



## AN ABSTRACT OF THE THESIS OF

Douglas L. Van Bossuyt for the degree of Master of Science in  
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Mechanical Engineering Design Across Cultures: A Method of Designing for Cultures

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Mechanical design is often based on formal methodologies such as Quality Function Deployment. Techniques to quantitatively account for attractability, sensory perception, and affective design have been successfully incorporated into these methods and are receiving growing acceptance across many industries.

Although the adoption of these methods marks a large improvement for mechanical designers, more advances in design methodology are needed.

Recently, mechanical design engineers have run into problems moving designs across cultural boundaries. As mechanical design engineers move forward with creating designs to be sold to culturally different and distinct groups of consumers, methods must be developed to aid in minimizing the number of people who are un-attracted to a product.

This thesis proposes one potential method to address cultural factors in the design process. An extensive review of literature on subjects important to the

development of techniques for incorporation of cultural considerations into mechanical engineering design methodologies is presented. Cultural methods used in other disciplines are surveyed. Practical advice on avoiding ethnocentrism in engineering design is given. An example of the method proposed in this thesis is developed. The shortcomings and strengths of the proposed method are discussed. The thesis concludes with potential future avenues of research.

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Mechanical Engineering Design Across Cultures: A Method of  
Designing for Cultures

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I understand that my thesis will become part of the permanent collection of Oregon State University libraries. My signature below authorizes release of my thesis to any reader upon request.

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Douglas L. Van Bossuyt, Author

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## DEDICATION

To my friends and family all around the world.

## Chapter 1 – Introduction

By no fault of their own, many mechanical design engineers in the private world and academia do not think about how their designs affect and are accepted by cultures other than their own. There are many different sources for this ignorance of other cultures. To rectify the situation, some advocate for in-depth training in cross-cultural understanding, cultural awareness, and other soft sciences [5].

Some universities do try to instill a broad cultural background in their engineering students by requiring liberal arts courses in language, anthropology, and other culture-heavy topics. However, engineers often do not gain substantial cultural knowledge from these classes. Further, many engineers, not realizing the worth of such coursework, neglect the liberal arts content in favor of hard science and engineering material.

Certainly, it would be very desirable for design engineers to receive and remember in-depth cross-cultural training. However, it is not practical for engineers to become well-versed in these fields. Instead, a tool is needed to provide a competent engineer with the ability to quickly and effectively diagnose a design or proposed design with regards to its compatibility with a specific culture or group of cultures. This text attempts to create and demonstrate the use of just such a tool.

Mechanical engineering design is often based on formal methodologies such as Quality Function Deployment (QFD). Techniques to quantitatively account

for attractability, sensory perception, and affective design have been successfully incorporated into these methods and are receiving growing acceptance across many industries. As mechanical design engineers move forward with creating designs to be sold to culturally different and distinct groups of consumers, new methods need to be developed that work under the umbrella of QFD.

This text first reviews justifications for the research. Several examples of cultural problems in mechanical design are presented. An overview of current tools, or the lack thereof, in engineering is given.

The definition of culture is given in-depth treatment. Many different definitions exist in many different disciplines. Finding a definition that suits mechanical engineering design proves to be somewhat challenging although one is settled upon.

An overview of the field of cultural dimensions research is provided. Background on the development and application of cultural dimensions is reviewed. Specific attention is paid to Global Leadership and Organizational Behavior Effectiveness Research Program (GLOBE) and Hofstede's cultural dimensions schemes – the two most mainstream in the literature and in practice.

Applications of cultural dimensions in other fields is examined. User interface design and website design are two of the largest application spaces within the broad context of engineering. The one lone example of a design that can be construed as mechanical is reviewed and found wanting.

A method for combining information garnered from sources of cultural information into QFD and the House of Quality (HoQ) are presented. Cultural dimension data, cultural profiles, and cultural probes (when available) are mined for poten-

tial cultural customer requirements. Methods for dealing with multiple cultural customers are presented. An example of the method in action is presented using an airplane lavatory as the subject of the design.

The major pertinent shortcomings and benefits of the presented method are discussed. Avenues for mitigating the shortcomings are examined. Future potential research possibilities are presented.

The work presented herein is a first attempt at bringing cultural considerations into the mechanical design process. It is not expected to be a gold standard that can never be improved upon. This effort will be considered a success if it starts design engineers thinking more critically about the role that culture plays in their designs.

## Chapter 2 – Justification of Research Topic

### 2.1 So What is the Problem?

Designing effectively for cultures that a designer has never had significant and meaningful exposure to is difficult. This is as a result of the cultural norms and implicit assumptions a designer makes about the customer. A designer creating a product for the same market to which the designer is native has a higher probability of creating a design that is satisfying or perhaps even delighting [6, 7] than if creating a design for a different culture that the engineer has never before encountered. Often, designs developed under the latter condition result in product failure and customer dissatisfaction [8].

Some may believe that they know everything there is to know about a culture, be it their own or another, but as Rohner states, “. . . no single individual ever knows the totality of equivalent and complementary learned meanings that define the ‘culture’ of a given population, and it is therefore unlikely that the person is able to activate, at any given moment, the full range of meanings that define the ‘culture’ of his or her people” [9]. It might not be necessary, however to know every detail about a culture to design for it. Rohner continues, “complementary meanings free one from the necessity of having to know all of one’s ‘culture.’ For example, most persons do not need to know how to behave as a physician or

shaman if they are ill, only how to behave properly as a patient. However, as even the most basic marketing textbook states, 'Know Thy Customer.' Not every facet of life of a carpenter in Indonesia must be known to support the development of a new hammer but enough must be known to develop one that the carpenter can use and will want to use" [9].

Failed designs and systems include a major aircraft interior manufacturer's attempt to add enjoyable scents to aircraft; color choice for software in China; the use of dogs to sniff out bombs, drugs, and other contraband items; the failure of the Walt Disney Corporation to adequately determine what aspect of the EuroDisney theme park would produce revenue; amusement park rides that require participants to wear pants and aisle chairs used to transfer mobility impaired passengers onto airplanes that require passengers to wear pants; and rice cookers that cook rice not to the taste of certain cultures. Many other examples of failed designs exist in literature and in everyday life. Even armed with the knowledge that customers are unhappy, most companies and governments that use the examples listed above persist with dissatisfying customers. The examples are discussed below.

*Aircraft Smell:* At one time, a major aircraft interior manufacturer tried to develop a scent to inject into aircraft cabins. The scent was designed to smell pleasing, elicit a sense of calm and security, and pacify the passengers during boarding, the flight, and disembarking. The interior manufacturer conducted the appropriate research and user testing, and developed an odor that was pleasant for everyone in the test groups. This manufacturer was based in the United States of America. All testing and development was done in the USA. Soon, it came time

to give it a try in some overseas markets.

The Chinese users who were first exposed to it hated the smell. Rather than pleasant and pacifying, the odor was nauseating and agitating. The manufacturer was baffled at first. Upon further research, they found that the odor preference for Chinese users is very different than for USA users. In fact, smells that the Chinese test subjects enjoyed were found to be disagreeable to American subjects. The company ended up never bringing an aircraft smell to market. There was no way of satisfying all users of an aircraft all the time because there was too much variability between what different customers would want their olfactory senses to detect.

*Chinese Color Choice:* Many international firms have moved into China in the last two decades. Some of these companies sell software to Chinese users. Until recently, software was designed for an American or European target market. Localization generally only went so far as to change the language of the text displayed in the programs. Color to distinguish warning screens, important system messages, and other functions of the software was chosen based on color interpretations of the culture designing the software. For instance, the color red indicates danger or a warning in Western cultures while it represents good luck and celebration in China [10]. Similarly, yellow serves as a warning color in the west while it is perceived as nourishing in China [10].

Not surprisingly, the colors that were chosen represented their desired meanings in the cultures that authored the code but had far different meanings in China [11]. In fact, it turns out that the colors sometimes had the opposite meaning to a

Chinese user as they would to an American or German user. Assigning color based on American or European preferences largely ignores variations in color association across cultures [12]. Further research in China has found that even within a nation that might be viewed as largely homogeneous, cultural variations occur. Users in southern regions of China prefer bright colors while those in the north of China prefer more subdued palettes [13].

However, At least in China's case, things do change [14]. What once were unfamiliar color meanings are now being internalized by Chinese users. They have begun to associate standard colors used in the western workplace with certain meanings [15]. These associations did not previously exist [16, 17].

*Working Dogs:* Dogs have been used for thousands of years for many different jobs. The first record of dogs being used to find something or someone based on smell date back to 300 Before Common Era (BCE)<sup>1</sup> [18]. Today, dogs are found working with police units all around the world [19]. They can be trained to detect materials commonly used to start fires in arson investigations, explosives, people trapped in avalanches and collapsed buildings, early cancer indicators in urine [20], and illegal narcotics and controlled medications [21]. They can also be used for tasks such as crowd control, and fugitive apprehension.

While many people love dogs and keep them as pets at home, some cultures despise dogs. For instance, most cultures in the Arab world view dogs as unclean and are fearful of them [22]. In countries where political protests often occur, many

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<sup>1</sup>It should be noted that there is some debate over the appropriateness of using BCE over Before Christ (BC) or negative numbering common in astronomical texts. BCE is used here to indicate neutrality in this text on the topic of religion.

people are afraid of dogs. Even when smaller dogs, selected for their superior olfactory abilities [23], are used to conduct searches, many people still hold the image in their minds of civil unrest being quelled by ferocious dogs.

*EuroDisney:* Disneyland has been a cultural cornerstone of American society for over 50 years. Expanding from its original park in California to Disney World in Florida and Tokyo Disney in Japan, it seemed as if the Mickey Mouse juggernaut was too big and too ubiquitous to fail [24]. EuroDisney, now known as Disneyland Paris, proved that the company's success in the Japanese and American markets was not as easily replicable in the European market.

Within the first two years of opening, EuroDisney was on the verge of financial meltdown. At the time, a recession was in full swing in Europe. The Walt Disney Corporation, a 49% stake-holder in EuroDisney, blamed the economy and an unusually strong French Franc for the unfortunate turn of events in the Magic Kingdom[25]. Many academics believe that it was a clash of cultures that led to the restructuring of EuroDisney into Disneyland Paris [25, 24].

*Pants on Rides and in Planes:* Most exhilarating roller coaster rides built in the last 20 years require restraint by a harness or other device that straps between the legs of the rider. This keeps the thrill-seekers well-secured but can pose problems for those who do not wear pants. If the riders who wear skirts do not mind exposing skin for all the world to see, they can ride the ride. However, for those who take issue with exposing ankles, such as very conservative Muslims, these rides are inaccessible [26].

Likewise, mobility-impaired airline passengers must wear pants to be trans-

ferred onto and off of aircraft using many current aisle chairs. Many systems use straps that loop around or over the legs to hold people in place during entry and egress of the aircraft. Those who for religious or personal reasons who wear skirts or robes cannot use many aisle chairs [27, 28].

*Rice Cookers:* A domestic appliance company based in Europe found that entering the Asian rice cooker market was not as straight-forward as selling an existing product in a new market. Instead, they found it necessary to redesign the machine to suit Asian tastes - aesthetically, functionally, and gustationally [29]. Consumer tastes vary widely across cultures.

## 2.2 Tools Available to Mechanical Engineers

Currently, there are not many tools that provide explicit guidance for design based on culture. Various affective design tools can be used, but a deep and meaningful understanding of the culture must exist in the designer in order to be successful. Some tools, examined in Chapter 5, give suggestions as to how a mechanical engineering-specific tool can be created but nothing currently exists in the literature that allows for quantitative analysis of culture in mechanical designs.

This lack of clear guidance for mechanical design engineers needs to be filled. The world has and continues to globalize at an ever increasing pace [30]. Engineers from mono-cultural backgrounds and even those who have multi-cultural experience are generally not equipped to develop designs for cultures other than those in which they have experience. The tool developed in the following sections aims

to fill a portion of the gap in methodology for mechanical design engineers. It is not meant to be a complete solution that will design a perfect product every time. Instead, the tool is meant to aid competent engineers in the process of designing for cultures other than their own. Perhaps this tool will also hold value even for engineers designing within their own cultures.

## Chapter 3 – Defining Culture

Invoking the word *culture* brings up a myriad of potential meanings and images. The English word finds its roots in the Latin word *cultura* that stems from *colere*, meaning “to cultivate” [31]. Cells and tissues are cultured in biology. Whole organs can be grown to replace ones that are old, damaged, and defective [32]. Plants can be cultivated. None of the previously mentioned biologic systems are of interest to the purposes of this thesis. There is one more thing that can be cultured: the mind.

Looking inside the mind, what increases the amount of culture present? How does one enter cultural programming into the brain? The phenomenon of “mental programming” is mentioned in the work of Ibn Khaldun where he states: “Indeed, the mind in its original state is ready to absorb any influence, good or bad. As Mohammed has said: ‘Every child is born in a natural state. It is his parents who make him into [a specific culture]’ ” [33].

Is it even possible to have more or less culture between different minds? Questions of the level of culture present between different groups of Humans have been posed for many hundreds of years with sometimes disastrous results. Modern theories show that one culture being different from another is not grounds to call one primitive and the other civilized. Instead, cultural complexity and diversity is found spread throughout all of the known cultures of the world [34].

Television shows, sporting events, political rallies, and pop music concerts all are cultural events [35]. High-brow symphony performances and art gallery showings can be considered cultured [36]. Museums and aquariums are cultural institutions. Bridges and monuments, too can be part of the cultural landscape. Social codes and norms such as the way people dress, the language they speak, the religion they practice, the rituals they follow, and the manners they practice are all considered part of culture [37].

Is culture, therefore, part of society? Are they the same things? Kashima, from a Cross-Cultural Psychologist's perspective states:

“First, culture should be conceptually distinguished from society, by which I mean a human grouping of some size and structure. A grouping could vary in size from a relatively small tribe, to a nation-state, to humanity as a whole. A culture may be shared (to some extent) in a society, but culture and society refer to analytically separable, theoretical entities” [38].

Thus, as Kashima states, there are many different levels of culture. One culture can be contained partially or entirely within another.

Culture exists not only in the Human world but also in the animal kingdom [39]. Primatologists view culture as something that exists within all primates, not just *Homo sapiens* [40]. Other fields similarly argue that culture exists in elephants, dolphins, and many other animals [41].

With so many different facets and aspects to the word *culture*, how can an all-

encompassing definition be made? The oft-overlooked key is that there are many different definitions of *culture* that apply either very narrowly, as in the case of cultivating cells, or very broadly, as is the case in many of the definitions discussed in Section 3.1.

### 3.1 The Many Definitions of Culture

Culture has been defined, parsed, and redefined thousands of times across an untold number of fields. Many of these definitions do not prove particularly instructive to the main purpose of this text and are thus not discussed here. Even with throwing out definitions of culture often used by art critics, pop music icons, and microbiologists, hundreds of definitions remain. The mainstream definitions used in several fields including anthropology, business, psychology, and related areas are detailed in the subsequent subsections.

#### 3.1.1 Definitions in Anthropology

Many people first encounter a formal definition of culture when studying anthropology. Anthropology, after all, is the root of the bulk of modern studies of culture. If any field were expected to have standardized on a definition, it is anthropology that has had the longest time to create a definition. It can be argued that the most scholarly discourse of any field has also occurred in Anthropology. Instead of concentrating on a single, refined definition of culture, hundreds of definitions

have been created with more being spawned every day.

For instance, in 1953, Kroeber and Kluckhohn inventoried 164 different definitions of culture in the anthropological literature of the day [42]. These definitions not only approach culture with varying degrees of focus, but they also approach it either from an emic or etic perspective <sup>1</sup>. While Kroeber and Kluckhohn [42] did not explicitly call for a single definition to be settled upon, two decades later Keesing called upon the anthropological community to try to settle upon one narrow definition of culture [44]. Keesing's plea fell upon largely deaf ears. The number of definitions within anthropology continues to multiply with every passing year.

To add to the large body of definitions, both Kroeber and Kluckhohn defined their own meanings of culture at various points in their careers. Kluckhohn's definition reads, "Culture consists in patterned ways of thinking, feeling and reacting, acquired and transmitted mainly by symbols, constituting the distinctive achievements of human groups, including their embodiments in artifacts; the essential core of culture consists of traditional (ie: historically derived and selected) ideas and especially their attached values" [45]. Kroeber defines culture as "transmitted and created content and patterns of values, ideas and other symbolic-meaningful systems as factors in the shaping of human behavior and the artifacts produced

---

<sup>1</sup>In terms of research, including research on culture, research conducted from an emic approach aims to understand a topic from the inside. Research using an etic approach tries to understand a subject using universal categories [43]. In the case of culture, this would put descriptive anthropologists who describe a culture from first-hand accounts and field research in the emic camp. People who construct cultural dimensions to explain culture would be found with the etics.

through behavior” [46].

Similarly, Hall, another prolific anthropological writer, defined culture based upon patterns of context, time, information flow, and space [47, 48, 49]. De Mooij found that her concept of context as related to culture is very useful for understanding consumer behavior and advertising in different cultures [35].

The original anthropological definition comes from Tylor who in 1874 defined culture thusly:

“Culture or civilization, taken in its wide ethnographic sense, is that complex whole which includes knowledge, belief, art, morals, law, custom, and any other capabilities and habits acquired by man as a member of society” [50].

### 3.1.2 Definitions in Psychology

Psychology is rich with definitions of culture and the ensuing scholarly arguments back and forth between researchers. Psychology has a legacy of being intertwined with culture. At one time, psychology and culture used to be closely connected. Culture was an integral part of psychology, but then it was decoupled and ignored. In the last few decades, culture in psychology has made a comeback [38].

Nisbett describes four basic assumptions that have been made in psychology regarding human cognition and culture. They are listed in Table 3.1

Table 3.1: Nisbett’s Four Basic Assumptions of Cognition and Culture in Psychology (Adapted from [51, 52])

---

*Universality:* Basic cognitive processes such as sensation, perception, attention and memory are found throughout humanity and do not vary between cultures.

*Content Independence:* Basic cognitive processes do not vary between different content nor do they vary across different content and different cultures.

*Environmental Sufficiency:* General learning and inference cognitive processes equip children based on environmental circumstances. Environmental differences explain cognitive differences rather than cultural differences.

*Infinite Cultural Variance:* Cognition does not place constraints on the design space of cultures.

---

In general, psychologists study culture as the study of peoples, not people [53]. This is partially as a result of the bridge between culture and anthropology in the form of cultural psychologists. Shweder states the main goal of cultural psychologists is “not to draw up lists of common denominators. It is to understand a particular way of life, from a psychological point of view” [54].

Kashima distinguishes culture by way of breaking it apart from society. He thus defines culture by what it is not. “[A society is a] human grouping of some

size and structure. A grouping could vary in size from a relatively small tribe, to a nation-state, to humanity as a whole. A culture may be shared (to some extent) in a society, but culture and society refer to analytically separable, theoretical entities” [38]. Shweder extends the definition of culture to “local or community-specific ideas about what is true, good, beautiful, and efficient” [54]. Culture is thus somewhat muddled in psychology, much like it is in anthropology.

### 3.1.3 United Nations Definition of Culture

The United Nations Education, Scientific, and Cultural Organization (UNESCO) recently stated that “culture should be regarded as the set of distinctive spiritual, material, intellectual and emotional features of society or a social group, and that it encompasses, in addition to art and literature, lifestyles, ways of living together, value systems, traditions and beliefs” [55]. The definition comes from a United Nations (UN) declaration on the 2002 International Mother Language Day. The decree further goes on to outline what UNESCO does to promote and retain cultural and linguistic diversity. The UN definition encompasses a large portion of what prior definitions try to convey while also clearly bounding what is considered culture.

### 3.1.4 Definitions in Business

A couple of methods of defining and using culture have been settled upon in the academic business community. For instance, de Mooij found that it was more useful to use culture in advertising than try to define it. On the other hand, Hofstede succinctly defined culture and has made a career of quantifying the cultures of the world.

#### 3.1.4.1 de Mooij's Use of Culture

De Mooij states that, in the English language, culture is a very complicated word. She notes that culture is used to describe high art such as classical music, painting, sculpture, and the theater. It is used to describe popular art like Madonna or the Beatles. Biologists produce cultures of bacteria, and agriculture and horticulture are both incorporate the word into their respective fields. She finds that it is not as useful in business to define culture as it is to use it to find differences in the expressions of culture for marketing and advertising purposes [35].

#### 3.1.4.2 Hofstede's Culture Definition

Hofstede has become known as one of the leading scholars of culture among the business academic community. Starting in the 1960's during his stint at International Business Machines Corporation (IBM), Hofstede developed his first models of culture. Coming from a mechanical engineering background, he attempted to

quantify culture, discussed in Section 4.2. Hofstede’s definition of culture is very instructive for the rest of this text.

Hofstede defines culture simply as “the collective programming of the mind that distinguishes the members of one group or category of people from another” [1]. He reaches this definition from looking at several scholars in other disciplines including Kluckhohn [45, 56, 42], Kroeber and Parsons [46], and Triandis [57], and fusing this information with his own long experience. Hofstede goes on to expand on his definition of culture to include an “onion diagram” visualization, as seen in Figure 3.1 that places values at the center, rituals the next level out, heroes one level further out, and symbols as the outer-most layer. Practices is shown to penetrate from the surface through to the core-values.

#### 3.1.4.3 GLOBEs Culture Definition

The Global Leadership and Organizational Behavior Effectiveness Research Program (GLOBE) Study is a massive undertaking that recently created a new scheme of cultural dimensions. It is discussed in depth in Section 4.3. GLOBE is meant primarily as a tool for business researchers. The GLOBE definition of culture is “shared motives, values, beliefs, identities, and interpretations or meanings of significant events that result from common experiences of members of collectives that are transmitted across generations” [4].

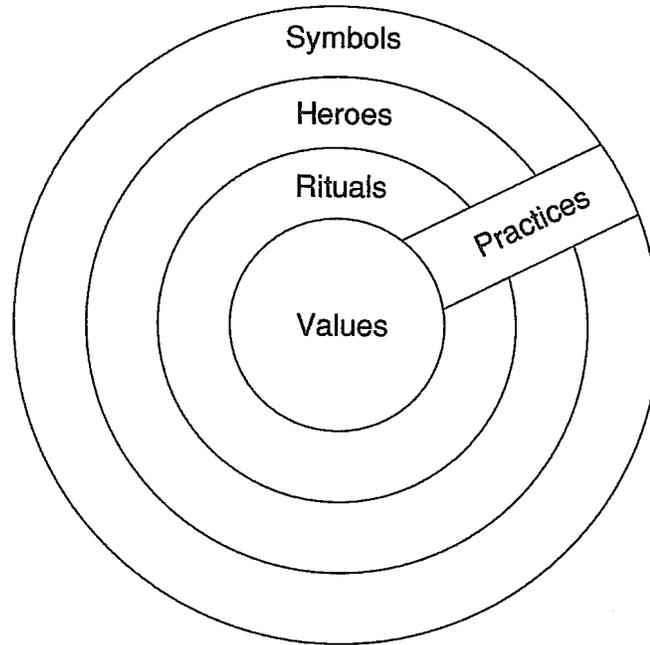


Figure 3.1: Hofstede's Onion Model of Culture: Cultural Values are located at the core and are surrounded by Rituals, Heros, and Symbols with Practices drilling down from the outside to the Values center. Reproduced from [1].

### 3.1.5 Do We Even Need to Define Culture?

Some scholars argue that it is not all that important to specifically define culture [58]. Segall argues that culture does not need a robust definition for academics to study its manifestations [59]. A few academics have hypothesized about an impending global cultural convergence due to industrialization and globalization [60]. These viewpoints are in the minority.

