- Not at all well

19. How well does the animated symbol below describes the action "INSTALL NUT"?

[animation]

- Extremely well
- Very well
- Moderately well
- Slightly well
- Not at all well

20. How important is to add a written explanation of the meaning of an animated symbol to be more understandable?

- Extremely important
- Very important
- Moderately important
- Slightly important
- Not at all important

21. To what extent do you agree that animated symbols help to understand better the instructions from technical information?

- I strongly agree
- I agree
- I partly agree
- I disagree
- I strongly disagree

22. How much easier is to understand animated symbols in comparison to static symbols?

- Much easier
- Slightly easier
- About the same
- Slightly difficult
- Much difficult

23. Do you find animated symbols visually disturbing while performing a task?

- Yes
- No

24. In what kind of situations would you find animated symbols useful? Where and/or when would they help you to understand instructions in a more effective way?

25. Any other comments regarding symbols or about this questionnaire?