Toolkit for Designing Intercultural Automotive HMI

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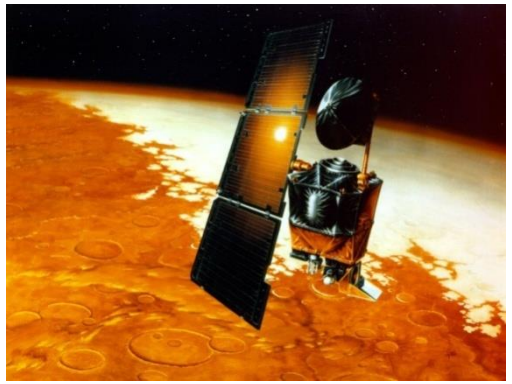
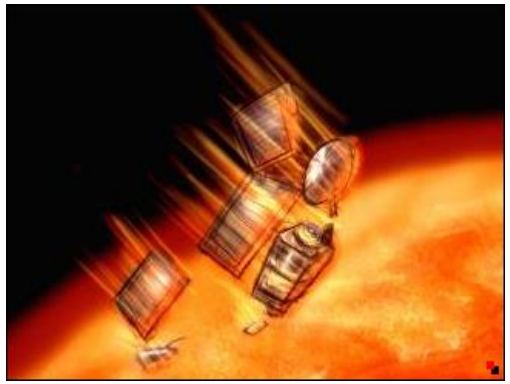
CEO, Principal Consultant, Assessor, Author

Mars Climate Orbiter Havary (1998)

Intention



Fact



Reason:

Software used imperial units (pounds of force) rather than metric units (Newtons)

http://en.wikipedia.org/wiki/Mars_Climate_Orbiter

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Culture and HMI

CHALLENGES

CULTURAL INFLUENCES ON DESIGN

GLOBALIZATION-LOCALIZATION

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Challenges and Examples

- Successful IC Design requires more than adopted language and visual presentation (like e.g. colors and symbols):
  - different mentalities
  - thought patterns
  - problem solving strategies

  } deeply anchored in culture

欢迎 ברוך הבא

добро пожаловать

환영 مرحبا

Parts from: Helmut Windl, Panasonic AG, Frankfurt

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Automotive HMI

- Driver Work Place – culturally affected parts:
  - Display
  - Interaction
  - Information presentation
  - India vs. Germany

- Picture from: Continental AG Website, last access 10.11.2019, https://www.continental-automotive.com/en-gl/Trucks-Buses/Interior-Cabin/Drivers-Workplaces/Modular-Drivers-Workplace

Example: Driver navigation systems

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Intercultural User Interface Consulting (IUIC)

01

IUID Research (hypothesizing, studying, modeling)