There are some who argue that even thinking of cross-cultural research is a Western construct of a universalist value proposition. For instance, Taft states:

“By the very act of engaging in cross-cultural research, the Western scholar has automatically imposed his own values into his transaction with his subjects, and if he wishes to go through with the exercise, they must accept the element of ethnocentrism that is inherent in this” [61].

Most, however, believe that culture does need at least some form of definition [62]. Many go as far as to develop their own theoretical and working definitions [9, 63], as were presented above. The author of this text believes that existing definitions of culture are sufficient for the purposes of this document.

### 3.2 Culture: A Phenomena at What Level?

Among the many definitions of culture there also exist many levels of culture. For instance, there are specific cultures within a home, in a neighborhood, at an elementary school, in a town, in a state, in a region, and in a country. Often, neighborhoods, towns, and even countries share many of the same cultural traits. Sometimes households can have radically different cultures within yet still be neighbors. It is therefore difficult to pick at exactly what level of culture is appropriate to conduct analysis [64].

Looking at within-nation-level cultural variations, Schwartz found that in 183 of 187 instances, the cultural differences between nations were greater than the differences within nations [65]. However, Marcus found that even within a nation that might be viewed as largely homogeneous, cultural variations occur. He found that people in southern regions of China prefer bright colors while people in the

north of China prefer more subdued palates [13].

A multitude of studies have studied and confirmed cognitive differences between Asians and Europeans. For instance, casual attributions and predictions, categorizations based on rules, family values, and shared taxonomical labels or relationships differ between Eastern and Western societies [66, 67, 68, 69, 70, 71]. Asian cultures are generally field dependent with respect to detecting relationships between objects and are not as capable of distinguishing objects from the surroundings in the Rod and Frame test<sup>2</sup> as European cultures [72] but Asians see more background information and relationships than Westerners [73]. Clearly, cultural groups such as Easterners and Westerners must be analyzed. But does culture need to be discretized to a lower level than this?

Hoeken et. al. studied Western European markets to determine if they are truly segmented between nations for advertising campaigns. They tested two hypotheses listed in Table 3.2. The authors determined that Western European audiences can in fact receive the same value appeals with the same results [74].

---

<sup>2</sup>The Rode and Frame test is a measure of field dependence versus independence where the subject is placed in a completely dark room. The subject attempts to adjust a luminous rod contained within a tilted luminous frame. The object is to adjust the rod to be completely vertical regardless of the frame tilt. People who are field dependent will be influenced more heavily by the presence of the frame. This results in a rod that is more tilted than the rod of people who are not as field dependent. Field dependence/independence is a cognitive style that is characterized by the ability to distinguish between perceptual and other experiences from their contexts or backgrounds. People with weak field independence have a hard time divorcing the object of interest from background objects.

Table 3.2: Hypotheses of Advertising in Western Europe.

(Adapted from [74])

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*Hypothesis 1:* Appealing to a high uncertainty avoidance value yields a more persuasive advertisement in Belgium and Spain whereas appealing to a low uncertainty avoidance value yields a more persuasive advertisement in the Netherlands.

*Hypothesis 2:* Appealing to a masculine value yields a more persuasive advertisement in Germany and the UK whereas appealing to a feminine value yields a more persuasive advertisement in the Netherlands.

---

It is thus very difficult for a researcher to determine at what level to examine culture. Determining this level has to be done on a project-by-project basis. As will be detailed in Chapter 4, most existing accepted data reside at the nation-level view of culture. Because of this, much of the quantitative research performed using quantitative cultural data is performed at the national level.

### 3.3 Culture: Ever-Changing or Always Constant?

Over time, cultures can acquire new associations due to usage of an initially unfamiliar user interface. For instance, Chinese users have come to associate standard colors used in the western workplace with certain meanings [15]. Previously, these

associations did not exist [16, 17].

Cognitive dissonance theory [75] has been used to estimate the likelihood of cultural change. Disparity between practices and values is seen as evidence of cognitive dissonance in respondents' minds. The tension caused by the cognitive dissonance logically must be resolved by an eventual shift in the culture. Two processes have been proposed for resolving cognitive dissonance [76].

The first proposed process to create cognitive consonance is individual behavior change. That is, changing current practices to align with desired cultural values. However, doing this on an individual level will not result in a nation-level cultural shift. Because of this, most people don't try. However, if it appears that most people are changing their practices toward a desired cultural value, people are more likely to change their practices [76].

The second process involves changing an individual's perception of their native culture. In other words, changing the perceived desirable values to the present reality of the culture. This, however, is unlikely to occur in most cases [76].

Most core cultural beliefs and values, however, do not change with any great speed. Data collected 40 years ago is generally as useful as data collected very recently. For instance, Hofstede found minimal deviation when he compared two surveys separated four years [1].

## Chapter 4 – Quantifying Culture

The concept of measuring culture in quantifiable terms first started showing up in the literature in the 1960's. Hall published a series of anecdotes in the Harvard Business Review that were intended to get American business people thinking about how cultures in different countries would affect their work overseas [49]. As part of the article, Hall broke cultural differences into different categories that he called “languages.” These “languages” are listed in Table 4.1.

Table 4.1: Hall’s Cultural Languages Categories.  
(Adapted from [49])

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Time
Space
Material Possession
Friendship Patterns
Agreements

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In the following decades, several scholars began to further refine the idea of quantifying culture. Hofstede was the first to publish a significant study defining (originally) four cultural dimensions [77]. Others followed suit including Schwartz [78, 79, 80, 65] and the Global Leadership and Organizational Behavior Effective-

ness Research Program (GLOBE) Study [4, 76]. The work of Schwartz has been largely ignored and dismissed by the bulk of the cultural dimensions community, and the GLOBE Study is still too new and too large for many researchers to use. Hofstede's original four cultural dimensions have been expanded first to five [1] and quite recently to six [81]. The GLOBE Study, however, will most likely one day supplant Hofstede's research as hundreds of academics have pinned their collective carriers on the successful outcome of the study.

#### 4.1 Schwartz's Cultural Dimensions

Schwartz and Bilsky found seven different measures of culture. However unlike Hofstede's dimensions, the Schwartz's measures are not independent of one another and thus are not dimensions. The seven measures are listed in Table 4.2.

Table 4.2: Schwartz's Cultural Measures

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Conservatism
Intellectual Autonomy
Affective Autonomy
Hierarchy
Mastery
Egalitarian Commitment
Harmony

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Some of Schwartz and Bilsky's measures do correlate with Hofstede's dimensions. Many of the measures also correlate with gross national per capita income. However, due to the method of construction of Schwartz and Bilsky's measures, their method becomes overly complicated for other researchers to effectively use. In the end, Schwartz's measures boil down to one dimension that can be summed up as a dimension representing a passive versus active attitude toward life. Additionally, limited data are available for countries as compared to Hofstede and GLOBE [78, 79, 80].

## 4.2 Hofstede's Cultural Dimensions

Hofstede's Cultural Dimensions first started to take shape in the late 1960's and early 1970's during his employment at International Business Machines Corporation (IBM). He and his colleagues conducted two rounds of surveys across the company's many worldwide offices. In total, more than 116,000 responses from 72 countries in 20 languages were generated. Hofstede's initial analysis was limited to 40 countries who had 50 or more respondents to the survey. Later Hofstede was able to add three multi-country regions and ten additional individual nations to the dataset [1].

The analysis Hofstede conducted on the massive dataset focused on the differences between countries in answers to questions about employee values. He validated the data taken from the employees at IBM by comparing it to data collected at the former International Management Development Institute in Lausanne,

Switzerland. Statistical analysis across individuals was conducted. Variance analysis was also performed on the data set by using country, occupation, gender, and age as criteria. It was found that the most crucial analytic tools were correlation and factor analyses that were based on matched employee samples across countries [77].

Through the lengthy analysis process, Hofstede found four cultural dimensions. They are Power Distance Index (PDI), Uncertainty Avoidance Index (UAI), Individualism versus Collectivism Index (IDV), and Masculinity versus Femininity Index (MAS) [77]. The PDI and UAI dimensions were found through what Hofstede terms an “eclectic” analysis of the data based on correlation analysis and theoretical reasoning. IDV and MAS were derived from country-level factor analysis of scores on work goal importance, standardized for eliminating acquiescence [1]. Further information on the derivation of this dimension can be found in Appendix C. Upon later reflection and research, Hofstede found that Inkeles and Levinson predicted Hofstede’s four cultural dimensions in a review article published in 1969 [1, 82].

Hofstede conducted a country-level factor analysis of the dataset to create an integrated picture of the four dimensions. He conducted a comparison between the two survey rounds and found that there were only minor country-level value shifts over the six years between the surveys. He verified the statistical independence of the four dimensions. The four dimensions were validated against Rokeach’s Values Survey [83]. The results compared favorably [43]. Hofstede’s four dimensions allowed him to form cultural clusters of nations throughout the world where the

cultural dimensions are largely the same [1]. Further information on how Hofstede conducted his research and data analysis can be found in Appendix C.

Several years after Hofstede released his seminal work, Bond and Hofstede collaborated on a survey known as the Chinese Values Survey [84]. From that survey, Hofstede found a fifth dimension that would remain his final cultural dimension until 2008. It is Long-term versus Short-term Orientation Index (LTO). The five cultural dimensions and Hofstede’s descriptions of them are presented in Table 4.3.

Table 4.3: Hofstede’s Five Cultural Dimensions. (Quoted and adapted from [1])

Cultural Dimension	Description
Power Distance Index (PDI)	The extent to which the less powerful members of organizations and institutions accept and expect that power is distributed unequally. The basic problem involved is the degree of human inequality that underlies the functioning of each particular society. <sup>1</sup>

Continued. . .

<sup>1</sup>Hofstede borrowed the term “Power Distance” from the Dutch social psychologist Mulder who conducted experiments in the 1960’s investigating interpersonal power dynamics [85, 86, 87].

Table 4.3: (Continued)

Cultural Dimension		Description
Uncertainty Index (UAI)	Avoidance	The extent to which a culture programs its members to feel either uncomfortable or comfortable in unstructured situations. Unstructured situations are novel, unknown, surprising, and different from usual. The basic problem involved is the degree to which a society tries to control the uncontrollable. <sup>2</sup>
Individualism Index (IDV)	ver- sus Collectivism	The degree to which individuals are supposed to look after themselves or remain integrated into groups, usually around the family. Positioning itself between these poles is a very basic problem all societies face. <sup>3</sup>

Continued. . .

<sup>2</sup>The term Uncertainty Avoidance is borrowed from Cyret and March [88].

<sup>3</sup>Sociology provides a variety of distinctions associated with IDV. Tönnie's distinction between *gemeinschaft* (low individualism) and *gesellschaft* (high individualism) is especially instructive [89].

Table 4.3: (Continued)

Cultural Dimension	Description
Masculinity versus Femininity Index (MAS)	The distribution of emotional roles between the genders, which is another fundamental problem for any society to which a range of solutions are found; it opposes “tough” masculine to “tender” feminine societies. <sup>4</sup>
Long-term versus Short-term Orientation Index (LTO)	The extent to which a culture programs its members to accept delayed gratification of their material, social, and emotional needs. <sup>5</sup>

In Hofstede’s 2001 book, he noted that additional dimensions must be both conceptually and statistically independent from the five dimensions that he had previously established. Further, he stated that they must be validated by significant correlations with external measures. He did not rule out more dimensions but he did challenge the community by stating “candidates are welcome to apply” [1].

<sup>4</sup>Surveys on the importance of work goals conducted at IBM and other companies showed that women almost universally attach more importance to social goals such as relationships, helping others, and the physical environment. Men attach more importance to ego goals such as careers and money. Additionally, the IBM database revealed that the importance respondents attached to “feminine” and “masculine” work goals varies across countries and occupations [1].

<sup>5</sup>LTO was unintentionally excluded due to the formulation of the original questions in Hofstede’s IBM surveys. This is most likely because the original surveys were written and exclusively by Westerner researchers including Dutch, British, French, Norwegians, and Americans who had their own cultural biases. From Bond’s later work in China, this dimension emerged [84].

In early 2008, Hofstede and his colleagues released a new cultural dimension. Hofstede's new cultural dimension is Indulgence versus Restraint [81]. This new dimension comes from research conducted by Minkov who used the World Values Survey databank [90] to find several potential new dimensions [91]. Hofstede currently only includes Indulgence versus Restraint in his cultural dimensions. The other dimensions that Minkov proposed are Exclusionism versus Universalism and Monumentalism versus Flexiunity. Table 4.4 provides more information on these new dimensions.

Table 4.4: Minkov's Proposed Additions to Hofstede's Cultural Dimensions. (Quoted and adapted from [92, 91, 81])

Cultural Dimension	Description
Indulgence versus Restraint (IVR)	Indulgence stands for societies that generally allow free gratification of desires and feelings, especially leisure, merrymaking with friends, spending, consumption, and sex. Restraint stands for a society which controls gratification, and where people are less able to enjoy their lives [81]. It is similar to the Tightness versus Looseness dimension that Gelfand [93, 94] recently proposed [91].

Continued...

Table 4.4: (Continued)

Cultural Dimension	Description
Exclusionism versus Universalism	This dimension is statistically very similar to Hofstede's IDV.
Monumentalism versus Self-Effacement <sup>6</sup>	The positive pole in this dimension is defined by national pride, the desire to make parents proud, and viewing religion as important. The negative pole contains the concepts of humility, and not believing one has a stable and invariant self. Minkov believes there are some correlations between this dimension and Hofstede's masculinity - femininity dimension [91, 92]. Hofstede also believes there is significant correlation but is continuing to investigate this proposed dimension [81].

<sup>6</sup>Originally Self-Effacement was called Flexumility, combination of Flexibility and Humility, by Minkov.

#### 4.2.1 Attempted Expansions and Explanations of Hofstede's Dimensions

Several scholars have attempted to expand on and explain the cultural dimensions produced by Hofstede. Several examples are listed below. Many of the derivative works, like those shown below, have not been accepted by mainstream scholars.

Tang and Koveos argue that changes in economic conditions are the primary drivers of cultural changes. They found that Hofstede's dimensions of individualism, long-term orientation, and power distance have a curvilinear relationship to national wealth as measured by GDP per capita. On the other hand, the dimensions of uncertainty avoidance and masculinity were found to be rooted in institutional characteristics and traditions such as language, religion, ethnic homogeneity, climate, and legal orientation. These dimensions, the authors theorize, are less likely to change over time [95].

De Mooji extends Hofstede's work from the domain of work-related values to that of consumption-related values and motives. She validates this through content analysis of television commercials and print advertisements, and by linking the data produced by Hofstede with secondary data on consumption, attitudes, and behavior [35].

Singelis et al. attempted to add additional dimensions to Hofstede's dimensions. They created a vertical and horizontal axis for the Individual versus Collectivism dimension [96]. It has not been met with much acceptance.

A paper by van de Vliert tested predictions relating to leadership and orga-

nizational behavior derived from the interaction between climatic circumstances faced by nations in different latitudes and national wealth. Van de Vliert's model shows that over time, climatic effects create different sets of challenges for different nations which are overcome either well, poorly, or not at all as a partial result of the level of wealth of that nation. Latitude, van de Vliert found, was an accurate way of determining cultural dimensions [97, 98, 99].

Smith suggests "the creation of national cultures must entail reference to historical factors, and must acknowledge wealth as being both a cause and an effect of other elements in a nation's adaptation to its context" [100, 101].

Georgas et al. identified wealth as explaining 77% of the variance in 23 different indices of ecology, economy, education, use of media, and population sampled from a total of 174 nations. There is obviously some sort of interaction going on between wealth and its various measures, and several dimensions proposed by GLOBE, Hofstede, and other researchers. Just how much it influences the dimensions and if it is significant in the grand scheme of things remains to be fully debated in the community [102].

#### 4.2.2 Criticisms of Hofstede's Cultural Dimensions

Since Hofstede's seminal work, some have criticized his efforts [103]. The authors of competing cultural dimension schemes are quick to criticize. So too are some academics that appear to have vengeance in mind rather than scholarly discourse. Typical examples of the criticisms Hofstede receives are presented in this section.

An article authored by several of the GLOBE survey investigators reads much like a personal attack [104]. The authors attempt to discredit Hofstede's work by detailing several areas that they feel the GLOBE survey addresses more appropriately than Hofstede's methods. The article is in response to a scathing critique that Hofstede wrote about the GLOBE study [105].

One researcher questioned Hofstede's cultural dimensions and the underlying assumptions [106]. Over the years, the author has continued to argue his point. A particularly entertaining back-and-forth battle has been raging on the Wikipedia entry for Geert Hofstede. It is somewhat obvious that the author of the critique continues to try to push his view while others among the Wikipedia community continue to remove it [107].

### 4.3 The GLOBE Study

The GLOBE Study, started in the early 1990's, took more than a decade to approach fruition. Part of the reason for the long duration between inception and results is the size and complexity of the study. In total, 170 investigators participated in 62 different cultures. Data was pulled from more than 17300 managers in 951 organizations to test 27 hypotheses [4, 76]. The study was massive in scope and participation. Many hundreds of professors and their grad students have attached themselves to the study, and have a vested interest in its success.

GLOBE attempts to answer five specific questions, listed in Table 4.5. The researchers believe that GLOBE has answered the questions. Others, such as

Hofstede, have their doubts [105].

Table 4.5: GLOBEs Specific Questions. (Quoted from [4])

- 
1. Are there leader behaviors, attributes, and organizational practices that are universally accepted and effective across cultures?
  2. Are there leader behaviors, attributes, and organizational practices that are accepted and effective in only some cultures?
  3. How do attributes of societal and organizational cultures influence whether specific leader behaviors will be accepted and effective?
  4. How do attributes of societal and organizational cultures affect selected organizational practices?
  5. What is the relationship between societal cultural variables and international competitiveness of the societies studied?
- 

Through statistical analysis, GLOBE found nine cultural dimensions. Some, however, claim that in fact GLOBE has 18 dimensions [105]. This is as a result of two measures of each dimension being present. One measure ranks an individual's perception of him or herself while the other measure ranks an individual's perception of other people within his or her own culture. Table 4.6 lists the dimensions and their GLOBE descriptions.

Table 4.6: GLOBE Cultural Dimensions (Quoted and adapted from [4])

Cultural Dimension	Description
Uncertainty Avoidance	The extent to which members of an organization or society strive to avoid uncertainty by relying on established social norms, rituals, and bureaucratic practices. People in high uncertainty avoidance cultures actively seek to decrease the probability of unpredictable future events that could adversely affect the operation of an organization or society and remedy the success of such adverse effects.
Power Distance	The degree to which members of an organization or society expect and agree that power should be stratified and concentrated at higher levels of an organization or government.
Institutional Collectivism (Collectivism I)	The degree to which organizational and societal institutional practices encourage and reward collective distribution of resources and collective action.

Continued...

Table 4.6: (Continued)

Cultural Dimension	Description
In-Group Collectivism (Collectivism II)	The degree to which individuals express pride, loyalty, and cohesiveness in their organizations or families.
Gender Egalitarianism	The degree to which an organization or a society minimizes gender role differences while promoting gender equality.
Assertiveness	The degree to which individuals in organizations or societies are assertive, confrontational, and aggressive in social relationships.
Future Orientation	The degree to which individuals in organizations or societies engage in future-oriented behaviors such as planning, investing in the future, and delaying individual or collective gratification.
Performance Orientation	The degree to which an organization or society encourages and rewards group members for performance improvement and excellence.

Continued...

Table 4.6: (Continued)

Cultural Dimension	Description
Humane Orientation	The degree to which individuals in organizations or societies encourage and reward individuals for being fair, altruistic, friendly, generous, caring, and kind to others.

The GLOBE study found that Hofstede’s Masculinity dimension was lacking. GLOBE replaced Hofstede’s one dimension with two: Gender Egalitarianism and Assertiveness. GLOBE researchers believe that Hofstede’s dimension is confounded by many items which they believe are irrelevant to the concept of masculinity. Further, they believe the Masculinity dimension also measures multiple constructs making it a non-pure dimension.

GLOBE counters the claims of Hofstede and others [105] by stating

“On an individual level of analysis [the level that GLOBE measures to make inferences about societal and organizational culture] the disparity between perceptions of practices and value judgments can be interpreted as deprivation. That is, when respondents perceive practices as less or more dominant in their society or organization than they think they should be, or perceive them as inappropriate, there will be a disparity between their reports of practices and values. On

a society or organizational level of analysis, their common perceptions of a disparity between practices and values imply the people’s sympathy with respectively higher or lower levels of cultural values than practices” [76].

Another phase of the GLOBE Study was recently released that attempts to combine both culture-specific and culture-general <sup>7</sup> approaches. A total of 25 individual country chapters are presented both at a culture-general level and a culture-specific level. The questions raised by Triandis and others [110] about sufficient sample size in the GLOBE Study are answered in [76] through follow-up work to confirm hypotheses that was conducted in India and the United States of America.

It should be noted that only leadership in organizations was studied by GLOBE. The sample populations consisted of middle managers who were selected from two to three identical industries found in all countries included in the survey. Clearly this does not provide a representative sample of an entire country. It does, however, provide a very representative sample of the group surveyed [4, 76, 111].

A problem not limited to GLOBE or Hofstede’s work comes from the investigators themselves. They all have their own cultural biases. Especially in the case of the GLOBE survey, where each country had its own set of domestic investigators administering the quantitative surveys and conducting qualitative cultural research, there is a real risk of cultural blindness. A phrase such as “the fish is

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<sup>7</sup>The standard criticism of the culture-general approach – neglecting the nuances and subtleties of a culture due to high levels of abstraction [108] – is addressed in [76] by augmenting constructs of the culture-general approach with culturally contingent findings and concepts [109].

the last to discover water” nicely sums up the problem of being blinded to one’s own cultural differences. Varying efforts are made within most modern respected studies to correct for within-culture cultural biases. This can take the form of culturally removed observers examining the research to multiple co-investigators from widely different cultural backgrounds and other techniques. In the end, however, no survey can ever escape cultural bias [1, 76].

#### 4.3.1 Criticisms of the GLOBE Survey

Several criticisms of GLOBE have been leveled since its introduction. The most well thought-out discussion comes from Hofstede who takes issue with several parts of GLOBE. For instance, Hofstede states that the GLOBE has 18 dimensions of culture which he believes is too many to be useful for most researchers [105, 112].<sup>8</sup> From reanalysis of the GLOBE data, Hofstede also found that there are five meta factors in the 18 dimensions which all point to Hofstede’s original cultural dimensions [105]. Finally, Hofstede believes that the respondents to the GLOBE survey classified questions in a way that researchers did not account for and, furthermore, classified them in a way that resembles the original Hofstede dimensions [105].

GLOBE is still too young to have received much criticism or many accolades outside of those from GLOBE researchers and others with vested interests in the study. Because of its newness and the lack of much work based on GLOBE, it is

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<sup>8</sup>Often in applications of various cultural dimensions schemes, only one or two dimensions are actively used. A reasonable number of dimensions is 7 +/- 2, based upon what the human mind can easily remember [113].

the opinion of the author of this text that GLOBE is not yet ready to be used in the engineering world.

#### 4.4 Problems in Both GLOBE and Hofstede's Cultural Dimensions

Smith has summarized the problems that he and many other researchers have found over the years in both Hofstede's and GLOBE's work. He highlights four portions of the debate between Hofstede [105] and Javidan et al. [104] that he feels require particular attention as they were lost in the fray between the two cultural dimension camps [100].

First, Smith analyzes the difference between characterizing cultures based on self-perception versus perception of others in one's own society. The conclusion is that the two methods are not equivalent and produce different results. He finds that neither can be considered the best [100].

Second, Smith believes that the number of cultural dimensions found in a study must be proportional to the number of survey respondents. Further, he feels that having too many dimensions will defeat many research attempts. He cites the tendency for the community to ignore three of Hofstede's five dimensions and believes that the nine dimensions in the GLOBE study will either be ignored or further frustrate researchers [100].

Third, Smith takes issue with the work of both Hofstede [1] and GLOBE [4, 76] with regards to data analysis. He believes that the way both studies aggregated individual-level data, while different, still did so in a way that "does not prevent

detection of differing relations between items at different levels of analysis” [100]. In the case of Hofstede, a clear description of the data analysis is presented and has been followed by most major nation-level researchers since the introduction of Hofstede’s dimensions [1, 77, 100]. Hofstede aggregates the score for each individual survey item to the national level before interrelations between items are explored [100]. More information on Hofstede’s methods can be found in Appendix C. The GLOBE survey, on the other hand, did not initially state how they went about their individual-level data aggregation [100, 114]. More recently, however, detail has been released about the complex sequence of confirmatory factor analysis employed by GLOBE [115]. Initially, individual-level pan-cultural factor analysis was performed on pilot studies of the GLOBE data but once the full dataset was released, only high-level analysis was conducted [100, 115]. In the end, Smith concludes that, in fact, the GLOBE aggregate individual-level analysis was performed in line with Hofstede’s methods but is disappointed that GLOBE did not state this initially [100].

Fourth, Smith feels that the field needs greater clarity with respect to national wealth and how it relates to other aspects of culture [100].

Smith calls for a continuation of the current efforts to survey cultural differences. He asks researchers to use a broad range of methodologies in the hopes of achieving greater levels of confidence in the results when findings from several unrelated studies converge, as they have in several studies already completed [100].

In spite of the troubles Smith sees in the cultural dimensions world, he sees promise for the future. Smith takes heart in that the viability of nation-level

analysis has been reinforced from the exchange between Hofstede and Javidan [105, 104]. He also feels that the difference between Hofstede's approach [77, 1] and the GLOBE approach [4, 76] with respect to how many researchers participate in a study will trend toward a middle ground, rather than being produced and maintained by a lone researcher or 200+ contributors [100].

It should also be noted that some believe large, multi-national studies should be set aside in favor of smaller, mid-range studies and theories that can produce more direct explanations and applications for organizational phenomena in a national and cultural context [116]. This view is held in many anthropology circles but is not well regarded elsewhere. For the purposes of this text, this viewpoint is ignored. This is largely driven by the currently available datasets which is further discussed in Chapter 6.

## Chapter 5 – Tools in Other Disciplines that Use Cultural Dimensions or Correlate to Cultural Dimensions

Several fields have adopted cultural dimensions in a variety of fashions. Business and marketing have found it useful to determine appropriate marketing campaigns for various culturally segmented markets. Usability engineering and interface design have both made use of cultural dimensions to better understand their customers. Several other fields, such as technical writing, medicine, and human capabilities development, have started to make use of the information present in the cultural dimension schemes. This chapter presents a sampling of how cultural dimensions are used in other disciplines.

### 5.1 Examples in Business and Marketing

Some of the original uses of Hofstede's Cultural Dimensions were in business leadership. At around the same time as some were starting to call for new non-ethnocentric management strategies in international firms, Hofstede released his cultural dimensions into the community. With his dimensions, Hofstede quantitatively showed that the then-current management strategies needed to change for firms to remain competitive and profitable [117, 118].

The Big Five personality test, an often used tool in American corporations, has

been correlated with Hofstede's cultural dimensions [119]. Two opposing conclusions have been offered for these results. One view is that personality influences culture while the other is that culture influences personality[120]. However, it appears that the Big Five leaves out at least one additional personality trait, "Dependence on Others," that some researchers believe would make the tool more portable to non-western cultures [121].

Hofstede's dimensions have been used to explain differences in the ethical climates of salespeople in Mexico and America [122]. The researchers believe this is due to different scores on the Collectivism dimension between the two countries. Many other studies have used Collectivism, among other dimensions, to examine multi-cultural team interactions and the problems that can result from culture clashes [123].

In marketing, cultural dimensions have been used to tackle the challenge of marketing across different cultures [124]. De Mooij and others have been advocating the use of cultural dimensions to explain phenomena and help with determining how to effectively internationalize brands and companies. Many consultants now use methods that de Mooij has encouraged [35].

## 5.2 Examples in Computer Science

Cultural dimensions have been applied to many different Human Computer Interaction (HCI) problems, questions, and issues. For instance, differences in website design and satisfaction while using websites are seen in different cultures [125, 126, 127].

Many researchers have analyzed these differences based on Hofstede's dimensions [128].

Chong et al. found that cultural differences affect on-line trust, the perceived value of goods and services, and the intent to purchase an item on-line. They ascribed these differences to Hofstede's cultural dimensions of individualism-collectivism and uncertainty avoidance [129]. Culture affects other areas of on-line interaction as well.

Walton and Vukovic found that there are patterns in the way different cultures browse for information on the Internet. In their study of South African students, they found that most students were not able to operate breadcrumb<sup>1</sup> and tree structures<sup>2</sup> because they were unfamiliar with the concept and underlying metaphor in their culture. They summed up their findings by saying "In developing contexts, the user's goals and practices may be vastly different from our assumptions, and they may not be able to crack the many codes by which we have encoded the scent" [130]. This means that cultural context-driven designs may not translate well across cultures when the metaphor or other in-culture knowledge does not exist in other cultures.

Several other sets of researchers found that, in spite of using cultural dimension-specific website designs, South African users did not have a noticeable improvement in performance [131, 132]. From this, one researcher concluded that cultural di-

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<sup>1</sup>Breadcrumb trails are a navigational technique used in many user interfaces. It allows users to keep track of their location within a document or program. The fairy tale Hansel and Gretel is purportedly the inspiration for the term.

<sup>2</sup>Tree structures represent data in a hierarchical structure showing parent and child data. Family trees, for instance, are often displayed in a tree structure.

mensions are generally derived to describe a culture and not to prescribe how to design a user interface [133]. However, the vast majority of researchers have found success using cultural dimensions to design user interfaces.

A whole host of other computer science researchers and professionals have used cultural dimensions to describe situations they face or design solutions for cultures before problems arise. The previous examples are but a few of the vast quantity that exist in the literature [134, 135, 136, 137, 131, 132].

### 5.3 Cultural Dimensions in Usability Engineering and User Interface Design

There has been much research conducted in the realm of Usability Engineering [138], Usability Testing [139, 140, 141], HCI [14], and User Interface Design. While there is an obvious advantage for compatibility with standardizing user interfaces, many have found that creating a standardized user interface design creates usability problems for people in cultural environments other than the original designers' culture. More often than not, metaphors, representations, color associations, and navigation logic, among others, are based on American culture. This approach largely ignores variations in color association across cultures, cultural preference for textual display orientation, visual representation of concepts, and other aspects of user interface design [12].

In the last ten years, several researchers have found that terms frequently used in Usability Engineering such as user-friendly, logical, intuitive, etc, can easily be

misinterpreted [142]. Winschiers calls for tight definitions to be established in order for a common meaning to prevail, especially across different cultural backgrounds [143].

Researchers have found that culture affects the usability evaluation process [52, 144, 145, 146, 147, 148, 149, 134, 150, 151]. Culture also affects how focus groups function [144]. Further, culture affects the think-aloud protocol [151]. It also affects questionnaires [145]. Finally, culture affects how people understand metaphors and interface design [147] among other areas of cognition and social interaction.

The western, and until recently, supposedly universal view that user satisfaction is correlated to efficient and effective task completion was found to be far from true in Namibia. Instead, Namibian users will test an information system against their own knowledge. If they find the system lacking in some areas of information, they lose trust in the system and reject it [152].

In some cultures, the depth of the interface is affected by culture. Lee found that the depth of the design of the interface was the largest contributing factor to usability for American and Korean users. Among Japanese, it was found that the layout was the most significant factor. Lee concluded that cultural characteristics account for the variance among user interaction styles [153]. No information was provided to judge if language could be the underlying cause of the differences. Instead, nationality was used as the differentiating variable.

Winschiers quotes Aaron Marcus in an attempt to elicit the importance of further research in cross-cultural Usability Engineering [143]. He quotes: “we have

barely begun to discover the startling and currently un-researched assumptions about metaphors, mental models, interaction, and appearance . . . We have an interesting and challenging time ahead of us as we explore the full meaning of cross-cultural user-experience development” [154].

#### 5.4 Cultural Dimensions in Other Engineering Disciplines

Cultural dimensions have been used in several other engineering areas. These include coastal defense design, and robot-human social interaction design. The most pertinent published work is reviewed below.

Bijker analyzed the differences between the coastal defenses built in the Netherlands and the USA. In the Netherlands, the approach is to keep all water out while the USA focuses on flood hazard mitigation. The USA has a predilection for a brute force approach to coastal defense design while the Netherlands is typified by an adage from Vierlingh that reads “niet met forsigheit maar met soetigheid” [155]. The adage loosely translates to “don’t fight the sea with brute force but with soft persuasion.” Bijker concludes that it is cultural differences between Dutch and American societies that make the Dutch focus on keeping all water out and the Americans focus on mitigating flood hazards [156].

Nomura et al found that there is a difference between Western and Asian societies with regards to the perception of the desired levels of autonomy, social relationship with humans, and emotional capacity of humanoid robots. Further, their research shows that there is a difference between Japanese and Korean results.

There was also a difference in the assumed roles of the robots between the different cultures. The image that respondents have of the robots also differs between cultures with Koreans and Japanese finding humanoid robots more of a blasphemy of nature than Americans do [157].

Kaplan found that the cartoon *Testuwan Atom*, a popular television program shown to Japanese audiences in 1951 that had a small infant-like robot in it equipped with an “atomic heart,” led many now-older Japanese engineers to become roboticists. The author goes on to attempt to explain western reactions to humanoid robots by recounting stories of early artificial creation such as Pygmalion’s Tale<sup>3</sup>, Golem<sup>4</sup>, and Homunculus<sup>5</sup>. Later, the romantic movement led to westerners not appreciating the artificial. Frankenstein<sup>6</sup> and Metropolis<sup>7</sup>, among other works of fiction, propagated fear. The author compares the two cultures using Hofstede’s cultural dimensions among others and attempts to analyze why

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<sup>3</sup>Pygmalion’s Tale is the Greek story of a sculptor named Pygmalion who carved an ivory tusk into the shape of a beautiful woman. Over the course of many months, Pygmalion becomes very attached to his ivory woman, sharing every part of his day with the sculpture. The story ends with the statue coming to life and the sculptor and his ivory woman living happily ever after [158].

<sup>4</sup>Golems appear in western mythology with some examples pre-dating the Talmud. Golems are generally described as creatures created from clay that are then animated or brought to life for various, generally good purposes [159].

<sup>5</sup>Homunculus refers to “little men” often found inside of objects and living things but also periodically in a free form. Alchemists attempted to create artificial Homunculus in the lab. The artificial Homunculus purportedly would protect their creators in exchange for food [160].

<sup>6</sup>Frankenstein is the story of a scientist who creates a monster from the body parts of recently deceased humans. The monster, ostracized by society, murders the friends and family of his creator before finally killing his creator and himself [161].

<sup>7</sup>Metropolis is a 1927 film produced in Germany. The film is set in a dystopian future where workers and the ruling class are at odds. A robot created in the image of one of the main characters to fool the workers. The robot is eventually destroyed. Multiple versions of this film exist with different but similar plots. The original version is largely lost [162].

Japan accepts robots differently than the West. The research is ongoing and a final conclusion has not yet been reached [163].

A group of researchers sent a questionnaire to people in seven different countries to determine peoples' attitudes toward robots, toward the social influence of robots, and attitudes towards emotions in interactions with robots. The researchers compared people who had used the AIBO robot with people who had not. It was found that participants from different cultural backgrounds had significantly different attitudes toward robots. Participants in Japan were apprehensive about robots while Americans embraced them. Mexicans were particularly negative toward robots. People who had interacted with the AIBO were more likely to have positive feelings toward robots but causality could not be concluded because people who like robots to begin with might be attracted to using the AIBO. The researchers believe that the work of Hofstede might be useful for robots [164].

## 5.5 Examples of Cultural Dimensions in Other Fields

Some examples of using cultural dimensions exist in other fields not already surveyed. Several have been listed below with varying degrees of detail. It seems that cultural dimensions are finding uses in a large variety of fields and disciplines.

Engineering education in Europe has been examined with respect to cross-cultural differences in teaching and learning contexts. Mainwaring and Karkowski found that variations in evaluation, teacher-student relationships, student autonomy, motivation, and the scope of studies all can be related to Hofstede's cultural

dimensions [165]. Additional research is ongoing.

Dong presents a potential avenue for appropriate design<sup>8</sup> for culture based on the Capabilities Approach [166], pioneered by Amartya Sen [167, 168], an economist, and Martha Nussbaum [169], a philosopher. Capabilities theorists believe that public policy should be primarily concerned with increasing the capacity of people to live the type of life that they value, whatever that might be [166]. While not directly using cultural dimensions, the basic framework Dong lays out is suggestive of being influenced by cultural dimensions research.

Recently Hofstede's Power Distance Index was strongly positively correlated with the acceptance of antibiotic use. This suggests that the way people deal with authority in different cultures is an important factor in explaining antibiotic use. The same study also found a positive correlation with Hofstede's Uncertainty Index and antibiotic use but the authors indicated more research was needed before conclusions could be drawn [170].

Aslam extensively reviews the psychological and socio-cultural aspects of color. Country-culture clusters and semantic differentials are employed to examine the communication value of color. The author discusses the "country of origin" effect where different countries have different tastes in colors and have different color meanings [10].

Ongoing research by Carpenter et. al. in the field of technical writing is exploring technical writing in high context and low context cultures. The researchers

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<sup>8</sup>Design in this particular context is used very broadly to encompass architecture, community planning, and a whole host of other areas that are beyond the traditional engineering scope of design.

have designed a rubric to support technical writing in high and low context cultures. The majority of the research is focused on Japan, a high-context culture, and America, a low-context culture [171].

## 5.6 The Lone Mechanical Engineering-Related Example

To date, no substantial effort has been put forth in mechanical engineering to use cultural dimensions to quantify culture in an effort to create better designs for different cultures. One group, however, did apply Hofstede's dimensions to the design of an automotive wheel balancer with some success. They, however, focused on the electronic user interface and software of the system, not the mechanical aspects of the system [172]. Beyond this one lone example that in actuality focused on user interface design, no significant work exists in the literature focusing on mechanical engineering design.

With no substantial work being done in mechanical engineering design, an opportunity exists to create a new tool that utilizes cultural dimensions. Cultural dimensions allow for a level of quantification of culture that is not otherwise available. Design engineers generally require quantitative data to back up design decisions. The following chapter outlines one potential tool that utilizes cultural dimensions to further the mechanical design process.

## Chapter 6 – Using Culture as a Metric in Mechanical Engineering Design

There currently exists no formalized tool to account for culture in the mechanical design process. To fill that gap, a method for integrating cultural considerations into customer requirements via “Cultural Customer Requirements” is detailed below. An concise version for the design engineer in industry with a background in Quality Function Deployment (QFD) is available in Appendix B.

To use culture in the mechanical design process, a designer first must take preparatory steps to lay the groundwork for integration of cultural data into commonly used mechanical design tools. The methods presented below are crafted to allow a competent design engineer with little background experience in cultural research or cross-cultural interactions to quickly ascertain what is important to the product design and integrate that information into the House of Quality (HoQ). Attention is also paid to the issue of ethnocentrism, especially in relation to engineers designing for other cultures.

### 6.1 Preparing Cultural Information for the Design Process

Several steps must be taken to collect and prepare data before cultural information can be used in the design process. The following questions should be answered by

the designer to enable culture to be used as a metric in the design process.

1. Who is my customer?
2. Does culture play a role in my design?
  - Does the customer sense the product?
  - Do I have the same cultural background as my customer?
3. What cultures do I need to design for?
4. What cultural metrics do I use?

By answering these questions, a designer lays the groundwork for using cultural information in the design process. Details of what should be investigated in each question is presented below. The design engineer is also reminded to avoid the trap of ethnocentrism. Resources and information on avoiding ethnocentrism and working with other cultures are available [35, 173, 174, 175, 57, 176, 121, 1, 177, 150, 178, 179, 180, 143, 181, 52, 74, 182, 183, 58, 184, 185].

### 6.1.1 Who is My Customer?

As most experienced designers know, almost every design has more than one customer. Customers for a design can include the actual end user of the product, the manufacturing personnel, the sales staff, the maintenance staff, the management of the designers and engineers, the shipping companies that transport the product, the disposal and remanufacturing companies, and many other groups of

people. Anyone who comes into contact with a product can be considered one of the customers that should be designed for.

One type of customer, such as the sales staff, quickly becomes many different types of customers when a product is sold in several international markets. Each local sales staff will have its own cultural aspects that must be considered. Thus, a design that begins with 10 or 15 different customers all located within one culturally homogeneous group can quickly become a design with hundreds of customers spanning tens of cultures when the product is marketed internationally.

While all customers are important, not all are equally important. For instance, the shipping companies are not as important as the end users who buy the product. The design engineer must determine which customers are more important than others. Existing resources and literature cover this topic in detail with respect to single-culture customers and are thus omitted from this document [186, 187, 188, 189, 190, 191, 192].

When designing for several cultures, it is important to decide which cultures have priority in the product design process. Does the American market hold more sway than the Argentinian market? When selling to the European Union, which culture is the most important for product success? Determining the answers to these questions are addressed in international business texts. At this point, it is important for a design engineer to determine relative importance between different cultures. This data will be used later to build the HoQ.

There are many ways to determine the importance of one customer over another. One crude but effective way to rank the importance of one customer over

another is to simply state that a particular customer is the most important and all others are irrelevant. In some design processes, this is a completely valid and acceptable method. However, most will benefit from a more rigorous and quantitative assessment of customer importance.

Other, more effective methods include ordering customer importance by each customer's financial impact upon the design. For instance, the customer that purchases the product is probably more important than the customer who ships the product from the factory to the showroom. Likewise, a customer group in Saudi Arabia with billions of Euros earmarked for the purchase of the product being designed is more important than a customer group in Sri Lanka that only has one million Euros. While it might seem that customers other than the end user or purchaser of the design can be discounted as they don't directly purchase a product, other customers can have a large effect on things such as the cost of the product, the willingness of the end user to purchase the product, time to market for the design, and a whole host of other metrics. It is the advice of the author that design engineers consider the relative importance of customers carefully while assigning relative importance values.

### 6.1.2 Does Culture Play a Role in My Design?

Not all designs necessarily are affected by culture. A design must be examined to see what interactions, if any, the customer has with the product. The first question a design engineer must ask is if they are from the same cultural background as the

customer. The second question is if the customer interacts with the product in any way.

#### 6.1.2.1 Sensing a Product

The human senses<sup>1</sup> – both the five classical senses and the at least six additional modern senses – serve as a good guide to determine if customers interact with a product. Not all designs register as sensory perceptions with the customer. For instance, a set of gears buried deep inside a machine that is never designed to be serviced and is assembled by robots probably has very minimal interaction with the customer. On the other hand, an automobile interacts with with nearly every sense the customer possesses.

The five classical human senses are: sight, touch, taste, smell, and hearing. Customer interactions can range from seeing a product to smelling an exhaust odor caused by the product. These interactions can be passive, such as hearing the sounds produced by a device; active, such as turning control knobs or reading data from a display; or a combination of both.

Beyond the classical senses, modern researchers have defined at least six more senses that humans utilize. These additional senses are: pain, balance, proprioception and kinesthesia (motion and acceleration of joints and limbs), sense of time, thermoception (sense of temperature differences), and a weak sense of direction due to magnetism. Customer interaction with these sense can take the form of

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<sup>1</sup>In this document, a sense refers to a faculty by which a stimulus from outside or inside the body is received and interpreted.

vibrations that the customer can feel, increasing the temperature of a space occupied by the customer, or a change in the sense of direction of the customer due to a magnetic field.

Additional senses exist in the form of introspective senses. Introspective senses are generated from within the human body. Examples include sensory perception of a full bladder, stretch receptors that sense the inflation of the pulmonary system, and others. No additional introspective senses are reproduced here as most products that mechanical design engineers develop do not affect the introspective senses.

A designer should analyze the expected functionality of a design to determine what customer sensory interactions, if any, will occur. If no part of the design interacts with any of the senses of the customer, the design does not require any analysis based upon culture. If, however, there are aspects of the design that do interact with the customer, as defined in subsection 6.1.1, culture might be a factor worth considering.

#### 6.1.2.2 Customer's Culture and Designer's Culture: The Same or Different?

Even if culture does factor into a design, it is very possible that culture does not explicitly affect the design process because the design engineer shares the same cultural background as the customer. To determine this, the designer must look at what level of cultural discretization they will use in the design. This is covered

in Subsection 6.1.3 of this document.

If the cultures are determined to have minimal or negligible differences, or be identical, then the cultural techniques discussed in this document are not directly applicable to the design. However, using the techniques described below still might be beneficial to the design process. Looking at the cultural implications of one's own culture can provide insight by stepping back and examining the culture from a third-person perspective.

### 6.1.3 What Cultures do I Need to Design for?

While there may be many different types of customers, ranging from the end user to a design engineer's boss, not every customer necessarily needs to be designed for. Likewise, the range of cultures present in a design does not necessarily require that the design satisfy each culture. A design engineer must decide which cultures are the most important to target, which cultures are of secondary importance, and which can be ignored.

Further, a designer must decide what level of cultural discretization is desired. Is the product destined for a global market, a regional market, a nation-level market, a subculture within a nation, or a subculture that crosses national boundaries? This information often is generated by a sales department, marketing department, management, or dictated by the customer directly and thus is fairly easy to determine. If it is left up to the engineer to determine the target market, many introductory texts in marketing and sales describe the process of determining the

target market.

The methods presented in this text focus on nation-level cultures. This is because the most widely accepted cultural characterizations that are valid across large swaths of the globe currently largely focus on nation-level cultures. As other data become available, the information that results can be used in the presented methods. Another option for the well-funded designer is to conduct research to determine the cultural differences between the culture of the designer and the culture of the consumer. Guidance is provided by Hofstede [1], Global Leadership and Organizational Behavior Effectiveness Research Program (GLOBE) [4], and others to create appropriate survey tools.

#### 6.1.4 What Cultural Metrics do I Use?

As was reviewed in Chapter 4, there are several sets of competing and complementary cultural metrics all based upon multiple dimensions of culture. While it is up to the design engineer to choose which set of cultural dimensions to follow, the author of this thesis recommends using Hofstede's Cultural Dimensions [1] because they are the most widely accepted and used in research and in practice, as was shown in Chapter 5.

The GLOBE study [4, 76] does not yet have that many researchers outside of the GLOBE cadre of researchers and related academics using the cultural dimensions that GLOBE found. Until a larger body of research and practical applications is available, the author of this thesis would not recommend using GLOBE. It

can be expected that by the year 2015, sufficient experience will have been gained within the academic community to decide if GLOBE contains a valid set of cultural dimensions. The debate on whether the GLOBE dimensions are any more or less valid than the dimensions presented by Hofstede will rage for many years to come.

The methods of Schwartz [78] are viewed by most other researchers as largely invalid because the cultural dimensions that Schwartz produces overlap and are dependent upon one another [112]. Thus, they are not recommended for use. Similarly, other non-main stream cultural dimension schemes are not recommended for use by design engineers. If, over time, non-main stream approaches are adopted in the research community, the fringe methods might be worth reexamination for use in mechanical design.

## 6.2 Using Cultural Information in the Design Process

It can be very instructional to examine the cultural dimensions data provided by Hofstede, GLOBE, and others. This only provides a qualitative look at the effects of culture on a specific design. Providing quantitative analysis requires a different approach. This text advocates using QFD methodology as the underpinning of analyzing the effects of culture on a mechanical design quantitatively.

The original creator of QFD, Yoji Akao, states that QFD is a “method to transform user demands into design quality, to deploy the functions forming quality, and to deploy methods for achieving the design quality into subsystems and component parts, and ultimately to specific elements of the manufacturing process” [193].