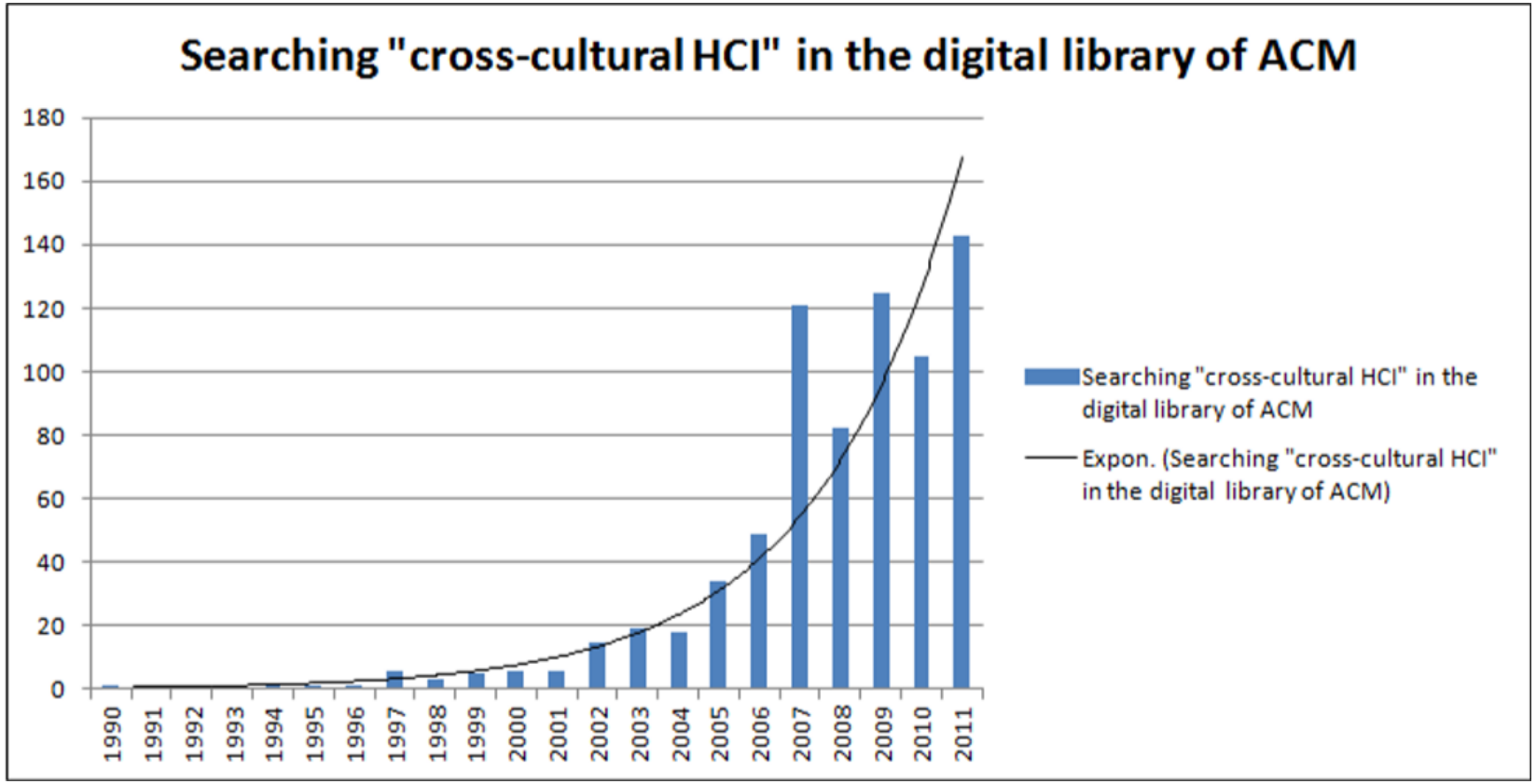
02

IUID Training (lectures, workshops, tutorials)

03

IUID Consulting (supporting, coaching, advising)

Rise of publications in the new millennium



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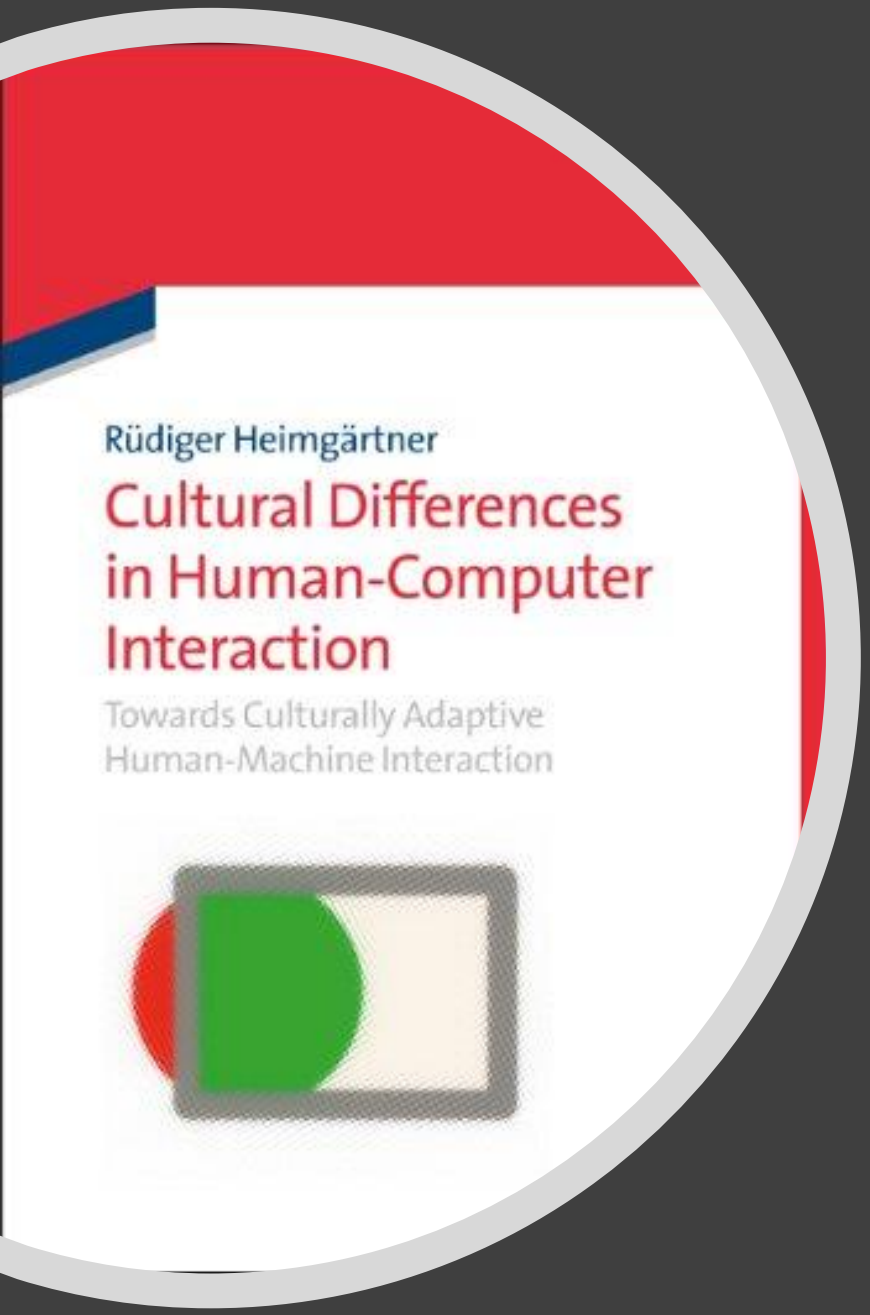