QFD is used by designers to focus on the characteristics and properties of a new or existing design. The viewpoint of the customer and the technology requirements are paramount to the methodology.

A typical tool used to deploy QFD is the HoQ. In large product development projects, the HoQ generally is implemented as four separate Houses of Quality. The first HoQ, The Functional House of Quality, feeds information into the second HoQ, The House of Quality for Part Design, and so on through the House of Quality for Production and House of Quality for Quality Control. Figure 6.1 shows a typical House of Quality for Part Design. Figure 6.2 shows how the four houses are interrelated. The four HoQs enable a design team to take a product from conception through the design process, production, and quality control.

The HoQ provides an avenue to bring qualitative information into a quantitative analysis to support decision-making in the design process. This ability to make qualitative information useful in a quantitative analysis makes the HoQ ideally suited to integrating qualitative information garnered from Cultural Dimensions into the design process. Before Cultural Dimension information can make its way into the HoQ, it must be prepared.

### 6.2.1 Cultural Information and the House of Quality

Several steps must be taken to prepare cultural information for and insert it into the HoQ. The foundations were already laid in the preceding sections of this chapter. The below subsections identify a place to insert cultural information into the

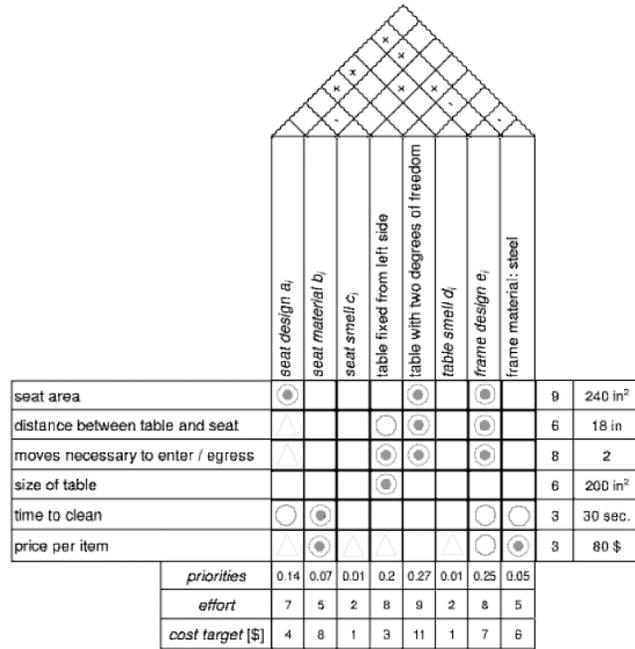


Figure 6.1: A Typical House of Quality for Part Design. (Adapted from [2])

HoQ, a method for refining cultural information into Cultural Requirements, and a strategy to separate universal customer requirements from cultural requirements and method for organizing potentially conflicting cultural requirements from different cultures.

### 6.2.1.1 Finding a Home for Cultural Information into the House of Quality

While there are many places that cultural information could find a home within the HoQ, it is the opinion of the author that cultural information should find its

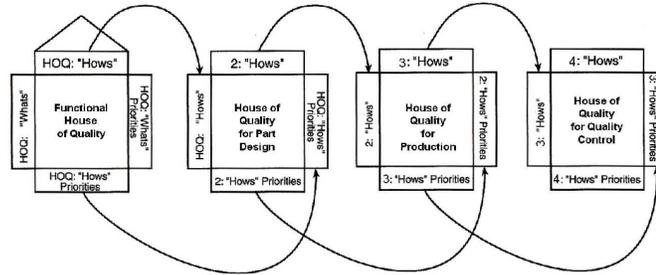


Figure 6.2: Interrelated Houses of Quality: Each HoQ feeds information into the next HoQ to take a product from conception through quality control. (Adapted from [3])

home in the Customer Requirements portion of the HoQ. The Customer Requirements section is already the home of the wants, needs, and desires of the customer. Augmenting the Customer Requirements with a subsection entitled Cultural Requirements is a logical extension of QFD methodology. This also allows for the methods presented in this thesis to be used in single and four HoQ QFD deployments.

Another potential location where cultural information can be inserted include alongside the Technical Solutions in the House of Quality for Part Design, as Van Bossuyt, Gibson, Wörz, and Zaworski [2] did with affective design solutions. This potential method is not explored in this document but the author believes that this could be a promising avenue to explore in the future.

### 6.2.1.2 Managing Customer Requirements and Cultural Requirements

Separating Customer Requirements from Cultural Requirements and segregating Cultural Requirements derived from one culture from those derived from another becomes increasingly important with increasing complexity of the HoQ and with increasing dissimilarities between cultures. As Cultural Requirements are simply a subset of Customer Requirements, one method to divide Customer Requirements into more manageable and useful segments is to separate Universal Customer Requirements from the more specific Cultural Customer Requirements. Universal Customer Requirements are the wants, needs, and desires that all customers considered in a QFD analysis hold. Cultural Customer Requirements are the wants, needs, and desires that customers from a specific culture have.

One way of segregating Cultural Customer Requirements from Universal Customer Requirements is to place these requirements into a hierarchy. Mono-culture designs containing 200+ customer requirements provide a good example and framework. In mono-culture designs, 200-400 Customer Requirements are often generated from focus groups and one-on-one interviews with potential customers [194]. One way that engineering teams deal with the overwhelming number of Customer Requirements is to place them into a hierarchy. The hierarchy can take the form of primary, secondary, and tertiary requirements [194]. This framework is extensible to whatever depth is required. For instance, in one example from Toyota, eight hierarchy levels were used [195].

The concept of placing Customer Requirements into hierarchies can be adapted

to customers from different cultural backgrounds. The top-level hierarchy should contain two categories: Universal Customer Requirements and Cultural Customer Requirements. Within the Cultural Customer Requirements section, several potential organizing schemes can be used. When only a few cultures are part of the analysis, each culture is given a subsection. For example, “Chinese Requirements, American Requirements,” and “Spanish Requirements” all are valid subsections.

In instances where many cultures are analyzed, it is worthwhile to organize cultures into cultural clusters. Generally, the various cultural dimension schemes [4, 76, 1] present clusters of similar cultures. Table 6.1 reproduces the cultural clusters found by the GLOBE survey. Table 6.2 reproduces the cultural clusters found by Hofstede. The design engineer must select which cultural cluster schema to follow based upon what set of cultural dimensions are being used.

Within cultural clusters, it is possible that all of the cultures share the same Cultural Requirements. In this case, no further discretization and segregation of the hierarchy based upon culture is required. Most likely, however, there will be a mix of requirements that vary between cultures within a cluster and requirements that are universal to that cluster. If this is the case, a Cultural Cluster Customer Requirements section and several Cultural Customer Requirements sections should be included. An example would be: “Latin American Customer Requirements, El Salvadoran Customer Requirements, Brazilian Customer Requirements, Mexican Customer Requirements.” Table 6.3 presents an example heirarchy.

The use of the above hierarchical structure should in no way interfere with normal hierarchy structures [194] found in industry. The normal methods of cat-

Table 6.1: GLOBE Cultural Clusters [4].

Cluster	Cultures
Confucian Asia	Singapore, Hong Kong, Taiwan, China, South Korea
Southern Asia	Philippines, Indonesia, Malaysia, India, Thailand, Iran
Latin America	Ecuador, El Salvador, Columbia, Bolivia, Brazil, Guatemala, Argentina, Costa Rica, Venezuela, Mexico
Nordic Europe	Denmark, Finland, Sweden
Anglo	Canada, USA, Australia, Ireland, England, South Africa (White Sample), New Zealand
Germanic Europe	Austria, The Netherlands, Switzerland, Germany-East, Germany-West
Sub-Saharan Africa	Zimbabwe, Namibia, Zambia, Nigeria, South Africa (Black Sample)
Eastern Europe	Greece, Hungary, Albania, Slovenia, Poland, Russia, Georgia, Kazakhstan
Middle East	Turkey, Kuwait, Egypt, Morocco, Qatar

Table 6.2: Hofstede's Cultural Clusters [1].

Cluster Number	Culture(s)
1	Korea, Peru, El Salvador, Chile, Portugal, Uruguay
2	Turkey, (former) Yugoslavia, Arabic-Speaking Countries, Greece, Argentina, Spain, Brazil
3	Ecuador, Venezuela, Colombia, Mexico
4	Pakistan, Iran, Indonesia, Thailand, Taiwan, East and West Africa
5	Guatemala, Panama, Costa Rica
6	Malaysia, Philippines, India, Hong Kong, Singapore, Jamaica
7	Denmark, Sweden, Netherlands, Norway, Finland
8	Australia, United States, Canada, Great Britain, Ireland, New Zealand
9	Germany, Switzerland, South Africa, Italy
10	Austria, Israel
11	Belgium, France
12	Japan

Table 6.3: Universal and Cultural Customer Requirements Hierarchy Example for a HoQ

	Relative Customer Importance	Technical Solution #1	Technical Solution #2	Technical Solution #3	Technical Solution #4	Technical Solution #5
Universal Customer Requirements						
Universal Customer Requirement #1						
Universal Customer Requirement #2						
Latin American Cultural Customer Requirements						
El Salvador Cultural Customer Requirements						
El Salvador Customer Requirement #1						
El Salvador Customer Requirement #2						
Brazil Cultural Customer Requirements						
Brazil Customer Requirement #1						
Brazil Customer Requirement #2						
Mexico Cultural Customer Requirements						
Mexico Customer Requirement #1						
Mexico Customer Requirement #2						

egorizing customer requirements should be used in the levels below the cultural portion of the hierarchy. While using the cultural portion of the hierarchy will expand the number of sub-levels of the overall hierarchy, this level of discretization is desirable in the context of designing for cultures.

### 6.2.2 Determining Cultural Requirements

Determining cultural requirements is a daunting challenge regardless of familiarity with the cultures being designed for. Luckily, there are several tools and references that make the design engineer's job easier. For instance, the GLOBE [4, 76] and Hofstede's [1] cultural dimensions schemes, the GLOBE country cultural profiles [76, 111], and cultural probes are all useful tools to begin to determine cultural requirements.

The human senses serve as a reference for potential customer cultural touchpoints, as was described in Section 6.1.2.1. Each part of a design that elicits a response or noticeable lack of response from the customer is a touchpoint and potentially could be affected by cultural factors. Identifying these potential customer cultural touchpoints is the first step to determining cultural requirements.

As was discussed in Chapter 4, there are several competing cultural dimensions schemes. These include GLOBE, Hofstede, and others. Section 6.1.4 outlines reasons for using Hofstede's dimensions over others.

Hofstede's dimensions can provide valuable information. By comparing the design engineer's culture against the culture being designed for, it for instance can

be determined that a designer in Germany has a higher Power Distance score than a Japanese customer. This information then can be used to review the extensive collection of anecdotal tables Hofstede present [1] for insights into a particular culture. Hofstede's tables have been reproduced in their entirety in Appendix A. It should be noted that GLOBE has similar tables that correspond to the GLOBE dimensions.

Further insight into a culture can be gained from reviewing existing country profiles. Many different country profiles exist including the Central Intelligence Agency (CIA) World Factbook [196], the British Broadcasting Corporation (BBC) Country Profiles [197], and the Country Profiles currently being compiled by GLOBE [76, 111]. The CIA World Factbook, BBC Country Profiles, and similar products are useful when attempting to understand certain aspects of a culture such as statistical and demographic facts, geopolitical newsworthy events, and other statistics and hard news facts.

The GLOBE Country Profiles provide a window into the culture of a country. To date, 25 countries have been reviewed in-depth by GLOBE authors and another 15 have received a broader overview. The GLOBE Survey plans to issue country profiles on all of the countries and populations profiled in the survey.

The Finland chapter of [76] provides a good example of what is found in most country chapters. A background is given to the development of Finnish history and culture. The education system and religion are examined. The state of the Finnish industrial sector is reviewed. A detailed analysis of the results obtained from the GLOBE survey is performed. Results are discussed about the societal culture

of Finland with respect to the nine GLOBE cultural dimensions. A discussion of Finnish leadership is presented with attention paid to outstanding leaders in Finland's past. Qualitative and quantitative results about Finnish leadership are discussed. Implications for cross-cultural research and practice on the topic of effective Finnish leadership are presented. This same pattern repeats across all country chapters produced by GLOBE.

GLOBE's Country Profiles do not encompass all that a design engineer needs to know about a country. For various reasons, GLOBE focuses on cultural information that is relevant to business leadership. However, it is one more window into an unknown culture.

With the insights gained from Hofstede's dimensions and corresponding anecdotes, and from country profiles provided by GLOBE and others, a design engineer should be able to formulate further questions about a customer's culture. These questions can be broad or focused on a specific aspect of a proposed design. Potential questions based on an American engineer designing for a Finnish audience are presented in Table 6.4.

Questions generated by the design engineer can be answered in several different ways. Literature searches can be performed to determine if someone had previously asked the same question. More often than not, however, literature will not provide the answer. If time and money are not a luxury for the design engineer, cursory Internet research and conversations with one or two native-born cultural informants or people who have had experience in the culture might have to suffice for finding answers to the questions. If resources and time are available, a large

Table 6.4: Example Questions Generated by an American Engineer Designing for Finland.

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What sort of color preferences do the Finns have?
Will the design be offensive if it is primarily operated with the left hand and right foot?
What is the relationship between Finns and their technology? Are they accepting of automation?
How often are computers used on a daily basis? What sorts of activities are usually performed on a computer?

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sample group can be attained to achieve statistical significance. The Semantic Differential Method, among others, can prove useful in this case [2, 198]. However, as most surveys will be qualitative, this would require a large pool of participants. Additionally, in-culture blindness can prevent cultural informants from producing answers that help the designer [1, 4, 80].

Another option for designs with some degree of time and resources is the use of cultural probes. Cultural probes, developed by Gaver et al. [199], provide a method to peer into the lives of customers through a series of questions asked via methods not normally considered in traditional engineering designs. For instance, one of the original uses of cultural probes was to examine retirement communities and the retired residents of the communities, how they related to their environment, and to the rest of the community [199]. A package of information was issued to each participant that included such items as disposable cameras, post cards, a small journal, and other such friendly and familiar objects. Simple open-ended questions such as “photograph something you like” were printed on the items. Each

item had pre-paid postage attached and was returned to the researchers via the mail. While at times confusing, the resulting information did provide insight into the minds and lives of the participants.

Since the initial introduction of cultural probes, their use has increased and fragmented into many different areas with many different permutations. Different types of probes include: cultural probes, informational probes, technology probes, mobile probes, empathy probes, domestic probes, and urban probes among others. Probes have been developed to do the following tasks: they capture artifacts, take auto-biographical accounts, make invisible things visible, focus on the participant as the expert, and create a dialog and conversation. Probes are good at humanizing the probe subjects, creating fragmented data, using uncertainty to elicit new ideas from the researchers and users of the data, inspiring the people who use the data and results, and provoke further thought among the researchers. The cultural probe method is not without its problems. Challenges for probes include: probes are a lot of work for participants, probes often have low return rates, probes can disrupt everyday practices of participants through enforcing awareness and visibility of actions previously invisible, etc [200].

It should be noted that the original instigators of cultural probes are not pleased with the wide adoption and usurpation of the method by other disciplines. In particular, they are not happy about design groups quantifying data and creating more rigorous scientific processes to conduct probe studies. Gaver et al. reconfirm that they intended probes to be qualitative tools and that they should not be used in statistical studies or deeply analyzed. However, Gaver et al. do believe that

probes can be use quantitatively. They simply don't like the idea sullyng their original concept [201].

The questions developed, such as those presented in Table 6.4 can be adapted to create probe questions. A reasonable timetable to receive information back from probe participants is three months. The resulting information can help to answer some questions for the design engineer but also might end up creating more questions. Naturally, using probes assumes ready access to the culture under consideration.

With a better idea of the cultures of the customers, a design engineer can then begin to assemble informed cultural customer requirements. The requirements can be created in the same manner as normal customer requirements are generated from customer information. The end result should be equivalent to traditional customer requirements but with a focus placed on cultural needs, wants, and desires. The design engineer should also keep the Kano model in mind when creating the cultural customer requirements. Focusing on the aspects of a design that can excite and delight a customer while steering away from those things that can disgust a customer is especially important when working with unfamiliar cultures [6, 202].

Now that cultural customer requirements have been properly generated and prepared, and a framework to manage multiple cultural customer requirements has been developed, the design engineer is ready to integrate cultural customer requirements into the HoQ. An example of the entire process outlined in this chapter is presented in Chapter 7. A concise summary of the method laid out in

this chapter is available in Appendix B. It should be remembered that the methods outlined above are only one possible way to achieve better designs for unfamiliar cultures.

## Chapter 7 – An Example: An Airplane Lavatory

This chapter presents an example of the methods laid out in Chapter 6 to address culture in the mechanical design process. A standard commercial aircraft lavatory is used to create an example of a cultural design process. Illustrative portions of the aircraft lavatory are used while other, less informative or redundant sections are excluded.

### 7.1 Preparing Cultural Information for the Design Process

Several steps must be taken to collect and prepare data before cultural information can be used in the design process. The following questions are answered in the succeeding sections.

1. Who is my customer?
2. Does culture play a role in my design?
  - Does the customer sense the product?
  - Do I have the same cultural background as my customer?
3. What cultures do I need to design for?
4. What cultural metrics do I use?

### 7.1.1 Who is My Customer?

There are many different customers and classes of customers for the average lavatory. The broad classes include the airline passengers who use the lavatories, the airline employees who maintain the lavatories, the workers who build, install, and remove and decommission the lavatories, airline management who decide which brand and style of lavatories to buy, and the design engineers who create the bathroom. Within each of these classes, there can be many different individual groups of customers. For instance, airline employees range from the crew aboard the aircraft during flight to the staff that cleans the airplane in between flights to the maintenance crew who fixes broken plumbing and electrical shorts. Every class and group of customer can also come from any country of the world. Customers living in China will have different expectations and requirements than customers from Sweden or Brazil.

For the purposes of this example, airplane passengers from Japan, Finland, Australia, and Mexico will serve as the customers. These customers' wants, needs, and desires must be met in order to make their experience satisfactory and ideally they should be delighted in order to ensure happy customers and repeat business. Additionally, the design engineers creating the bathroom design and using this methodology will be Americans.

Through a fictitious market analysis, this example uses relative customer importance values listed in Table 7.1. This relative importance data could be derived from many sources including market analyses, relative importance to continued

Table 7.1: Relative Importance of Customers

Customer	Relative Importance
Japan	0.5
Finland	0.25
Mexico	0.15
Australia	0.1

employment of the design engineer, or many other metrics. This data will become useful in the event of conflicting customer requirements.

### 7.1.2 Does Culture Play a Role in My Design?

This design is clearly affected by culture as the customers all have interactions with the product. Additionally, the designers are from very different cultures than some of the customers. Therefore, culture does play a role in the design and must be considered.

#### 7.1.2.1 Sensing a Product

For the purposes of this example, the design engineers will constrain themselves to examining the five classical senses. The other modernly defined senses will be ignored for brevity.

All five classical human senses interact with an airplane lavatory. For instance, a lavatory with thin walls where noise easily permeates into the passenger cabin

Table 7.2: Potential Customer Sensory Interactions with an Aircraft Lavatory

Customer Sensory Interaction
The color-coding on the various parts interacts with the sense of sight.
The coatings and textures on the panels register with the sense of touch.
Sitting nearby a lavatory, the sense of hearing is impacted by noises emanating from the lavatory – either human or mechanical.
Biological and chemical smells coming from the toilet interact with the passengers’ sense of smell.
The color and lighting of the interior and exterior of the lavatory interact with the sense of sight.
Small children might very well find themselves tasting various parts of the lavatory.

would be undesirable for many passengers. Likewise, a lavatory with very bright lighting and wrap-around mirrors will interact with customers’ sense of sight. A brief list of potential sensory interactions is provided in Table 7.2. In a full-fledged Quality Function Deployment (QFD) analysis, this would be a much more exhaustive list.

#### 7.1.2.2 Customer’s Culture and Designer’s Culture: The Same or Different?

Examining the country cultural dimension scores as presented by Hofstede [1], it is clear that there are differences between the nation-level customer groups. The scores are reproduced in Table 7.3. Striking differences on all axes are present

between the four cultures used in this example.

Table 7.3: Hofstede's Cultural Dimension Scores for Example Customers

Customer Country of Origin	Power Distance	Dis-Individualism	Individualism	Uncertainty Avoidance	Masculinity	Long-Term Orientation
Japan	54	46	92	95	80	
Finland	33	63	59	26	-	
Australia	36	90	51	61	31	
Mexico	81	30	82	69	-	
America <sup>1</sup>	40	91	46	62	29	

It should be noted that Finland and Mexico do not have Long-Term Orientation index scores. Many countries are missing one or multiple cultural dimensions due to a lack of data. This is a reality of the available dataset and must be accepted as a shortcoming of this design method. In the future when Global Leadership and Organizational Behavior Effectiveness Research Program (GLOBE) and similar efforts have been more thoroughly vetted, larger and more complete datasets will be available to the design engineer.

<sup>1</sup>America is listed for completeness to compare index values between the culture of the design engineers and the cultures of the customers

### 7.1.3 What Cultures do I Need to Design for?

While the customer base has already been limited for the scope of this example, it can easily be recognized that of all 195 nations [203] in the world<sup>2</sup>, not all will be as important as others. This is because the aircraft lavatory or almost any design will be targeted at every possible group of users. Many of the small, financially poor nations can and are often ignored in the development of products. As George Orwell wrote, “all [people] are equal but some are more equal than others” [205]. Whether this is an ethical and moral practice is left to another thesis to debate.

The question of what cultures to design for should be answered by a market analysis. If, for instance, a product is not expected to return much revenue from a particular culture or if it is politically unwise to design for a specific culture, then that country can be left out. Also, if two or more cultures are very similar, such as those listed in the cultural groups of Table 6.2 of Chapter 6, only one culture can be included for brevity. However, the relative importance weighting of the culture being neglected should be added to the culture that is representing both cultures. Deciding what cultures to keep and which to toss from an analysis is left up to the design engineer to decide.

In this example, the four previously listed cultures will be used in the design process. Other cultures could have been used including China and India, for example, but were excluded. This exclusion could be based on a number of the

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<sup>2</sup>It should be noted that depending on what source is referenced, this number generally varies between 192 and 195. This is due to two independent countries, Vatican City and Kosovo, not being a part of the UN [204] and Taiwan, Palestine, Western Sahara, the Cook Islands, Niue, and others not being recognized as independent nations.

previously listed reasons.

#### 7.1.4 What Cultural Metrics do I Use?

The most accessible cultural metrics that can be compared between cultures are those developed by the various cultural dimension schemes. Therefore, it is suggested that cultural dimension are used as the primary cultural metrics. As was detailed in Chapter 6, at the time of writing, it is the recommendation of this text that Hofstede's Cultural Dimensions [1] be used in the mechanical design process. Other cultural metrics that can be used are cultural profiles and cultural probes. Cultural profiles and cultural dimensions will be used in this example but not cultural probes.

## 7.2 Preparing the House of Quality for Cultural Customer Requirements

A typical House of Quality (HoQ) is presented in Table 7.4. Customer requirements are listed on the left while technical responses are listed on the top. A column has been added for relative customer importance. This HoQ has been stripped down to the bare essentials, neglecting many of the rooms of the house of quality [202]. This is was done for clarity and brevity. Cultural Customer Requirements and related hierarchy structures have been added to the HoQ. Also, Sweden was added to the cultural cluster including Finland as an example of how to nest

cultural requirements.

Table 7.4: Customer Requirements of a HoQ for the Example

	Relative Customer Importance	Technical Solution #1	Technical Solution #2	Technical Solution #3	Technical Solution #4	Technical Solution #5
Universal Customer Requirements						
Universal Customer Requirement #1						
Universal Customer Requirement #2						
Cultural Customer Requirements						
Hofstede Cluster #1						
Japan						
Japan Customer Requirement #1						
Japan Customer Requirement #2						
Hofstede Cluster #7						
Intra-Cluster Requirements						
Cluster Customer Requirement #1						
Cluster Customer Requirement #2						
Finland						
Finland Customer Requirement #1						
Finland Customer Requirement #2						
Sweden						
Sweden Customer Requirement #1						
Sweden Customer Requirement #2						
Hofstede Cluster #8						
Australia						
Australia Customer Requirement #1						
Australia Customer Requirement #2						
Hofstede Cluster #3						
Mexico						
Mexico Customer Requirement #1						
Mexico Customer Requirement #2						

### 7.3 Determining Cultural Requirements from Cultural dimensions

To start getting an idea about the cultures of the customers, it is useful to look at the various anecdotal tables prepared by Hofstede. They are reproduced in Appendix A. Similar tables exist for those using GLOBE and other cultural dimensions schemes. For the sake of this example, Uncertainty Avoidance Index (UAI) and Power Distance Index (PDI) will be examined while excluding the other dimensions.

Looking at the country scores, Finland and Australia have similar low PDI scores while Japan is somewhat in the middle and Mexico is high. Japan and Mexico both have high UAI scores while Finland and Australia have scores that fall in the middle. It should also be remembered that during the process of determining cultural customer requirements, design engineers must remember to compare their own index scores to that of the cultures they are designing for. While an aspect of the design might be distasteful or downright offensive to the designer, it could be very attractive to the customer.

The number and variety of anecdotal tables can be overwhelming to the design engineer at first. There are six long tables covering PDI and five surveying UAI. The messages these tables hold can also be confusing. For instance, how do the antecedents and consequents of four concepts measured across low and high PDI countries provide insight into the culture? This is where imagination and creativity on the part of the design engineer come into play.

Examining the various anecdotal tables at the design engineer's disposal, Ta-

Table 7.5: Cultural Customer Requirements Based on Freedom and Conformity

Customer Country of Origin	Cultural Customer Requirement
Australia and Finland	New, innovative ideas are desirable.
Mexico	Feature-packed lavatory. Keep design simple. Use traditional styles and methods of interacting with devices.

ble A.2 in Appendix A can be interpreted to indicate that low PDI cultures are interested in freedom and independence while cultures that are high PDI value equality and conformity. A design engineer can then use this information to create a cultural customer requirement. One potential cultural customer requirement could be that high PDI cultures want equal lavatories in all parts of the aircraft and want a standardized way of operating the equipment that is familiar to them. They would be unlikely to adopt new methods of flushing a toilet, for instance. Conversely, low PDI cultures might desire fancier and more feature-rich bathrooms in the first class cabin as compared to coach. They also might be more open to adopting new technologies and methods of washing their hands on a plane. Table 7.5 lists several potential cultural customer requirements.

Another example from Table A.2 in Appendix A comes from attitudes toward wealth and power. Low PDI cultures have positive associations toward wealth and power while high PDI cultures have negative attitudes. One might interpret this

Table 7.6: Cultural Customer Requirements Based on Wealth and Power

Customer Country of Origin	Cultural Customer Requirement
Australia and Finland	Functional, understated decorations. No gaudy or overly ornate designs.
Mexico	Ornate, opulent ornamentation is desirable. Power and wealth should be felt while on the toilet.

to mean high PDI cultures prefer opulent lavatories that portray an aura of power and wealth while low PDI cultures would feel uncomfortable in such lavatories and instead feel more at home in utilitarian lavatory designs. A good cultural customer requirement for each culture can now be formulated. They are presented in Table 7.6.

Now turning to the UAI scores, Table A.7 in Appendix A shows that low UAI cultures are comfortable with ambiguity and chaos while high UAI cultures desire clarity and structure. Potential cultural customer requirements from these norms are presented in Table 7.7.

Another UAI set of customer cultural requirements can be generated from Table A.8 in Appendix A. Low UAI cultures generally have lenient rules on what is dirty and taboo while high UAI cultures have tight rules. This brings up an interesting question on what is considered dirty and taboo in a specific culture. Hofstede's Cultural Dimensions and accompanying anecdotal tables do not provide guidance on specific cultures and their taboos. Instead, one must look toward cultural

Table 7.7: Cultural Customer Requirements Based on Ambiguity and Clarity

Customer Country of Origin	Cultural Customer Requirement
Japan	Functions of lavatory must be clear.
Mexico	Functions of lavatory don't need to be clear or logical.

Table 7.8: Cultural Customer Requirements Based on Rules on Taboos

Customer Country of Origin	Cultural Customer Requirement
Australia	Cultural taboos are not as important to avoid.
Japan and Mexico	Cultural taboos and things considered dirty must be avoided.

insiders, cultural country profiles, and cultural probes. However, for initial HoQ work, a design engineer can use a placeholder cultural customer requirement. This is displayed in Table 7.8

#### 7.4 Determining Cultural Requirements from Country Cultural Profiles

While by no means a substitute for deeply understanding a culture, country profiles like those produced by the British Broadcasting Corporation (BBC), Central Intelligence Agency (CIA), and GLOBE can help a design engineer gain a clearer

picture of the customer. For brevity, only the GLOBE cultural profiles [76] will be used<sup>3</sup>. The currently available set of country profiles from GLOBE only has in-depth coverage of 25 nations. In this example, Australia, Mexico, and Finland are represented but Japan is not. Holes in the data are common, must be anticipated by the design engineer, and must be worked around.

The cultural profile prepared by GLOBE of Finland contains many interesting insights into the culture of the country. Two in particular are applicable to the design of an aircraft lavatory. The first is that Finland is a collectivist society where equality between women and men is high. The second is that in-group behavior<sup>4</sup> is generally stressed but in a family context, individuality is valued. Table 7.9 displays the cultural customer requirements generated from this information.

Australia, like Finland, has a tendency toward gender egalitarianism. While public perception may lean toward a sexist society, according to the GLOBE cultural profile, the sexes are on fairly equal footing in Australia. A desire to be less stratified also permeates Australia. Table 7.9 reflects several cultural customer requirements that came about from this information. Note that two are identical to those found in the Finish model. It is expected overlaps like this will occur and are, in fact, desirable as one design that will satisfy more people is possible.

A traditional society, Mexico emphasizes family, class, reverence for the past,

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<sup>3</sup>While the GLOBE cultural dimensions are not widely accepted outside of the GLOBE research cadre, GLOBE cultural profiles are a good source of cultural information for design engineers. The cultural profiles that GLOBE produces are in large part separate from the GLOBE cultural dimension scheme and can stand alone.

<sup>4</sup>In-group behavior refers to the interactions between members of a group. In this context, in-group behavior is applied to cultural groups [4].

and ascribed status more than merit, rationality, and progress. Time is often not viewed with any sense of urgency and punctuality and long-range planning are often not considered important. Mexicans generally expect to be treated with courtesy and friendliness in interactions with others. Interpersonal relationships form the backbone of power structures. Table 7.9 lists the cultural customer requirements derived from these observations.

Table 7.9: Cultural Customer Requirements from Country Cultural Profiles

Customer Country of Origin	Cultural Customer Requirement
Finland	<p>Lavatory must be equally functional to men and women.</p> <p>Lavatory must be equally appealing to men and women.</p> <p>Lavatory should be as accessible as possible to people with disabilities<sup>5</sup>.</p>
Australia	<p>Lavatory must be equally functional to men and women.</p> <p>Lavatory must be equally appealing to men and women.</p>
Mexico	<p>More lavatories might be required<sup>6</sup>.</p> <p>A warm, friendly, and inviting lavatory design is desirable.</p>

Additional methods of determining Cultural Customer Requirements exist. For

<sup>5</sup>This is derived from high independence being valued within the family.

<sup>6</sup>This requirement was generated in response to the historically lower levels of long-range planning.

instance, cultural probes can be very useful to delve more deeply into the inner workings of a culture. However, they are time-consuming and expensive to conduct. Likewise, cultural informants can be very useful but are equally expensive and time-consuming.

This example will not delve into the world of cultural informants and cultural probes. However, designers are urged to attempt as much of those processes as possible to increase their understanding of the wants, needs, and desires of their customers. Increased knowledge of the culture of the customer increases the ability of the design engineer to create something that will not only satisfy but might also delight.

## 7.5 Cultural Customer Requirements in the House of Quality

As seen in Table 7.10, the Cultural Customer Requirements generated above have been inserted into the Customer Requirements room of the HoQ. There are several very interesting points to note. Several of the cultural customer requirements conflict with each other. For instance, Australians and Finns want understated decor while Mexicans prefer opulence. This is a result of the different cultural dimension values that Australia and Finland have compared to those of Mexico. In a complete HoQ, many cultural conflicts like this will be discovered. It is the design engineer's job to find technically feasible solutions that will satisfy as many of the customer cultural groups as possible. The design engineer is greatly aided in making cultural customer requirement trade-offs by assigning relative importance

scores early on to each customer. Because of the numbers assigned in Table 7.1, it can be seen that Australia and Finland's need for understated decor outweighs Mexico's desire for opulence. It can not be determined what Japan's needs for opulent versus understated lavatories because of Japan's middle PDI score.

Now that the design engineer has a list of universal and cultural customer requirements prepared, technical solutions can be created to address the wants, needs, and desires of the customers. Affective design techniques, such as those presented in [2] and elsewhere, can be very useful in creating solutions for the many competing customer requirements. The design engineer is urged, however, to be cautious with cultural customer requirements, just as a competent design engineer is with customer requirements in mono-cultural designs. Often, what a customer wants and what the engineering and marketing groups think the customer wants are two very different things. Adding a cultural layer to the complexity can increase the discontinuity between what is believed to be and what truly is desired.

Table 7.10: The Example House of Quality

	Rel. Imp	Tech Sol #2
Cultural Customer Requirements		
Inter-Culture Requirements		
Finland and Australia	0.35	
Lavatory must be equally functional to men and women		
Lavatory must be equally appealing to men and women		
New, innovative ideas are desirable		
Functional, understated decorations		
No gaudy or overly ornate designs		
Japan and Mexico	0.65	
Cultural taboos and things considered dirty must be avoided		
Hofstede Cluster #1		
Japan	0.5	
Functions of lavatory must be clear.		
Japan Customer Requirement #2		
Hofstede Cluster #7		
Finland	0.25	
Lavatory should be as accessible as possible to people with disabilities		
Hofstede Cluster #8		
Australia	0.1	
Cultural taboos are not as important to avoid		
Hofstede Cluster #3		
Mexico	0.15	
Ornate, opulent ornamentation is desirable		
Power and wealth should be felt while on the toilet		
Keep design simple		
Use traditional styles and methods of interacting with devices		
Functions of lavatory don't need to be clear or logical		
More lavatories might be required		
A warm, friendly, and inviting lavatory design is desirable		

## Chapter 8 – Discussion

Like all methods, the method presented in the preceding chapters suffers from a number of shortcomings. Several of the more pertinent shortcomings and potential remedies are discussed below. The benefits of this method are also briefly discussed.

### 8.1 Problems with Cultural Dimensions

Many problems with cultural dimensions have cropped up over the years. Arguments between the authors of Global Leadership and Organizational Behavior Effectiveness Research Program (GLOBE) and Hofstede have laid bare some of the more fundamental issues related to cultural dimensions and will not be reviewed here. See [104, 105] for more information. For the method presented in this thesis to be of use, the design engineer must accept that cultural dimensions, despite their imperfections, are based upon sound reasoning and principles. The problems of data holes, data resolution, and the appropriateness of using cultural dimensions designed for other disciplines are presented below.

#### 8.1.1 Dataset Holes

In a perfect world, every dataset would be complete, without gaps, and completely accurate. This is most certainly not a perfect world. Both Hofstede's dimensions

and GLOBEs dimensions are incomplete.

In Hofstede's cultural dimensions, roughly 50 countries have scores for at least some of the dimensions. The 50 countries are primarily represented because they all had International Business Machines Corporation (IBM) branches and because they answered Hofstede's original survey questionnaires. It is no coincidence that the countries IBM had a large enough presence in for Hofstede to acquire statistically relevant samples are also in the upper tier of nations with respect to wealth and spending. Because of this bias toward rich nations, many design engineers working in the commercial and industrial sectors will not be affected by this particular hole in Hofstede's data.

Another problem in Hofstede's dimensions is the partial inclusion of many countries. This is due in part to the increase in the number of cultural dimensions from four to five in the early 1990's. The fifth dimension score for many cultures have not yet been found in a statistically significant manner. Likewise, several countries have been added with only a score for the fifth dimension and no scores for the other four. Further splintering of the data is expected as the latest dimension, added in the winter of 2008 [81], is integrated into the full dataset.

The GLOBE dimensions have a similar problem with many countries being left out of the dataset. While more than 60 countries were included in the GLOBE survey, many were left out. The manner in which cultures were selected to be included in GLOBE was not driven by economic factors, as with Hofstede. Instead, countries were included based on what in-country collaborators the lead researchers could find in the countries of the world [4].

Regardless of the dataset, there will be holes. However, Hofstede and GLOBE both provide means to help fill in the dataset further. Each provides a pool of questions that was used in creating the original datasets. The eager design engineer with copious amounts of time and money can survey new cultures not included in the original datasets and run the appropriate analyses to find new cultural dimensions scores. For most design engineers, this multi-year effort is unthinkable and even laughable. Instead, they must rely on what has been published and extrapolate from what exists in the literature into uncharted territory.

There are several potential ways of finding information on countries that do not appear in Hofstede's or GLOBE's dimensions. For instance, drawing parallels with countries within the same cultural cluster can provide some degree of confidence that the design will appeal to the customers falling outside of GLOBE and Hofstede. Another possibility is to conduct unscientific surveys using subsets of the questions that Hofstede and GLOBE based their work upon. Other creative options exist and will no doubt be discovered by the clever design engineer.

### 8.1.2 Coarse Data Resolution

The current mainstream cultural dimension schemes all cite their reliance on nation-level discretization as a potential downfall to their methods. Within each country, many diverse subcultures, and at times entirely separate cultures, exist. Take for instance the United States of America where many different groups of people from many different cultural backgrounds live together. Homogenizing

such a diverse country into one set of cultural metrics loses much of the diversity and many of the opportunities for product specialization.

In some countries, such as South Africa, the now-unified Germany, and Switzerland, some researchers break up the different cultural and ethnic groups into separate parts. South Africa is divided into a White population that usually is placed in the Anglo cultural cluster, and a Black population that generally resides with other Black African cultural groups. Switzerland is often split up into German-speaking and French-speaking cultural units that are placed in their respective linguistic groups. Germany is sometimes split into east, formerly communist, and west, formerly capitalist, segments. This leaves out many of the nuances of where these different subgroups intersect.

In South Africa, many ethnic groups, such as Asians, Indians, and mixed-race groups muddy the clean-cut White and Black cultural groups. So too do the people of mixed ancestry. Separating between White and Black loses all of the nuances that exist in these countries.

Another tendency of the cultural dimensions researchers is to group countries together into large blocks when enough data is not available. This is usually the case with the Middle East and North Africa and with East and West Africa as well. Grouping so many cultures together, while related, obliterates the differences between them. Any expatriate who has served in one of the above mentioned regions for an extended period of time can attest to the diversity between the different countries comprising those regions.

Unfortunately, there is little the design engineer can do to improve the dataset

resolution without undertaking large multi-year surveys. This is a definite limitation to the further use and widespread implementation of cultural dimensions. Designs that are targeted for cultural groups too small to register on the large cultural dimensions surveys should use other methods, such as cultural probes, to determine cultural customer requirements.

### 8.1.3 Cultural Dimensions not Meant for Engineering

All of the mainstream cultural dimensions developed to date have been created to support international business leadership researcher. The research and practical implementations that have resulted from the cultural dimensions is very good and has helped many companies to improve profitability and increase their reach across the globe. The cultural dimensions, however, are not designed for engineers.

In most cases, the people surveyed were mid-level managers in major corporations. In Hofstede's case, primarily IBM employees make up the sample population. For GLOBE, several different industries were surveyed. The surveyed industries remained constant across cultures.

Because of the sample populations, there is question of the validity using the data to represent an entire cultural group. Researchers have compared to other groups of people, notably college students and others [1, 4], and found that the dataset does correlate well to other groups of people within the same culture. However, doubts still remain over how generalized the dataset can be made.

In spite of the data and cultural dimensions not being taken from the popu-

lation at large, many researchers in other fields (see for example Chapter 5) have found good success using cultural dimensions in their research and industrial work. It remains to be seen if cultural dimensions will be as successfully deployed in mechanical design as they have been elsewhere.

## 8.2 Problems with Cultural Profiles

As with cultural dimensions, cultural profiles are not without their problems. Mainstream cultural profiles that exist today have several shortcomings for design engineers. Some of the biggest problems are the biases introduced into the profiles, gaps in cultural profile availability, and no cultural profiles targeted at design engineers. These issues are discussed below.

### 8.2.1 Cultural Profiles not Written for Engineers

Currently, no widely available cultural profiles exist for design engineers. Instead, the profiles that do exist are designed for the general public, as is the case with the British Broadcasting Corporation (BBC) offerings [197], or for various political and other governmental consumers [196]. In the case of GLOBE, the cultural profiles are written for business leaders and researchers, and provide solid information for design engineers. However, gaps still exist.

To properly address these problems, a series of cultural profiles targeted at design engineers should be created [206]. Such an undertaking would be very time

and resource intensive. Until a team of researchers attempts to create cultural profiles for design engineers, the mechanical design community will have to continue to rely on existing cultural profiles.

### 8.2.2 Cultural Profiles Have Biases

Many cultural profile sets contain bias. For instance, the Central Intelligence Agency (CIA) World Factbook [196] is seen by some as a propaganda tool of America. The BBC offering similarly can be seen as containing propaganda or at the least containing very anglo-centric views. Likewise, the GLOBE profiles each contain their own biases introduced by the researchers who wrote them.

Bias is inescapable in almost any endeavor. Attempting to remove all bias is impossible. Instead, the competent design engineer must understand what those biases are. By understanding the bias of the cultural profiles as well as their own biases, design engineers can produce a design that is more likely to match the customer.

### 8.2.3 Not all Cultures Have Profiles

Like with cultural dimensions research, not all cultures have profiles, either. While the CIA and BBC cover all of the countries of the world, GLOBE does not. However, the gaps are being filled in. Further research is currently being conducted by GLOBE and others, and is expected to yield additional cultural profiles.

### 8.3 Interpretation of Cultural Information is Difficult

Interpreting the voice of the customer is difficult. A legion of consultants exist to do nothing but translate the customer's wishes into terms that design engineers can understand. Adding culture to the mix only complicates matters further.

Using cultural dimension scores and their associated meanings, cultural profiles, and cultural probes is a crude science in engineering. The method presented in this text outlines one way of using cultural data. However, no advice is given on how to interpret that data. This is something that is lacking in this thesis and should be improved in the future.

### 8.4 This Method is a Poor Substitute for Insider Knowledge

While working with cultural dimensions and cultural profiles can produce reasonable cultural customer requirements, they are no substitute. Only through direct interaction with the customer, be it through site visits, interviews, surveys, cultural probes, or any of the other myriad of techniques that exist, can an accurate and complete representation of customer requirements be generated. However, it is very expensive to send engineers out into the field, especially when dealing with customers on the other side of the planet.

Thus, while the the method presented in this text is crude and will never produce as good of results as other in-person methods, it is still worthwhile. Companies without large research and design budgets can use this tool to launch their products into the global marketplace. Design teams can use this method to gain

an initial understanding of the cultures of their customers.

This approach also is very good at generating questions in a structured and orderly manner. Rather than brainstorming which can lead to very different results, this method formalizes and facilitates finding pertinent questions that need to be answered. Questions produced from the creation of cultural customer requirements are not a hindrance. They are a benefit to the engineering design process.

## 8.5 Potential Future Research and Improvements

Several avenues of potential future research present themselves. The scope of the work presented in this document did not allow for many areas to be fully explored. The paragraphs below outline several potential useful follow-on projects.

Aside from the example presented in Chapter 7, this method has not been applied to mechanical design. To achieve any sort of traction in industry, it must be validated. One potential method would be to employ several undergraduate design teams. One group of design teams would be given the tool while the other group would not. The resulting designs could be compared by the customer to see which is more satisfying and pleasing. With consistent results, the tool could either be proven to have great or little value.

As was discussed in Section 8.2.1, cultural profiles do not exist for engineers. While it would be a major undertaking requiring researchers in multiple countries and at multiple institutions, the resulting cultural guidebook for engineers could be very valuable. A potential plan to complete in the neighborhood of three to

five such profiles in three years' time is presented in [206].

Testing of the method presented in this text must be conducted in industry. No amount of university-based testing will determine if this tool is truly a worthwhile contribution. Industrial testing will also speed the introduction and deployment of the tool if it proves to be a sound method.

In spite of the many problems with the tool presented in this document and the underlying data it relies on, the author believes that this tool has merit and will prove to be useful for mechanical design engineers in industry. Much research remains to be done, leaving a fertile field for the author of this text and other researchers. If the competent design engineer understands the limitations and shortcomings of this tool, it can be effectively deployed with the end result of increasing company profit.

## Chapter 9 – Conclusion

This text has outlined one potential method to integrate cultural considerations into the mechanical design process using Quality Function Deployment (QFD) and House of Quality (HoQ) in conjunction with cultural dimensions and cultural profiles. Culture was discretized down to the nation level for several reasons including a lack of quantified data to sub-cultures. The resulting tool is useful for nation-level design projects being built and/or sold across cultural boundaries.

The method proposed in this text was created in response to the increasing pace of globalization, the continued humanization of foreign cultures, and the lack of formal professional cultural awareness among mechanical design engineers. A method was needed to bridge the gap between gut feelings and seat-of-the-pants design for cultures and quantitative design based on QFD. The aircraft lavatory example included in this thesis provides an example of the method in action.

Problems do exist with the proposed method. Issues of data fidelity and gaps in the data set plague the cultural dimensions schemes. Biases, missing data, and primary audiences other than engineers affect the cultural profile repositories. Interpreting these cultural information sources and divining cultural customer requirements is an art, not a science. In spite of these shortcomings, the tool still appears to be valid and useful, especially in spurring deeper thinking on the part of the design engineer about cultural customer requirements and the importance

of determining what satisfies customers from different cultural backgrounds.

This text is a first attempt at bringing cultural considerations into the mechanical design process. It is not expected to be a gold standard that can never be improved upon. Quite the contrary; there are many areas that can stand to be improved. This effort will be considered a success if design engineers begin to think more critically about the role that culture plays in their designs.

## List of Acronyms

- IBM** International Business Machines Corporation
- UNESCO** United Nations Education, Scientific, and Cultural Organization
- UN** United Nations
- GLOBE** Global Leadership and Organizational Behavior Effectiveness Research Program
- CIA** Central Intelligence Agency
- BBC** British Broadcasting Corporation
- HoQ** House of Quality
- QFD** Quality Function Deployment
- PDI** Power Distance Index
- UAI** Uncertainty Avoidance Index
- IMEDE** IMEDE Management Development Institute
- ANOVA** Analysis of Variance
- IDV** Individualism versus Collectivism Index
- MAS** Masculinity versus Femininity Index

<b>LTO</b>	Long-term versus Short-term Orientation Index
<b>IRI</b>	Indulgence versus Restraint
<b>BCE</b>	Before Common Era
<b>BC</b>	Before Christ
<b>IVR</b>	Indulgence versus Restraint
<b>HCI</b>	Human Computer Interaction
<b>MBO</b>	Management by Objectives
<b>EU</b>	European Union
<b>WVS</b>	World Values Survey

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## APPENDICES

## Appendix A – Hofstede’s Cultural Dimensions Tables of Qualities

This appendix reproduces the anecdotal tables found in Hofstede’s book [1].