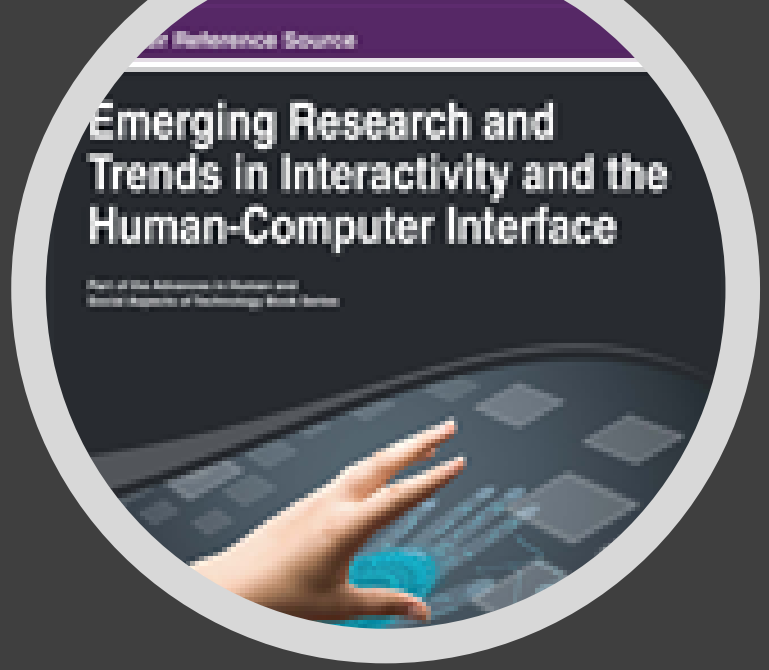

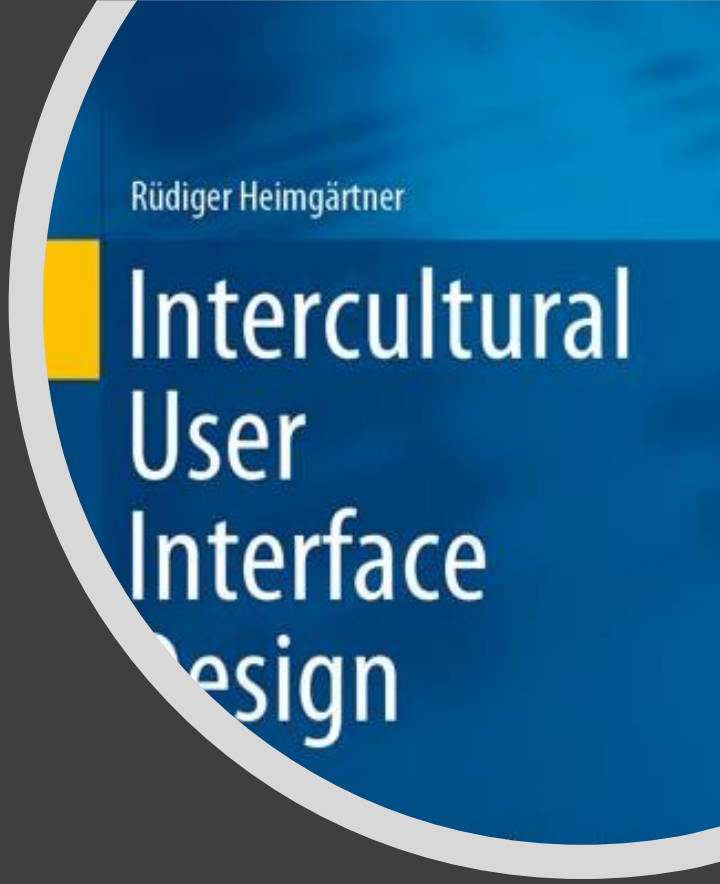

Continuously Summarizing the State of IUID Research

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Intercultural User Interface Design (IUID)

Denotes the process of adequately designing HCI while considering the requirements of the end users for the cultural context.