### Power Distance Index

Table A.1: Antecedents and Consequents of Four Concepts as Measured Among Male Students by Triandis et al. [57]. Reproduced from [1].

Low PDI	High PDI
	<i>Antecedents of “Freedom”</i>
Respect of individual equality	Tact
	Servitude
	Money
	<i>Consequents of “Freedom”</i>
	Industrial production
	Disorderly society
	Wealth
	<i>Antecedents of “Power”</i>

Continued. . .

Table A.1: (Continued)

Low PDI	High PDI
Leadership	Wrestling
Knowledge	
	<i>Consequents of "Power"</i>
	Cruelty
	<i>Antecedents of "Wealth"</i>
Happiness	Inheritance
Knowledge	Ancestral property
Love	High interest charges
	Stinginess
	Crime
	Deceit
	Theft
	<i>Consequents of "Wealth"</i>
Satisfaction	Fear of thieves
Happiness	Arrogance
	<i>Antecedents of "Respect"</i>
Love	Old age
	<i>Consequents of "Respect"</i>
Friendship	
Continued...	

Table A.1: (Continued)

Low PDI	High PDI
Recognition of superiority	
Liking	

Table A.2: Summary of Values and Attitudes Differences  
 Found Correlated with PDI. Reproduced from [1].

Low PDI	High PDI
National elites hold relatively unauthoritarian values.	National elites hold relatively authoritarian values.
Commercial airline pilots hold relatively unauthoritarian values.	Commercial airline pilots hold relatively authoritarian values.
Authoritarian attitudes in students a matter of individual personality.	Authoritarian attitudes in students a social norm.
Freedom more important than equality.	Equality more important than freedom.
Authority based on secular-rational arguments.	Authority based on tradition.
Continued...	

Table A.2: (Continued)

Low PDI	High PDI
Students have positive associations with “power” and “wealth.”	Students have negative associations with “power” and “wealth.”
Positive attitudes toward older people.	Negative attitudes toward older people.
Top leaders younger.	Top leaders older.
Middle age starts after 40.	Middle age starts before 40.
Students see world as a just place.	Students see world as an unjust place.
Less acquiescence in answering survey questions.	More acquiescence in answering survey questions.

Table A.3: The Power Distance Societal Norm. Reproduced from [1].

Low PDI	High PDI
All should be interdependent.	A few should be independent; most should be dependent.

Continued...

Table A.3: (Continued)

Low PDI	High PDI
Inequality in society should be minimized.	There should be an order of inequality in this world in which everyone has his/her rightful place; high and low are protected by this order.
Hierarchy means an inequality of roles, established for convenience.	Hierarchy means existential inequality.
Subordinates are people like me.	Superiors consider subordinates as being of a different kind.
Superiors are people like me.	Subordinates consider superiors as being of a different kind.
The use of power should be legitimate and is subject to the judgment between good and evil.	Power is a basic fact of society that antedates good or evil; its legitimacy is irrelevant.
All should have equal rights.	Power holders are entitled to privileges.
Powerful people should try to look less powerful than they are.	Powerful people should try to look as powerful as possible.
Stress on reward, legitimate and expert power.	Stress on coercive and referent power.
Continued. . .	

Table A.3: (Continued)

Low PDI	High PDI
The system is to blame.	The underdog is to blame.
The way to change a social system is by redistributing power.	The way to change a social system is by dethroning those in power.
Latent harmony between the powerful and the powerless.	Latent conflict between the powerful and the powerless.
Older people neither respected nor feared.	Older people respected and feared.

Table A.4: Key Differences Between Low- and High-PDI Societies: Family, School, Work Organization, Politics, and Ideas. Reproduced from [1].

Low PDI	High PDI
<i>In the Family</i>	
Parents treat children as equals.	Parents teach children obedience.
Children should enjoy leisure.	Children should work hard even if this is a burden.
Infertility no reason for divorce.	Infertility may be reason for divorce.
Continued. . .	

Table A.4: (Continued)

Low PDI	High PDI
Children should respect rules of civil morality.	Informal lenience toward rule of civil morality.
Children treat parents and older relatives as equals.	Respect for parents and older relatives is a basic virtue and lasts throughout life.
Children expected to be competent at a young age, especially socially.	Children not seen as competent until at a later age.
Children play no role in old-age security of parents.	Children are a source of old-age security, especially to fathers.
Small enterprises set up for job reasons.	Small enterprises for family interest.
<i>At School</i>	
Teachers treat students as equals.	Students depend on teachers.
Students treat teachers as equals.	Students treat teachers with respect, even outside class.
Student-centered education.	Teacher-centered education.
Students initiate some communication in class.	Teachers initiate all communication in class.
Continued. . .	

Table A.4: (Continued)

Low PDI	High PDI
Teachers are experts who transfer im- personal truths.	Teachers are gurus who transfer per- sonal wisdom.
Parents may side with students against teachers.	Parents supposed to side with teach- ers to keep students in order.
Quality of learning depends on two- way communication and excellence of students.	Quality of learning depends on excel- lence of teachers.
Lower educational levels maintain more authoritarian relations.	Authoritarian values independent of education level.
Educational system focuses on mid- dle levels.	Education system focuses on top level.
More Nobel Prizes in sciences per capita.	Fewer Nobel Prizes in sciences per capita.
More modest expectations on bene- fits of technology.	High expectations on benefits of tech- nology.
<i>In the Work Organization</i>	
Decentralized decision structures; less concentration of authority.	Centralized decision structures; more concentration of authority.
Flat organization pyramids.	Tall organization pyramids.
Continued. . .	

Table A.4: (Continued)

Low PDI	High PDI
Small proportion of supervisory personnel.	Large proportion of supervisory personnel.
Hierarchy in organizations means an inequality of roles, established for convenience.	Hierarchy in organizations reflects the existential inequality between higher-ups and lower-downs.
The ideal boss is a resourceful democrat; sees self as practical, orderly, and relying on support.	The ideal boss is a well-meaning autocrat or good father; sees self as benevolent decision maker.
Managers rely on personal experiences and on subordinates.	Managers rely on formal rules.
Subordinates expect to be consulted.	Subordinates expect to be told.
Consultative leadership leads to satisfaction, performance, and productivity.	Authoritative leadership and close supervision lead to satisfaction, performance, and productivity.
Subordinate-superior relations pragmatic.	Subordinate-superior relations polarized, often emotional.
Institutionalized grievance channels in case of power abuse by superior.	No defense against power abuse by superior.
Continued. . .	

Table A.4: (Continued)

Low PDI	High PDI
Subordinates influenced by bargaining and reasoning; Management by Objectives (MBO) is feasible.	Subordinates influenced by formal authority and sanctions; MBO cannot work.
Innovations need good champions.	Innovations need good support from hierarchy.
Managers involved in relevant purchasing decisions.	Managers not involved in relevant purchasing decisions.
Privileges and status symbols for managers are frowned upon.	Privileges and status symbols for managers are expected and popular.
Narrow salary range between top and bottom of organization.	Wide salary range between top and bottom of organization.
Managers feel adequately paid.	Managers feel underpaid.
Managers (increasingly) satisfied with career.	Managers dissatisfied with career.
Possibilities to escape from role ambiguity and overload.	Frequent role ambiguity and overload.
Openness with information, also to non-superiors.	Information constrained by hierarchy.
Continued...	

Table A.4: (Continued)

Low PDI	High PDI
Manual work same status as clerical work.	White-collar jobs valued more than blue-collar jobs.
<i>In Political Systems</i>	
Pluralist governments based on outcome of majority vote.	Military, autocratic, or oligarchic government based on co-optation.
Political parties exist and tend to be in the center with relatively weak left and right wings.	If political parties exist, there is a polarization between left and right with a weak center.
Government is frequently led by parties stressing equality, usually social democrats.	If government is based on election results, it tends to be led by right-wing parties.
Gradual changes in form of government (evolution and stability).	Sudden changes in form of government (revolution and/or instability).
Much discussion but little violence in domestic politics.	Little discussion but frequent violence in domestic politics.
Citizens satisfied with the way democracy works.	Citizens dissatisfied with the way democracy works.
Power, status, and wealth do not need to go together.	Status consistency; power brings status and wealth.
Continued...	

Table A.4: (Continued)

Low PDI	High PDI
Small income differentials in society, further reduced by the tax system.	Large income differentials in society, further increased by the tax system.
Administrative elites recruited from broad range of population.	Administrative elites unrepresentative for total population.
Citizens cooperate with authorities, as in waste recycling.	Citizens wait for action by authorities, as in environmental protection.
Citizens read more newspapers.	Citizens watch more television.
Citizens distrust press but trust police.	Citizens trust press but distrust police.
Less corruption; scandals end political careers.	More corruption; scandals expected to be covered up.
Free labor unions exist and are pragmatically oriented.	If free labor unions exist, they are ideologically and politically oriented.
<i>In Religion, Ideas, and Ideologies</i>	
Prevailing religions and philosophical systems stress equality.	Prevailing religions and philosophies stress stratification and hierarchy.
Prevailing political ideologies stress and practice power sharing.	Prevailing political ideologies stress and practice power struggle.
Pluralist ideas about society.	Elitist ideas about society.
Continued. . .	

Table A.4: (Continued)

Low PDI	High PDI
Non-zero-sum theories of power.	Zero-sum theories of power.
Use of force reveals the failure of power.	Use of force is essence of power.
More, Marx, Engles, weber, Mulder, Tannenbaum, Likert, Miller.	Machiavelli, La Boetie, Hobbes, Mosca, Pareto, Michels.

Table A.5: Origins of National PDI Differences. Reproduced from [1].

Low PDI	High PDI
Moderate to cold climates.	Tropical and subtropical climates.
Survival and population growth more dependent on human intervention with nature.	Survival and population growth less dependent on human intervention with nature.
More need for technology.	Less need for technology.
Historical events: early legislation applied to rulers; one-son inheritance.	More traditional agriculture, less modern industry, less urbanization.

Continued...

Table A.5: (Continued)

Low PDI	High PDI
More need for education of lower strata (literacy, mass communication).	Less need for education of lower strata.
Greater social mobility and strong development of middle class.	Less social mobility and weak development of middle class.
Greater national wealth.	Less national wealth.
Wealth more widely distributed.	Wealth concentrated in hands of small elite.
Political power based on system of representation.	Political power concentrated in hands of oligarchy or military.
Strong will to be independent: smaller size of population.	Little popular resistance to integration into a large state: large size of population.
Historical events: independence, federalism, negotiation.	Historical events: occupation, colonialism, imperialism.
Less centralization of political power.	Centralization of political power.
Faster population increase in wealthy countries.	Slower population increase in wealthy countries.
Technological momentum of change.	More static society.
Continued. . .	

Table A.5: (Continued)

Low PDI	High PDI
Children learn things that elders never learned: less dependent.	Children dependent on parents and elders.
Some teaching is two-way.	Teachers are omniscient, teaching is one-way.
More questioning of authority in general.	Less questioning of authority in general.

## Uncertainty Avoidance Index

Table A.6: Summary of values and other psychological characteristics related to UAI. Reproduced from [1].

Low UAI	High UAI
<i>Stress, Anxiety, and Expression of Emotions</i>	
Lower work stress.	Higher work stress.
Lower anxiety level in population.	Higher anxiety level in population.
Emotions have to be controlled.	Expression of emotions normal.
People claim not to express embarrassment, anger, guilt.	People claim the expression of embarrassment, anger, and guilt.
Facial expressions of sadness and fear easily readable by others.	Nature of emotions less accurately readable by others.
<i>Subjective Well-Being (Happiness)</i>	
More subjective well-being.	Less subjective well-being.
Feelings of happiness shared.	Feelings of happiness widely dispersed.
<i>Employment Stability, Seniority, Generation Gap</i>	
Less hesitation to change employers.	Tendency to stay with same employer.
Lower average seniority in jobs.	Higher average seniority in jobs.

Continued...

Table A.6: (Continued)

Low UAI	High UAI
Company loyalty is not a virtue.	Company loyalty is a virtue.
Managers should be selected on criteria other than seniority.	Managers should be selected on basis of seniority.
Preference for smaller organizations.	Preference for larger organizations.
Optimism about employers' motives.	Pessimism about employers' motives.
Admit dissatisfaction with employer.	Do not admit dissatisfaction with employer.
More ambition for advancement and management, and competition among employees acceptable.	Lower ambition for advancement and preference for specialist positions.
Individual decisions, authoritative management, and competition among employees acceptable.	Ideological preference for group decisions, consultative management, against competition among employees.
Favorable attitudes toward younger people; smaller generation gap.	Critical attitudes toward younger people; larger generation gap.
<i>Openness to New Experience and Information; Trust</i>	
If necessary, employees may break rules.	Company rules should not be broken.
Continued...	

Table A.6: (Continued)

Low UAI	High UAI
Less resistance to changes.	More resistance to changes.
Most people can be trusted.	One can not be careful enough with other people, not even with family.
Acceptance of foreigners as managers.	Suspicion of foreigners as managers.
Harmony with nature less appealing.	Ideological appeal of harmony with nature.

Table A.7: The UAI Societal Norm. Reproduced from [1].

Low UAI	High UAI
The uncertainty inherent in life is relatively easily accepted and each day is taken as it comes.	The uncertainty inherent in life is felt as a continuous threat that must be fought.
Ease, lower stress, less anxiety.	Higher stress, anxiety, neuroticism.
Being busy is not a virtue per se.	Inner urge to be busy.
Suppression of emotions.	Expression of emotions.
Continued. . .	

Table A.7: (Continued)

Low UAI	High UAI
Subjective well-being.	Expression of emotions.
Openness to change and innovation.	Conservatism, law and order.
Willingness to take unknown risks.	Only known risks are taken.
What is different is curious.	What is different is dangerous.
Tolerance of diversity.	Xenophobia.
Younger people are respected.	Older people are respected and feared.
Comfortable with ambiguity and chaos.	Need for clarity and structure.
Appeal of novelty and convenience.	Appeal of purity.
Belief in one's own ability to influence one's life, one's superior's and the world.	Feeling of powerlessness toward external forces.

Table A.8: Key Differences Between Low- and High-UAI societies: Family, School, Motivation, Consumer Behavior, Politics, Legislation, Nationalism, Xenophobia, Religion, and Theories and Games. Reproduced from [1].

Low UAI	High UAI
<i>In the Family</i>	
Parents control their emotions.	Parents behave emotionally.
Higher satisfaction with home life.	Lower satisfaction with home life.
Lenient rules on what is dirty and taboo.	Tight rules on what is dirty and taboo.
Truth is relative.	Concern for Truth with a capital T.
Few rules; if children cannot obey the rules, the rules should be changed.	Many rules; if children cannot obey the rules, they are sinners who should repent.
Mild superegos developed.	Strong superegos developed.
Children learn that the world is benevolent.	Children learn that the world is hostile.
Children exposed to unknown situations.	Children protected from the unknown.

Continued. . .

Table A.8: (Continued)

Low UAI	High UAI
Undifferentiated, informal ways of address.	Strictly differentiated forms of address.
Nontraditional gender roles accepted.	Traditional gender roles preferred.
<i>At School</i>	
Students expect open-ended learning situations and good discussions.	Students expect structured learning situations and seek right answers.
Teachers may say, "I do not know."	Teachers supposed to have all answers.
Students learn that truth may be relative.	Students learn that Truth is absolute.
Students attribute achievements to own ability.	Students attribute achievements to effort, context, and luck.
Children rate self-efficacy high.	Children rate self-efficacy low.
Parents' ideas sought by teachers.	Parents seen as extension of teachers.
Dialect speech positively valued.	Dialect speech negatively valued.
Independence for female students important.	Traditional role models for female students.
<i>In Motivation</i>	
Continued. . .	

Table A.8: (Continued)

Low UAI	High UAI
Traditional children's stories stress strong achievement motivation.	Traditional children's stories stress strong security motivation.
Hope of success.	Fear of failure.
Preference for tasks with uncertain outcomes, calculated risks, and requiring problem solving.	Preference for tasks with sure outcomes, no risks, and following instructions.
<i>In the Work Situation</i>	
Weak loyalty to employer; short average duration of employment.	Strong loyalty to employer, long average duration of employment.
Preference for smaller organizations but little self-employment.	Preference for larger organizations but at the same time much self-employment.
Skepticism toward technological solutions.	Strong appeal of technological solutions.
Innovators feel independent of rules.	Innovators feel constrained by rules.
Renegade championing.	Rational championing.
Top managers involved in strategy.	Top managers involved in operations.
Power of superiors depends on position and relationships.	Power of superiors depends on control of uncertainties.
Continued. . .	

Table A.8: (Continued)

Low UAI	High UAI
Tolerance for ambiguity in structures and procedures.	Highly formalized conception of management.
Appeal of transformational leader role.	Appeal of hierarchical control role.
Many new trademarks granted.	Few new trademarks granted.
Innovations welcomed but not necessarily taken seriously.	Innovations resisted but, if accepted, applied consistently.
Precision and punctuality have to be learned and managed.	Precision and punctuality come naturally.
Relationship orientation.	Task orientation.
Flexible working hours not appealing.	Flexible working hours popular.
Belief in generalists and common sense.	Belief in specialists and expertise.
Superiors optimistic about employees' ambition and leadership capacities.	Superiors pessimistic about employees' ambitions and leadership capacities.

*In Consumer Behavior*

Continued...

Table A.8: (Continued)

Low UAI	High UAI
Consumption of convenience products.	Consumption of “purity” products: mineral water, fresh fruits, sugar, textile washing powders.
Reading books and newspapers.	Less reading books and newspapers.
Use Internet and teletext.	Less use of Internet and teletext.
Main car bought secondhand.	Main car bought new.
“Do it yourself” in home.	Use specialists in home.
Investment in stocks.	Investment in precious metals and gems.
Short payment terms for bills.	Long payment terms for bills.
<i>In Political Systems</i>	
Citizens competent toward authorities.	Citizens incompetent toward authorities.
Citizens have confidence in civil service.	Citizens lack confidence in civil service.
Much participation in voluntary associations and activities.	Little participation in voluntary associations and activities.
Strong interest in politics.	Weak interest in politics.
Continued. . .	

Table A.8: (Continued)

Low UAI	High UAI
European Union (EU) members less in favor of European government.	EU members more in favor of European government.
Old democracies.	Young democracies.
Citizens may protest government decisions.	Citizen protest should be repressed.
No identify card obligation.	Carrying of identity card obligatory.
Decisions about infrastructure slow.	Decisions about infrastructure fast.
Civil servants positive toward politics.	Civil servants dislike politics.
Few law graduates in civil service.	Many law graduates in civil service.
Laypersons in key positions; high ratio of nurses to doctors.	Experts in key positions; low ratio of nurses to doctors.
In wealthy countries, less corruption.	In wealthy countries, more corruption.
In wealthy countries, less government intervention in the economy.	In wealthy countries, more government intervention in the economy.
<i>In Legislation</i>	
Few and general laws and regulations.	Many and precise laws and regulations.
Continued. . .	

Table A.8: (Continued)

Low UAI	High UAI
Citizens positive toward legal system.	Citizens negative toward legal system.
Laws usually on my side.	Laws usually against me.
Rule of law should prevail.	Laws should be broken if unjust.
Lower speed limits on motorways.	Higher speed limits on motorways.
<i>Nationalism and Xenophobia</i>	
Weak appeal of right-wing policies.	Strong appeal of right-wing policies.
Proud of own nation, willing to fight for it.	Not proud of own nation, unwilling to fight for it.
Expatriate students in United States consider own culture as superior but own language as undervalued.	Expatriate students in United States consider own culture as inferior but own language as highly respected.
Other races acceptable as neighbors.	Other races rejected as neighbors.
Immigrants tolerated.	Immigrants should be sent back.
Citizens can contribute to peace.	Citizens powerless to contribute to peace.
Compromising with opponents is safe.	Compromising with opponents is dangerous.
Willing to live day to day.	Worried about the future.
Continued. . .	

Table A.8: (Continued)

Low UAI	High UAI
More prepared to live abroad.	Less prepared to live abroad.
Loose societies.	Tight societies.
<i>In Religion</i>	
If Christian, predominantly Protestant.	If Christian, predominantly Catholic or Orthodox.
Faith: exemplarism and theism.	Certitude: conversionism and gnosticism.
Buddhism, Taoism, Hinduism, mysticisms.	Islam, Judaism, Shintoism.
Own truth should not be imposed on others.	There is only one Truth, and we have it.
Human rights: no persecution for beliefs.	Aggressive fundamentalisms.
<i>In Theories and Games</i>	
In philosophy and science, tendency toward relativism and empiricism.	In philosophy and science, belief in ultimate values and grand theories.
Induction: from the specific to the general.	Deduction: from the general to the specific.
Continued...	

Table A.8: (Continued)

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Low UAI	High UAI
Scientific opponents can be personal friends.	Scientific opponents must be personal enemies.
Games of chance popular.	Games of skill and strategy popular.

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## Individualism Versus Collectivism Index

Table A.9: Summary of Value Connotations of IDV Differences Found in Surveys and Other Comparative Studies. Reproduced from [1].

Low IDV	High IDV
Importance of provisions by company, such as physical conditions.	Importance of employees' personal lives (time).
More importance attached to training and use of skills in jobs.	More importance attached to freedom and challenge in jobs.
More acquiescence in response to "importance" questions.	More differentiation in response to "importance" questions.
Qualification for jobs in terms of years of schooling.	Qualification for jobs in terms of performance at previous tasks.
Staying with one company desirable, old-timers make better managers.	Staying with company undesirable, old-timer managers not better.
Large, foreign, successful, modern company attractive.	Smaller, local company attractive.
Company responsible for employees.	Employees responsible for themselves.
Moral involvement with company.	Calculative involvement.

Continued...

Table A.9: (Continued)

Low IDV	High IDV
Interesting work as important as earnings.	Earnings more important than interesting work.
Knowing the right people most important for career.	Ability most important for career.
Group decisions are better.	Individual decisions are better.
Collectivism among non-International Business Machines Corporation (IBM) managers and elites.	Individualism among non-IBM managers and elites.
Collectivism among airline pilots and consumers.	Individualism among airline pilots and consumers.
Collectivism among employees of other multinational companies.	Individualism among employees of other multinational companies.
In Schwartz's values surveys among teachers and students, conservatism; among teachers also hierarchy.	In Schwartz's values surveys: affective autonomy, intellectual autonomy, and egalitarian commitment.
Continued. . .	

Table A.9: (Continued)

Low IDV	High IDV
In Trompenaars's data from company personnel: personal relationships, ascription, particularism, and collectivism.	In Trompenaars's data: planning, achievement, universalism, and individualism.
In Inglehart's World Values Survey (WVS) analysis: survival values (materialist).	In Inglehart's WVS analysis: well-being values (postmaterialist).
Duty in life appealed to students.	Enjoyment in life appealed to students.
Managers chose duty, expertness, and prestige as life goals.	Managers chose pleasure, affection, and security as life goals.
Interpersonal relations important for students' happiness.	Intrapersonal hedonism important for students' happiness.
Friendships predetermined by social network.	Importance of making specific friendships.

Table A.10: The IDV Societal Norm. Reproduced from [1].

Low IDV	High IDV
In society, people are born into extended families or clans, which protect them in exchange for loyalty.	In society, everyone is supposed to take care of him- or herself and his or her immediate family only.
“We” consciousness.	“I” consciousness.
Gemeinschaft (community).	Gesellschaft (society).
Collectivity orientation.	Self-orientation.
Value standards differ for in-groups and out-groups: particularism.	Value standards should apply to all: universalism.
Identity is based in the social system.	Identity is based in the individual.
“Shame” cultures.	“Guilt” cultures.
High-context communication.	Low-context communication.
Emotional dependence of individuals on institutions and organizations.	Emotional independence of individuals from institutions or organizations.
Emphasis on belonging: membership ideal.	Emphasis on individual initiative and achievement: leadership ideal.

Continued. . .

Table A.10: (Continued)

Low IDV	High IDV
Private life is invaded by institutions and organizations to which one belongs.	Everyone has a right to a private life.
Survival.	Hedonism.
Activities imposed by context.	Self-started activities.
Expertise, order, duty, security provided by organization or clan.	Autonomy, variety, pleasure, individual financial security.
Traditional society.	“Modern” or “postmodern” society.

Table A.11: Key Differences Between Collectivist and Individualist Societies: Family, Personality, Language, School Issues, Work Situation, Management Methods, Consumer Behavior, Health, Politics, and Ideas. Reproduced from [1].

Low IDV	High IDV
<i>In the Family</i>	
Continued...	

Table A.11: (Continued)

Low IDV	High IDV
Horizontal integration: People live with or close to relatives or clan members.	People live in nuclear or one-parent families.
Others classified as in-group or out-group.	Others classified as individuals.
Family provides protection in exchange for lifelong loyalty.	Children are supposed to take care of themselves as soon as possible.
Strong family ties, frequent contacts. Fewer divorces.	Weak family ties, rare contacts. More divorces.
Children learn to think in terms of “we.”	Child learns to think in terms of “I.”
Non-family, unrelated persons can be adopted into family.	Family versus non-family distinction irrelevant.
Vertical integration: care for aged relatives and worship of ancestors.	Aged relatives should care for themselves; ancestors unknown, irrelevant.
A marriage without children is not complete.	Choosing to have no children in a marriage is a socially acceptable option.

Continued. . .

Table A.11: (Continued)

Low IDV	High IDV
Mothers expect to live with children in their old age.	Mothers expect to live apart in their old age.
Businesspersons live with parents.	Businesspersons live separately.
Nobody is ever alone.	Privacy is normal.
Harmony should always be maintained and direct confrontation avoided.	Speaking one's mind is a characteristic of an honest person.
Opinions predetermined by in-group.	Personal opinions expected.
Financial and ritual obligations to relatives.	Financial independence of relatives; few family rituals.
Togetherness does not demand speaking.	Visits are filled with talking.
Friendships predetermined by in-group.	Need for specific friendships.
Family relationships can be oppressive.	Lasting relationships difficult to achieve.
Trespassing leads to shame and loss of face for self and in-group.	Trespassing leads to guilt and loss of self-respect.
Continued. . .	

Table A.11: (Continued)

Low IDV	High IDV
Criteria for marriage partner: right pre- age, wealth, industriousness, and chastity of bride.	Criteria for marriage partner not pre- determined.
Marriages often arranged.	Marriages supposed to be love based.
Living with in-laws and shared in- come and religion normal.	Living with in-laws undesirable; in- dependence in income and religion.
<i>In Personality and Behavior</i>	
“Individualistic” not important as personality characteristics.	“Individualistic” important as a per- sonality characteristic.
Low public self-consciousness.	High public self-consciousness.
Other-directed behavior.	Extrovert and acting behavior.
Attitudes toward others depend on their group membership.	Attitudes toward others independent of group membership.
Harmony: confrontations to be avoided.	Confrontations are normal.
More conformity behavior (Asch).	Less conformity behavior.
Managers stress conformity and or- derliness.	Managers stress leadership and vari- ety.
Continued...	

Table A.11: (Continued)

Low IDV	High IDV
Women express emotions less strongly than men.	Women express emotions more strongly than men.
Emotional expression of sadness encouraged, happiness discouraged.	Emotional expression of happiness encouraged, sadness discouraged.
Activities dictated by role and context, slower walking.	More self-started activities, faster walking.
<i>In Language and Group identity</i>	
Languages in which the word I is not pronounced.	Languages in which the word I is indispensable for understanding.
Students abroad consider their language as not respected.	Students abroad consider their language as highly respected.
Students' gender and religion important for their identity.	Students' gender and religion less important for their identity.
Self-concept in terms of group.	Self-concept idiocentric.
<i>At School</i>	
Teachers deal with pupils as a group.	Teachers deal with individual pupils.
Pupils' individual initiatives discouraged.	Pupils' individual initiatives encouraged.
Continued...	

Table A.11: (Continued)

Low IDV	High IDV
Schoolchildren report ethnocentric, traditional views.	Schoolchildren report “modern” views.
Students associate according to pre-existing in-group ties.	Students associate according to tasks and current needs.
Students expect preferential treatment by teachers from their in-group.	In-group membership no reason to expect preferential treatment.
Harmony, face, and shaming in class.	Students’ selves respected.
Students will not speak up in class or large groups.	Students expected to speak up in class or large groups.
Students’ aggressive behavior bad for academic performance.	Students’ self-esteem good for academic performance.
Purpose of education is learning how to do.	Purpose of education is learning how to learn.
Diplomas provide entry to higher-status groups.	Diplomas increase economic worth and/or self-respect.
<i>In Work Situations</i>	
Employees act in the interest of their in-group, not necessarily of themselves.	Employees supposed to act as “economic men.”
Continued. . .	

Table A.11: (Continued)

Low IDV	High IDV
Hiring and promotion decisions take employees' in-group into account.	Hiring and promotion decisions should be based on skills and rules only.
Relatives of employers and employees preferred in hiring.	Family relationships seen as a disadvantage in hiring.
Employer-employee relationship is basically moral, like a family link.	Employer-employee relationship is a business deal in a "labor market."
Poor performance reason for other tasks.	Poor performance reason for dismissal.
Employee commitment to organization low.	Employee commitment to organization high.
Potential emotional commitment to union.	Relationship with union calculative.
Employees perform best in in-groups.	Employees perform best as individuals.
Training most effective when focused at group level.	Training most effective when focused at individual level.

Continued. . .

Table A.11: (Continued)

Low IDV	High IDV
Preferred reward allocation based on equality for in-group, equity for out-group.	Preferred reward allocation based on equity for all.
Relationships with colleagues cooperative for in-group members, hostile for out-group.	Relationships with colleagues do not depend on their group identity.
Treating friends better than others is normal and ethical: particularism.	Treating friends better than others is nepotism and unethical: universalism.
In business, personal relationships prevail over task and company.	In business, task and company prevail over personal relationships.
Organizational success attributed to sharing information, openly committing oneself, and political alliances.	Organizational success attributed to withholding information, not openly committing, and avoiding alliances.
Belief in collective decisions.	Belief in individual decisions.
Innovation champions in organizations want to involve others.	Innovation champions in organizations want to venture out on their own.
Continued. . .	

Table A.11: (Continued)

Low IDV	High IDV
Innovations within existing networks.	Innovations outside existing networks.
Fewer invention patents granted.	More invention patents granted.
Entrepreneurs claim contribution of others to their results.	Entrepreneurs claim own results without depending on others.
Employees and managers report teamwork, personal contacts, and discrimination at work.	Employees and managers report working individually.
Less control over job and working conditions; fewer hours worked.	More control over job and working conditions, longer hours worked.
Less social mobility across occupations.	Greater social mobility across occupations.
<i>In the Applicability of Management Methods</i>	
Management is management of groups.	Management is management of individuals.
Theories based on individual psychology of limited use.	Some theories based on individual psychology useful.
Employee has to be seen in family and social context.	Employee can be seen as individual.
Continued...	

Table A.11: (Continued)

Low IDV	High IDV
Keeping ethnic or other in-groups together supports productivity.	Composition of work groups based on individual criteria; in-groups unwanted.
Incentives to be given to in-groups.	Incentives to be given to individuals.
Leadership is inseparable from the context (PM leadership theory).	Leadership is a property of the leader (various U.S. theories).
<i>In Consumer Behavior</i>	
Live in apartments or flats.	Live in detached houses with private gardens; own motor homes.
Live with human companions.	Live with cats and/or dogs.
Security by social network.	Security by home and life insurance.
Ask friends for jobs around the house.	Do-it-yourself for jobs around the house.
Other-dependent lifestyles.	Self-supporting lifestyles.
Read fewer books, use fewer home computers, enjoy TV more.	More books, use computer, use answering machine.
Social network main source of information.	Media main source of information.
<i>In Matters of Health and Disability</i>	

Continued. . .

Table A.11: (Continued)

Low IDV	High IDV
Ways of coping with stress mainly emotional.	Ways of coping with stress mainly problem focused.
Depressed and schizophrenic patients remain integrated into social networks.	Depressed and schizophrenic patients isolated from social networks.
Smaller share of public and private money spent on health care.	Larger share of public and private money spent on health care.
Less satisfaction with health care.	More satisfaction with health care.
Disability is a shame for the family.	Disability is a handicap to be overcome.
Disability is a source of grief and pessimism.	Disability is a challenge to be handled with optimism.
Proportionally more traffic deaths.	Proportionally fewer traffic deaths.
<i>In Political Systems</i>	
Collective interests supposed to prevail over individual interests.	Individual interests supposed to prevail over collective interests.
Economy based on collective interests.	Economy based on individual interests.
Continued. . .	

Table A.11: (Continued)

Low IDV	High IDV
State capitalism or state socialism.	Market capitalism or market socialism.
Economic monopolies.	Competition stimulated.
Private life is invaded by public interests.	Everyone has a right to privacy.
Opinions and votes predetermined by in-group membership.	Everyone is expected to have a private opinion: one person, one vote.
Political power exercised by interests groups.	Political power exercised by voters.
Rigid social and occupational class systems.	Social and occupational mobility.
Large differences in wealth between sectors of the economy.	Wealth distributed fairly equally across sectors of the economy.
Laws and rights differ by group according to tradition and religion.	Laws and rights supposed to be the same for all.
In wealthy countries, low human rights ratings.	In wealthy countries, high human rights ratings.
Small share of national budget spent on education.	Large share of national budget spent on education.
Continued. . .	

Table A.11: (Continued)

Low IDV	High IDV
High risk of domestic intergroup conflict.	Low risk of domestic intergroup conflict.
<i>In Religions and Ideas</i>	
Religions stress collective devotional practices.	Religions stress individuals' relationship with the supernatural.
Collective conversions.	Individual conversions.
Polytheist religions.	Monotheist religions.
Placing individual over collective interests is evil.	Individualism is good.
Traditionalist ethic.	Modernist ethic.
Imported economic theories largely irrelevant because unable to deal with collective and particularist interests.	Native economic theories based on pursuit of individual self-interest.
Science and technology treated as magic.	Science and technology treated as matter-of-fact.
Public uninformed about technological facts.	Public knowledgeable about technological facts.

Table A.12: Origins of National IDV Index Differences.

Reproduced from [1].

Low IDV	High IDV
Less economic development.	More economic development.
Less social mobility and weak development of middle class.	Greater social mobility and stronger development of middle class.
Tropical and subtropical climates.	Moderate to cold climates.
Survival less dependent on individual initiative.	Survival more dependent on individual initiative.
Mode traditional agriculture, less modern industry, less urbanization.	Less traditional agriculture, more modern industry, more urbanization.
Extended family or tribal structures.	Nuclear family structure.
More children per parent couple.	Fewer children per nuclear family.
Traditional education systems, for minority of population.	Pragmatic educational systems, for majority of population.
Historical factors: tradition of collectivist thinking and action.	Historical factors: tradition of individualist thinking and action.
Smaller, particularist organization.	Larger, universalist organizations.

## Masculinity Versus Femininity Index

Table A.13: Summary of Value Connotations of MAS Differences Found in Surveys and Other Comparative Studies. Reproduced from [1].

Low MAS	High MAS
Cooperation at work and relationship with boss important.	Challenge and recognition in jobs important.
Living area and employment security important.	Advancement and earnings important.
Values of women and men hardly different.	Values of women and men very different.
Lower job stress.	Higher job stress.
Belief in group decisions.	Belief in individual decisions.
Preference for smaller companies.	Preference for large corporations.
Private life protected from employer.	Employer may invade employees' private lives.
Belief in Theory Y.	Belief in Theory X.
Promotion by merit.	Promotion by protection.
Work not central in a person's life space.	Work very central in a person's life space.

Continued. . .

Table A.13: (Continued)

Low MAS	High MAS
Relational self: empathy with others regardless of their group.	Self is ego: not my brother's keeper.
Among elites and consumers, stress on cooperation.	Among elites and consumers, stress on advancement.
Schwartz's values surveys among teachers and students: low mastery.	Schwartz's surveys: high mastery: ambitious, daring, independent.
Inglehart's WVS analysis: well-being values.	Inglehart's WVS analysis: survival values.
Higher well-being in rich countries.	Higher well-being in poor countries.
Achievement in terms of quality of contacts and environment.	Achievement in terms of ego boosting, wealth, and recognition.
Gordon's male students: more benevolence.	Gordon's male students: greater need for recognition.
IRGOM managers' life goals: service.	IRGOM managers' life goals: leadership and self-realization.
Higher norms for emotional stability and ego control.	Lower norms for emotional stability and ego control.

Table A.14: The Masculinity Societal Norm. Reproduced from [1].

Low MAS	High MAS
Relationship orientation.	Ego orientation.
Quality of life and people are important.	Money and things are important.
Stress on who you are.	Stress on what you do.
Work in order to live.	Live in order to work.
Minimum emotional and social role differentiation between the genders.	Maximum emotional and social role differentiation between the genders.
Men should be tender and take care of both performance and relationships; women should be the same.	Men should be tough and take care of performance; women should be tender and take care of relationships.
Men and women should be modest.	Men should be and women maybe assertive and ambitious.
Sympathy for the weak.	Sympathy for the strong.
Small and slow are beautiful.	Big and fast are beautiful.

Table A.15: The Masculinity Societal Norm. Reproduced from [1].

Low MAS	High MAS
Relationship orientation.	Ego orientation.
Quality of life and people are important.	Money and things are important.
Stress on who you are.	Stress on what you do.
Work in order to live.	Live in order to work.
Minimum emotional and social role differentiation between the genders.	Maximum emotional and social role differentiation between the genders.
Men should be tender and take care of both performance and relationships; women should be the same.	Men should be tough and take care of performance; women should be tender and take care of relationships.
Men and women should be modest.	Men should be and women maybe assertive and ambitious.
Sympathy for the weak.	Sympathy for the strong.
Small and slow are beautiful.	Big and fast are beautiful.

Table A.16: Key Differences Between Feminine and Masculine Societies: Family, School, Gender Roles, Consumer Behavior, the Work Situation, Politics, Sexuality, and Religion. Reproduced from [1].

Low MAS	High MAS
<i>In the Family</i>	
Weak gender differentiation in the socialization of children.	Strong gender differentiation in the socialization of children.
Similar role models: both fathers and mothers deal with facts and feelings.	Different role models: Fathers deal with facts, mothers with feelings.
Both boys and girls are allowed to cry but neither should fight.	Girls cry, boys do not; boys should fight back, girls should not fight.
No gender difference in children's playing goals.	Boys prevail in performance games, girls in relationship games.
Both boys and girls learn to be modest.	Both boys and girls learn to be ambitious.
Ideal opposite-sex partner likes children and quality of life.	Ideal opposite-sex partner as success at work.
Positive feelings about home and family.	Less satisfied with home life.
Continued...	

Table A.16: (Continued)

Low MAS	High MAS
Children do not express aggression.	Children may express aggression.
Friends and acquaintances important.	Family important.
Parents should earn children's love and respect.	Children should love and respect parents regardless of behavior.
More unmarried cohabitation.	More quick marriages.
Flexible family concepts.	Traditional family concepts.
Each partner has own interests.	Partners should share interests.
Same standards for brides and grooms.	Chastity and industriousness for brides, not for grooms.
In Asia, same criteria for husbands and boyfriends.	In Asia, husbands to be wealthy, boyfriends to have personality.
Mothers decide on number of children.	Fathers decide on number of children.
<i>At School</i>	
Friendliness in teachers appreciated.	Brilliance in teachers appreciated.
Students' social adaptation important.	Students' performance important.
Failing in school is a minor accident.	Failing in school is a disaster.
Continued...	

Table A.16: (Continued)

Low MAS	High MAS
Public praise to encourage weak students.	Public praise to reward good students.
No special awards.	Awards for good students, teachers.
Competitive sports extracurricular.	Competitive sports part of curriculum.
Average student is the norm.	Best student is the norm.
Curriculum choices guided by intrinsic interest.	Curriculum choices guided by career expectations.
Children socialized to avoid aggression.	Children socialized to fight back.
Students take own problems less seriously.	Own problems taken very seriously.
Ego effacing: own performance underrated.	Ego boosting: performance overrated.
Foreign students in U.S. efface national ego.	Foreign students in U.S. boost national ego.
Young children taught by men and women.	Young children taught by women only.
Continued...	

Table A.16: (Continued)

Low MAS	High MAS
Teachers give equal attention to girls and boys.	Teachers pay more attention to boys.
Boys and girls study same subject.	Boys and girls study different subjects.
Small gender difference in perceptual abilities.	Large differences in perceptual ability: boys analytic, girls contextual.
<i>In Gender Roles</i>	
Small gender culture gap.	Large gender culture gap.
More equal job and education opportunity, but only in affluent countries.	Less equal opportunity in affluent countries.
Larger share of women in professional and technical jobs.	Smaller share of women in professional and technical jobs.
Socialization toward nontraditional gender roles.	Socialization toward traditional gender roles.
Women describe themselves as more competitive than men do.	Men describe themselves as more competitive than women do.
Gender stereotypes rooted in universal biological differences.	Gender stereotypes country specific.
Continued. . .	

Table A.16: (Continued)

Low MAS	High MAS
Characteristics freely attributed to one or the other gender.	Attribution of characteristics less easily differentiated.
Women describe themselves as more competitive than men do.	Men describe themselves as more competitive than women do.
Gender stereotypes rooted in universal biological differences.	Gender stereotypes country specific.
Characteristics freely attributed to one or the other gender.	Attribution of characteristics less easily differentiated.
Women describe themselves in their own terms.	Women describe themselves in same terms as men.
Men allowed to be gentle, feminine, and weak.	Women should be gentle and feminine; nobody should be weak.
To Asian women, characteristics differ little by gender.	To Asian women, responsibility, decisiveness, ambition, are for men, caring and gentleness are for women.
Macho behavior ridiculed.	Machismo in men, marianismo or hembrismo in women.
Men claim suppressing joy and sadness.	Men claim showing joy and sadness.
Continued. . .	

Table A.16: (Continued)

Low MAS	High MAS
Women's liberation means that men and women should take equal shares both at home and at work.	Women's liberation means that women should be admitted to positions hitherto occupied only by men.
<i>In Consumer Behavior</i>	
Buying decisions and shopping shared between partners.	Men make main buying decisions, women shop for food.
Coffeemakers for coziness.	Fewer filter coffeemakers.
Homemade products popular.	Fewer products homemade.
Purchases for use.	Purchases for showing off.
Less appeal of foreign goods.	More appeal of foreign goods.
Engine power of cars irrelevant.	Engine power of cars important.
Motor homes: vacations in home on wheels.	Vacations include business-class flights.
Reading: more fiction.	Reading: more nonfiction.
Less confidence in advertising.	More confidence in advertising.
<i>In the Workplace</i>	
Work in order to live.	Live in order to work.
Continued...	

Table A.16: (Continued)

Low MAS	High MAS
Meaning of work for workers: relations and working conditions.	Meaning of work for workers: security, pay, and interesting work.
Stress on equality, solidarity, and quality of life.	Stress on equity, mutual competition, and performance.
Management as menage.	Management as manege.
Managers are employees like others.	Managers are culture heroes.
Managers expected to use intuition, deal with feelings, and seek consensus.	Managers expected to be decisive, firm, assertive, aggressive, competitive, just.
Successful managers seen as having both male and female characteristics.	Successful managers seen as having solely male characteristics.
More women in management.	Fewer women in management.
Smaller wage gap between genders.	Larger wage gap between genders.
Women choose female boss.	Women choose male boss.
Career ambitions are optional for both men and women.	Career ambitions are compulsory for men, optional for women.
Managers hold modest career aspirations.	Managers hold ambitious career aspirations.
Continued...	

Table A.16: (Continued)

Low MAS	High MAS
Managers less prepared to uproot their families for career reasons.	Managers more prepared to uproot their families for career reasons.
Women in management take having families for granted and adapt their careers.	Women in management take having careers for granted and adapt their families.
Job applicants undersell themselves.	Job applicants oversell themselves.
Humanization of work through creation of work groups.	Humanization of work through provision of task challenge.
Resolution of conflicts through problem solving, compromise, and negotiation.	Resolution of conflicts through denying them or fighting until the best “man” wins.
More sickness absence.	Less sickness absence.
Lower job stress: fewer burnout symptoms among healthy employees.	Higher job stress: more burnout symptoms among healthy employees.
Preference for smaller companies.	Preference for larger companies.
Preference for fewer hours worked.	Preference for higher pay.
Competitive advantage in service industries, consulting, live products, and biochemistry.	Competitive advantage in manufacturing industries, price competition, heavy products, and bulk chemistry.
Continued. . .	

Table A.16: (Continued)

Low MAS	High MAS
<i>In Political Priorities</i>	
Welfare society ideal.	Performance society ideal.
Low percentage poor and illiterate.	High percentage poor and illiterate.
The needy should be helped.	The strong should be supported.
The wealthy pay taxes to help the poor.	The fate of the poor is the poor's problem.
Permissive and corrective society.	Punitive society.
Immigrants should be integrated.	Immigrants should assimilate or be sent back.
Larger development cooperation budget.	Small development cooperation budget.
International conflicts should be resolved through negotiation and compromise.	International conflicts should be resolved through show of force or fighting.
Preservation of the environment should have the highest priority.	Economic growth should have the highest priority.
Greater public concern about risks of biotechnology.	Less public concern about risks of biotechnology.
<i>In Political Mores</i>	
Continued. . .	

Table A.16: (Continued)

Low MAS	High MAS
Political discourse moderate.	Political discourse adversarial.
More voters place themselves at the political left, fewer at the center.	More voters place themselves at the political center, few at the left.
More people see the world as a just place.	More people see the world as an unjust place.
Positive attitudes toward institutions and political establishment.	Negative attitudes toward institutions and political establishment.
In poor countries, less corruption.	In poor countries, more corruption.
More confidence in labor unions.	Less confidence in labor unions.
More participation in voluntary activities and associations.	Less participation in voluntary activities and associations.
Men and women discuss politics equally frequently.	Men discuss politics more often than do women.
More women in elected political positions and government.	Fewer women in elected political positions and government.
<i>In Sexual Behavior</i>	
Matter-of-fact attitudes about sex.	Moralistic attitudes about sex.
AIDS prevention campaigns very outspoken.	AIDS prevention campaigns restricted by taboos.
Continued. . .	

Table A.16: (Continued)

Low MAS	High MAS
Single standard for women and men.	Double standard: women should be chaste at marriage, men need not be.
Norm of active role of woman.	Norm of passive role of woman: machismo vs. marianismo.
Sexual attraction unrelated to career success.	Men become more attractive by career success, women less.
In uncertainty-accepting cultures, fewer teenage pregnancies.	In uncertainty-accepting cultures, frequent teenage pregnancies.
Young people more influenced by parents.	Young people more influenced by peers.
Other-oriented sex.	Ego-oriented sex.
Women enjoy first sex.	Women feel exploited by first sex.
Unwanted intimacies not major issue.	Sexual harassment major issue.
Homosexuality is a fact of life.	Homosexuality is a taboo and a threat.
Weak distinction between sex and love.	Sharp distinction between sex and love.
Sex and violence in media taboo.	Sex and violence in media frequent.
Continued...	

Table A.16: (Continued)

Low MAS	High MAS
Lovers should be educated, social.	Lovers should be successful, attractive.
Happy lovers over-benefit from the other.	Happy lovers get equitable mutual deal.
Interaction with other sex more intimate.	Interaction with other sex less intimate.
Sex is a way of relating to someone.	Sex is a way of performing.
<i>In Religion</i>	
“Tender” religions and religious currents.	“Tough” religions and religious currents.
Secularization in Christian countries.	Maintenance of traditional Christianity.
Religion not so important in life.	Religion most important in life.
Religion focuses on fellow human beings.	Religion focuses on God or gods.
Children socialized toward responsibility and politeness.	Children socialized toward religious faith.
Exemplarism and mysticism.	Traditionalism, theism, and conversionism.

Continued. . .

Table A.16: (Continued)

Low MAS	High MAS
Dominant religions stress complementarity of the sexes.	Dominant religions stress male prerogative.
Men and women can be priests.	Only men can be priests.
Sex is for procreation and recreation.	Sex is primarily for procreation.
Positive or neutral attitude toward sexual pleasure.	Negative attitude toward sexual pleasure.
Sexuality as one area of human motivation.	Sexuality as primordial area of human motivation.

## Long-Term versus Short-Term Orientation Index

Table A.17: Summary of Connotations of LTO Differences Found in Surveys and Other Comparative Studies of Values. Reproduced from [1].

Low LTO	High LTO
Quick results expected.	Persistence, perseverance.
Status not major issue in relationships.	Relationships ordered by status and this order observed.
Nice people know how to spend.	Nice people are thrifty, sparing with resources.
Shame is not a common feeling.	A sense of shame common.
Personal steadiness and stability.	Personal adaptability.
Protection of one's "face."	Face considerations common but considered a weakness.
Respect for traditions.	Adaptation of traditions to new circumstances.
Reciprocation of greetings, favors, and gifts.	Reciprocation considerations are problematic, risk of overspending.
Children should learn tolerance and respect for other people.	Children should learn thrift.

Continued. . .

Table A.17: (Continued)

Low LTO	High LTO
Leisure time important.	Leisure time not so important.
Most important events in life occurred in past or occur in present.	Most important events in life will occur in future.
Students consider “persistent” not an important personality trait.	Students consider “persistent” an important personality trait.
Small share of additional income saved.	Large share of additional income saved.
Investment in mutual funds.	Investment in real estate.

Table A.18: Key Differences Between Short- and Long-term Oriented Societies: In Family, Social Relations, and Work. Reproduced from [1].

Low LTO	High LTO
<i>In Family, Social Relations, and Work</i>	
Children should learn tolerance and respect for other people.	Children should learn thrift.
Continued...	

Table A.18: (Continued)

Low LTO	High LTO
Strong need for affiliation in traditional children's stories.	Weak need for affiliation in traditional children's stories.
Gifts to children for their self-concept and love.	Gifts to children for their education and finances.
All siblings are equal.	Differentiation between elder and younger brothers and sisters.
Living with in-laws is a problem.	Living with in-laws is no problem.
Couple should share tastes and interests.	Shared tastes and interests not a requirement for marriage.
Preschool child need not suffer if mother works.	Preschool child will suffer if mother works.
Marriage should last even if love has disappeared.	If love has disappeared from marriage it is best to make a new start.
"Humility" is a feminine virtue.	"Humility" is a general human virtue.
Young women expect affection from boyfriend, not husband.	Young women expect affection from husband.
Less satisfied with daily human relations.	Daily human relations (family, neighborhood, friends) satisfying.
Continued. . .	

Table A.18: (Continued)

Low LTO	High LTO
Less satisfied with own attempts at correcting social injustice.	No need to contribute more to correcting social injustice.
Old age seen as coming later.	Old age seen as coming sooner but as a satisfying life period.
In business, short-term results: the bottom line.	In business, building of relationships and market position.
Family and business sphere separated.	Vertical coordination, horizontal coordination, control, and adaptiveness.
Meritocracy: economic and social life to be ordered by abilities.	People should live more equally.
<i>In Ways of Thinking</i>	
Probabilistic thinking.	Either full or no confidence.
Belief in absolute guidelines about good and evil.	What is good and evil depends on the circumstances.
Short-term virtues taught.	Long-term virtues taught.
Need for cognitive consistency.	Opposites complement each other.
Government by law.	Government by men.
Analytic thinking.	Synthetic thinking.
Continued. . .	

Table A.18: (Continued)

Low LTO	High LTO
Lower performance in basic mathematics tasks.	Higher performance in basic mathematics tasks.

Table A.19: The Long-Term Orientation Societal Norm.

Reproduced from [1].

Low LTO	High LTO
Immediate gratification of needs expected.	Deferred gratification of needs accepted.
Traditions are sacrosanct.	Traditions adaptable to changed circumstances.
Family life guided by imperatives.	Family life guided by shared tasks.
Short-term virtues taught: social consumption.	Long-term virtues taught: frugality, perserverance.
Spending.	Saving, investing.
The bottom line.	Building a strong market position.
Analytic thinking.	Synthetic thinking.
Fuzzy problem solving.	Structured problem solving.

## Appendix B – Concise Guide to Cultural Customer Requirements and Inserting them into the House of Quality

This appendix provides a concise guide for design engineers interested in using the method presented in this document. Background information and in-depth discussions of the various steps of this method can be found in the preceding chapters. A discussion of the method, its benefits, and drawbacks is also presented in earlier sections.

### Preparing Cultural Information for the Design Process

The following questions must be answered by the design engineer in order to collect and prepare cultural information for the design process.

1. Who is my customer?
2. Does culture play a role in my design?
  - Does the customer sense the product?
  - Do I have the same cultural background as my customer?
3. What cultures do I need to design for?
4. What cultural metrics do I use?

## Preparing the House of Quality for Cultural Customer Requirements

Hierarchies have been used for some time to manage large lists of customer requirements [194, 195]. They are also useful for organizing and managing cultural customer requirements. A stripped down House of Quality (HoQ) is presented in Table B.1 that uses a hierarchy scheme to organize cultural customer requirements.

Cultural customer requirements are grouped into several categories. The *Universal Customer Requirement* category is filled with customer requirements that apply to all cultures being considered in the design. The *Cultural Customer Requirement* category is populated with customer requirements that are specific to individual cultures or groups of cultures but that are not shared by all cultures in the analysis.

Within the *Cultural Customer Requirement* category, there are several sub-categories. They include Cultural Clusters, signified by *Hofstede Cluster #1*, *Hofstede Cluster #3*, etc, and Cultural Customer Requirements shared by two or more countries that are not within the same cultural cluster, signified by *Sweden and Japan Customer Requirements*, *Japan and Finland Customer Requirements*, etc. Within the Cultural Clusters customer requirements sub-categories, sub-sub categories are present. They are culture-specific customer requirements such as *Japan*, *Finland*, *Sweden*, *Norway*, etc, and multi-culture customer requirements that only include cultures from within the same cultural cluster but that do not include all cultures being analyzed within that culture, such as *Norway and Sweden Customer Requirements*.

Table B.1: A Typical House of Quality Prepared for the Example

	Relative Importance	Technical Solution #1	Technical Solution #2	Technical Solution #3	Technical Solution #4	Technical Solution #5
Universal Customer Requirements						
Universal Customer Requirement #1						
Universal Customer Requirement #2						
Cultural Customer Requirements						
Hofstede Cluster #1						
Japan						
Japan Customer Requirement #1						
Japan Customer Requirement #2						
Hofstede Cluster #7						
Intra-Cluster Requirements						
Cluster Customer Requirement #1						
Cluster Customer Requirement #2						
Finland						
Finland Customer Requirement #1						
Finland Customer Requirement #2						
Sweden						
Sweden Customer Requirement #1						
Sweden Customer Requirement #2						
Norway						
Norway Customer Requirement #1						
Norway Customer Requirement #2						
Norway and Sweden Customer Requirements						
Norway and Sweden Customer Requirement #1						
Norway and Sweden Customer Requirement #2						
Sweden and Japan Customer Requirements						
Sweden and Japan Customer Requirement #1						
Sweden and Japan Customer Requirement #2						
Japan and Finland Customer Requirements						
Japan and Finland Customer Requirement #1						
Japan and Finland Customer Requirement #2						

Depending upon the number of cultures under consideration, the number of cultural customer requirements, and the level of detail and organization demanded, portions of the hierarchy can be compacted or ignored entirely. For instance, in a design that only considers one culture that is different than the design engineer's culture, the hierarchy can be ignored completely and Cultural Customer Requirements can entirely subsume Customer Requirements in the HoQ.

## Determining Cultural Requirements

There are several resources to draw upon when determining cultural customer requirements. They are: Cultural Dimensions and their associated anecdotal tables, cultural profiles, and cultural probes. While the first two are readily accessible to the design engineer, the third resource is time-consuming, expensive, and requires direct customer contact. The third resource will be ignored for the purposes of this concise guide.

To determine which anecdotal tables most align with the cultures under consideration, the design engineer must find cultural dimension scores for the cultures in question. When cultural dimensions scores do not exist for a culture, several different approaches may be taken. Other cultural dimension schemes might contain the cultures of interest. In this case, it might be appropriate to switch to a different cultural dimension scheme. Cultures falling within the same geographic, ethnographic, or cultural region can be analogous to the culture missing cultural dimension values. The design engineer is urged to use caution when assuming an-

other culture is representative of the culture under consideration. When no other credible or reliable source of cultural dimension data exists, a design engineer can either neglect analyzing the culture via cultural dimensions and skip on to cultural profiles or attempt to determine cultural dimension scores for the cultures in question. The later method is not recommended as it will take several years to complete and a large amount of resources.

After securing the cultural dimension scores for the cultures being analyzed, the design engineer can then determine which anecdotal tables to use for each culture. For instance, Finland and Australia have low Power Distance Index (PDI) scores in Hofstede's cultural dimensions which allows the design engineer to use the low PDI score tables. Some cultural dimension scores will fall in the middle of the range of cultural dimension scores. In this case, the cultural dimension that finds itself in the middle cannot be used as anecdotal tables are generally written for either low or high scores.

Determining cultural customer requirements from the anecdotal tables can be difficult. Methods used to create customer requirements in Quality Function Deployment (QFD) also work to create cultural customer requirements. It is left up to the design engineer to determine the best methods to transform information from the anecdotal tables into cultural customer requirements. The design engineer is cautioned to be cognizant of biases – cultural or otherwise – during the cultural customer requirement generation process.

Cultural profiles are useful in providing a deeper insight into cultures than is often provided from anecdotal tables attached to cultural dimensions. Many

sets of cultural profiles exist catered to different audiences. Sources of cultural profiles include the Global Leadership and Organizational Behavior Effectiveness Research Program (GLOBE) Survey, the British Broadcasting Corporation (BBC), and the Central Intelligence Agency (CIA). The design engineer must select the most relevant and informative set of cultural profiles for the design and cultures being analyzed. Distilling Cultural Customer Requirements from cultural profiles is left to the design engineer. Like with cultural dimensions and anecdotal tables, standard QFD techniques to determine customer requirements can be used.

### Cultural Customer Requirements in the House of Quality

It is often the case that cultural customer requirements for different cultural customers being analyzed in the design will conflict with one another. This is as a result of differing cultural dimension scores. The design engineer must find technically feasible solutions to satisfy as many customers as possible. However, it will periodically be the case that not all customers can be satisfied. In that eventuality, the design engineer must use good judgment when determining which customers to satisfy and which to leave wanting. By using relative importance values, the design engineer can quantitatively determine which cultural customer requirement should be designed for and which can be ignored or lessened in importance. An example HoQ populated with several cultural customer requirements is presented in Table B.2.

At this point, the design engineer can now use standard QFD and HoQ tech-

Table B.2: House of Quality Containing Cultural Customer Requirements

	Rel. Imp.	Tech Sol #1
Cultural Customer Requirements		
Inter-Culture Requirements		
Finland and Australia		
Lavatory must be equally functional to men and women		
Lavatory must be equally appealing to men and women		
New, innovative ideas are desirable		
Functional, understated decorations		
No gaudy or overly ornate designs		
Japan and Mexico		
Cultural taboos and things considered dirty must be avoided		
Hofstede Cluster #1		
Japan		
Functions of lavatory must be clear.		
Japan Customer Requirement #2		
Hofstede Cluster #7		
Finland		
Lavatory should be as accessible as possible to people with disabilities		
Hofstede Cluster #8		
Australia		
Cultural taboos are not as important to avoid		
Hofstede Cluster #3		
Mexico		
Ornate, opulent ornamentation is desirable		
Power and wealth should be felt while on the toilet		
Keep design simple		
Use traditional styles and methods of interacting with devices		
Functions of lavatory don't need to be clear or logical		
More lavatories might be required		
A warm, friendly, and inviting lavatory design is desirable		

niques to complete the design. It should also be noted that this same method can be used to generate cultural customer requirements for any field. The generated cultural customer requirements can also be used in any customer requirements-driven design process.

## Appendix C – The Distilling of Cultural Dimensions: A Brief Review

Both Hofstede and Global Leadership and Organizational Behavior Effectiveness Research Program (GLOBE) followed interesting and similar routes to arrive at their cultural dimensions. While the normal design engineer in industry does not need to be concerned with how the cultural dimensions were developed, a review of the development of Hofstede's cultural dimensions is presented for the interested reader from industry. Academics will find this section very informative and a good primer before delving into Chapters 1 and 2, and portions of Chapters 3, 4, 5, 6, and 7 of Hofstede's book, *Culture's Consequences* [1] where his process is explained in depth. The below text is adapted from Hofstede's book [1].

### Hofstede's Research Setting

From the mid 1960's through the early 1970's Hofstede was employed by International Business Machines Corporation (IBM) where he founded and managed the Personnel Research Department of IBM Europe. The IBM of the 1960's and 1970's was divided into two divisions – IBM Domestic covering the United States and IBM World Trade Corporation covering the rest of the world. At the time, IBM was one of the largest multi-national corporations in the world.

IBM World Trade Corporation was divided into subsidiaries in all of the coun-

tries that it did business and had operations. The main product lines at the time consisted of computers in the Data Processing Division and typewriters in the Office Products Division. During the data collection period between 1967 and 1973, IBM had research laboratories in 2 countries, developed products in 7 countries, manufactured products in 13 countries, and sold its machines in roughly 100 countries.

Country organizations employed primarily nationals of the country. Regional global management offices controlled the national offices. The top management that oversaw the entire company was almost exclusively American.

Employees in the marketing, service, and product development portions of IBM were middle-class. Working-class people were concentrated in the manufacturing plants. Different subcultures existed between the middle-class and working-class employees.

Hofstede used data from the marketing-plus-service organization to compare between countries because it was the only portion of the company that existed in each country in which IBM operated. When comparing among occupations, Hofstede used data collected from the manufacturing plants, marketing-plus-service, and product development organizations.

## Data Collection at IBM

During Hofstede's time at IBM, management was concerned with employee morale. Hofstede attributes this to the many customer-facing employees of the company

and the large effect they had on IBM's profitability. Due to the marketing-heavy structure of IBM, roughly half of the employees would regularly talk with customers.

Employee attitude surveys had been conducted at IBM as early as the 1950's. However, each survey used its own methods and pools of questions. There was no way to compare across surveys.

In 1966 and 1967, Hofstede headed a team of six researchers at IBM to create the first standardized international survey for the corporation. It consisted of 180 standardized questions that were based on open-ended pilot interviews conducted with a random sampling of employees in six different product development laboratories. The survey was administered to personnel in six countries. At roughly the same time, another survey was conducted across 26 Asian, Latin American, and Pacific countries. 183 questions were used, many of which were pulled from Hofstede's original set. Further surveys took place in Europe and the Middle East during 1968 and 1969.

Starting in 1970, a group of researchers from many different country divisions at IBM regularly met to determine what questions should be included in that year's questionnaire. A core group of 60 questions was established with an additional 66 questions provided as optional questions for the regional and country managers. The core group of 60 questions was based upon the minimum acceptable number needed to find the factors found in factor analysis of the original data. Details of this can be found elsewhere [207].

By 1973, a total of about 88,000 individuals had responded to Hofstede's sur-

veys. A total of 117,000 questionnaires had been completed, including those employees that had been surveyed twice over the course of several years to ascertain the amount of temporal drift in the results. It should be noted that no significant temporal drift was found.

The questionnaires always began their lives in English where they were written to avoid as many cultural idioms as possible. They were then translated into the appropriate languages and back-translated by different translators to check for consistency. Comparative correlation and factor analysis was conducted between items in different languages. Variance was found but translation errors were ruled out as the root cause. While Hofstede's methods of translating were not scientifically rigorous in favor of pragmatism, Hofstede is confident in the quality of the translations.

Hofstede later correlated and validated the dataset from IBM with survey results from IMEDE Management Development Institute (IMEDE). He also found that personality tests of the day only corresponded with  $r=.49$  which was comparable to the difference between any two test-takers ( $r=.48$ ). From the IMEDE dataset, Hofstede concluded that his IBM data was acceptable as a test of values and that he should continue analysis work with the data.

## Hofstede's Data Analysis

Initial data analysis was performed using frequency distributions. This was possible because most questions in the IBM questionnaire used a five-point ordinal<sup>1</sup> answer scale. Example distributions can be seen in Hofstede's book in Exhibit 2.2 [1].

In all of the data Hofstede collected, only 5% were thrown out for improper data entry errors. Common mistakes were not answering a question, over answering, answering outside of the limits (answering 6 when there were only 5 answer spaces), and other problems often associated with computer-tabulated tests. The invalid data was not included in any of Hofstede's analyses.

The data were extensively analyzed within sets of respondents considered homogeneous for Hofstede's purposes. Small standard deviations between members of groups showed that the groups were in fact homogeneous. Cross-tabulations, correlations, and factor analysis were used in the in-group analyses. The groups were then compared between one another using the within-group characteristics of correlation coefficients and factor loadings.

Hofstede found that the main reasons for differences between groups was country, occupation, gender, and age of respondents. Occupation and gender were closely related. This was linked to the fact that most job types were either dominated by men or women. Employee age and length of service with IBM were correlated. Hofstede ignored length of service for this reason. Occupation was

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<sup>1</sup>This means that the scales had unambiguous rank order from less to more important, worst to best, etc.

found to correlate with education level. It was mostly ignored.

The contribution to the data variance of each of the four criterion variables (country, occupation, gender, and age) were analyzed using Analysis of Variance (ANOVA) on a subset of the data. Gender and age were used as covariants. Exhibit 2.3 in Hofstede's book [1] shows the result of this stage of the analysis and is not presented here for brevity.

In spite of significant effect the nationality of respondents had on the answers to questions, nationality nor any of the other criterion could predict an individual's answer to any specific question. The total variance of answers in the subset analyzed found that only 4.2% could be accounted for by belonging to a specific nationality group. However, this is 16 times as much as can be expected by pure random chance.

The first edition of Hofstede's book contained 40 countries – 39 from the IBM survey and Yugoslavia that was added through other means detailed in Hofstede's book [1]. Later, Hofstede added an additional 10 countries plus three regions. Arabic-speaking countries became a region even though data at one point existed to segregate down to the national level. When Hofstede returned to analyze the Arab countries, he found that the tape with the data had been erased and the paper copy showing on a per-country basis had been lost. Only a region-level paper copy remained. Because of this, Hofstede was forced to group Egypt, Lebanon, Libya, Kuwait, Iraq, and Saudi Arabia<sup>2</sup> together. This lost some fidelity of the cultural

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<sup>2</sup>Note that Hofstede's book indicates that both the United Arab Republic and Egypt were included in the data set. This appears to be a typo in the 2nd edition of Hofstede's book [1]. The United Arab Republic originally consisted of present-day Syria and Egypt, and was formed

differences between the countries. Hofstede believes that there would have been different indexes for Egypt and for Lebanon.

Sub-Saharan Africa had very small IBM offices at the time of Hofstede's surveys. As a result, not enough data was available for Hofstede to conduct analysis on a per-country basis. Instead, Sub-Saharan Africa was divided into East Africa including Kenya, Ethiopia, Tanzania, and Zambia; and West Africa encompassing Ghana, Nigeria, and Sierra Leone. Again, fidelity and nuance between cultures was lost in exchange for at least some picture of the region.

## Finding the Four Original Dimensions

To find the first two original cultural dimensions, Hofstede used what he describes as an "eclectic analysis." The Power Distance Index (PDI) was formed based on clear patterns in answers to hierarchical questions differing across cultures. Questions A54, A55, and B46 were settled upon to create the PDI. The list of questions Hofstede used can be seen in his book [1] in Appendix 1. Uncertainty Avoidance Index (UAI) Was developed in a similar manner. Hofstede had a theoretical interest in work stress and its variation between occupations. Through analyzing the data, it turned out that there was much more variance between countries than between occupations. Questions A37, A43, and B60 were used to form the UAI.

The first two dimensions were found based on theoretical reasoning leaving

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in 1958. However, Syria succeeded from the union in 1961. In 1971, Egypt stopped using the name United Arab Republic and switched back to its prior and current name. It appears that the use of the United Arab Republic is a mistake and should be considered to be Egypt where found as Syria is not referenced anywhere in his book [1] or the cultural dimensions.

statistics to confirm the theories after theoretical reasoning had found certain questions as potentially relevant. An ecological factor analysis was performed at the end of the analysis process but only to create a complete picture. Hofstede states that the non-theoretical, statistics-driven approach not used in finding the first two dimensions has three major risks that a theory-based approach avoids. For instance, nuanced data is easily overlooked and obliterated through the heavy use of statistics. Another risk is that many trivial variables will obscure the meaning of the few critical ones in a factorial analysis. Finally, the theoretical meaning of statistical results might remain hidden.

The Individualism versus Collectivism Index (IDV) and Masculinity versus Femininity Index (MAS) indexes were created from a group of “work goal importance” questions. After correcting for acquiescence<sup>3</sup>, two groups of questions emerged that turned into representations of IDV and MAS. IDV is determined from questions A18, A12, A9, A13, A17, A5, A55, A46, A54, B53, B52, B59, B56, B55, B58, B24, and A15. MAS is determined from questions A16, A7, A8, A11, A5, A6, A14, A17, and A15.

Once the four original dimensions were found, Hofstede ran a cross-national factor analysis of all of the relevant data. The first factor analysis consisted of 48 variables across 40 countries. The full dataset used can be found in Appendixes 2 and 3 of Hofstede’s book [1]. The first four factors explained 37% of the variance. Trimming of the variables for unclear and redundant questions resulted in three

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<sup>3</sup>Acquiescence is the tendency to give a positive answer to any question regardless of its content. People who do this in cultures that do not look favorably upon it are often called “Yes Men.”

distinct factors which explained %49 of the variance.

To assure that the four original dimensions did not correlate or overlap and were statistically independent, Hofstede compared the index values between and across cultures. While PDI and IDV appear to correlate across the whole dataset, when controlled for Gross National Product per capita, the correlation becomes insignificant. In wealthier countries, UAI is correlated with IDV, PDI and MAS. However, these indexes did not show inter-correlation. Exhibit 2.7 in Hofstede's book [1] shows the correlations among the four IBM indexes.

### Validation of Hofstede's Dimensions

Many researchers have attempted to replicate Hofstede's surveys to determine if his dimensions are correct or not. The majority of studies have correlated well with Hofstede's dimensions [208, 209, 210, 211, 212, 213]. The few that don't are outliers or flawed studies. Hofstede mentions many of the studies that correlate with his work in the Validation section of Chapter 2 of his book [1].

### The Addition of the Fifth and Sixth Dimensions

Hofstede added the fifth and sixth dimensions via collaboration with other researchers. Analysis was performed in the same manner as with the original four dimensions to ensure that the dimensions were valid and were statistically independent. From working with Bond, the fifth dimension, Long-term versus Short-term

Orientation Index (LTO), appeared [84, 214]. Collaboration with Minkov [92, 81] yielded Indulgence versus Restraint (IRI).