It is not just the architecture and the parameterization of the software that must be adapted, but also the characteristics of the HMI for the designated cultural context.

For the adaptions in design and technology according to cultural context, the method mix for intercultural user interface design can be used.

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IUID Method-Mix

- Method of Culture-Oriented Design
- User Interface Characteristics
- HCI Dimensions
- Cultural Dimensions
- Cultural Variables
- Model of Culture-Dependent HCI

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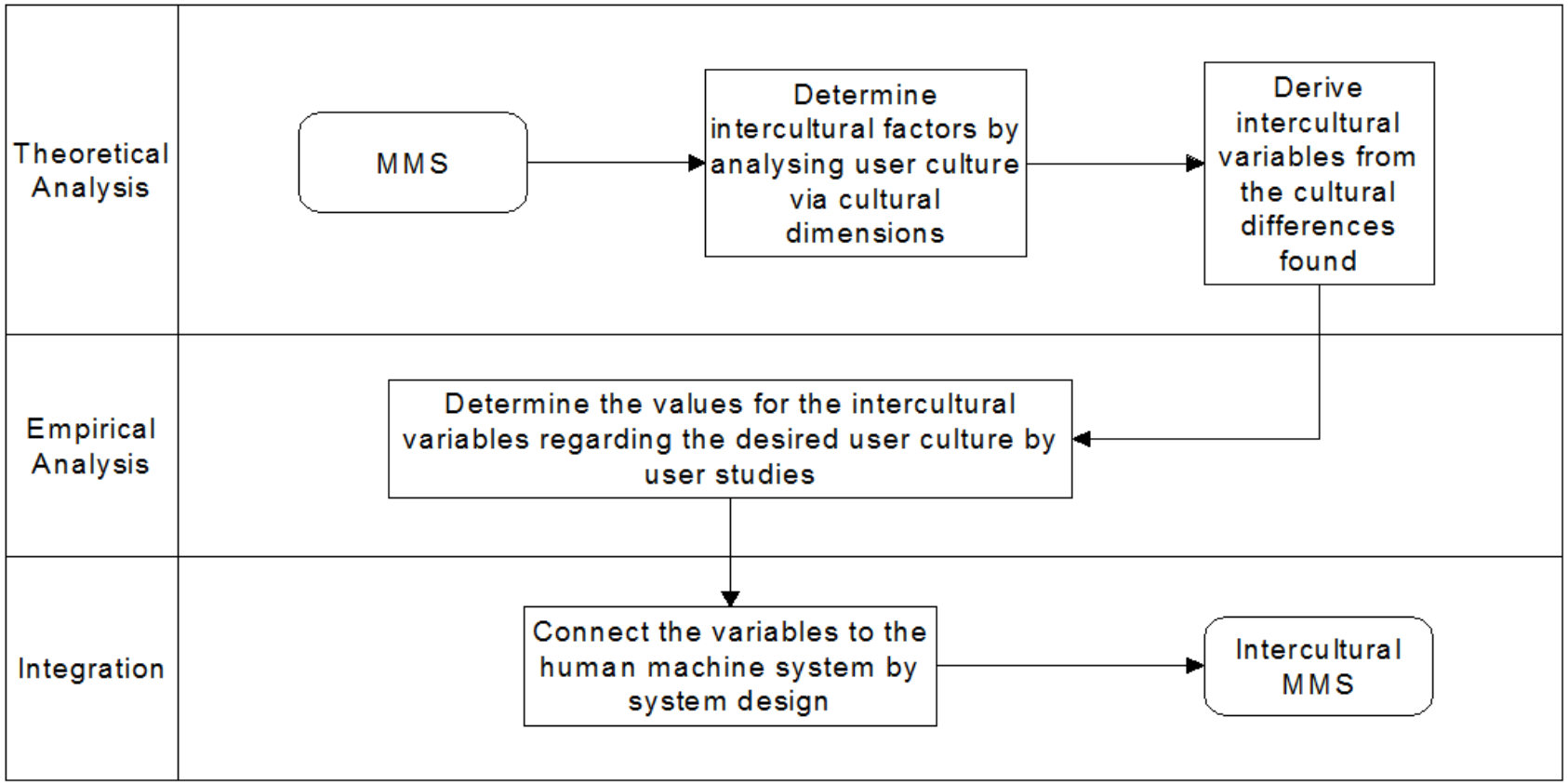
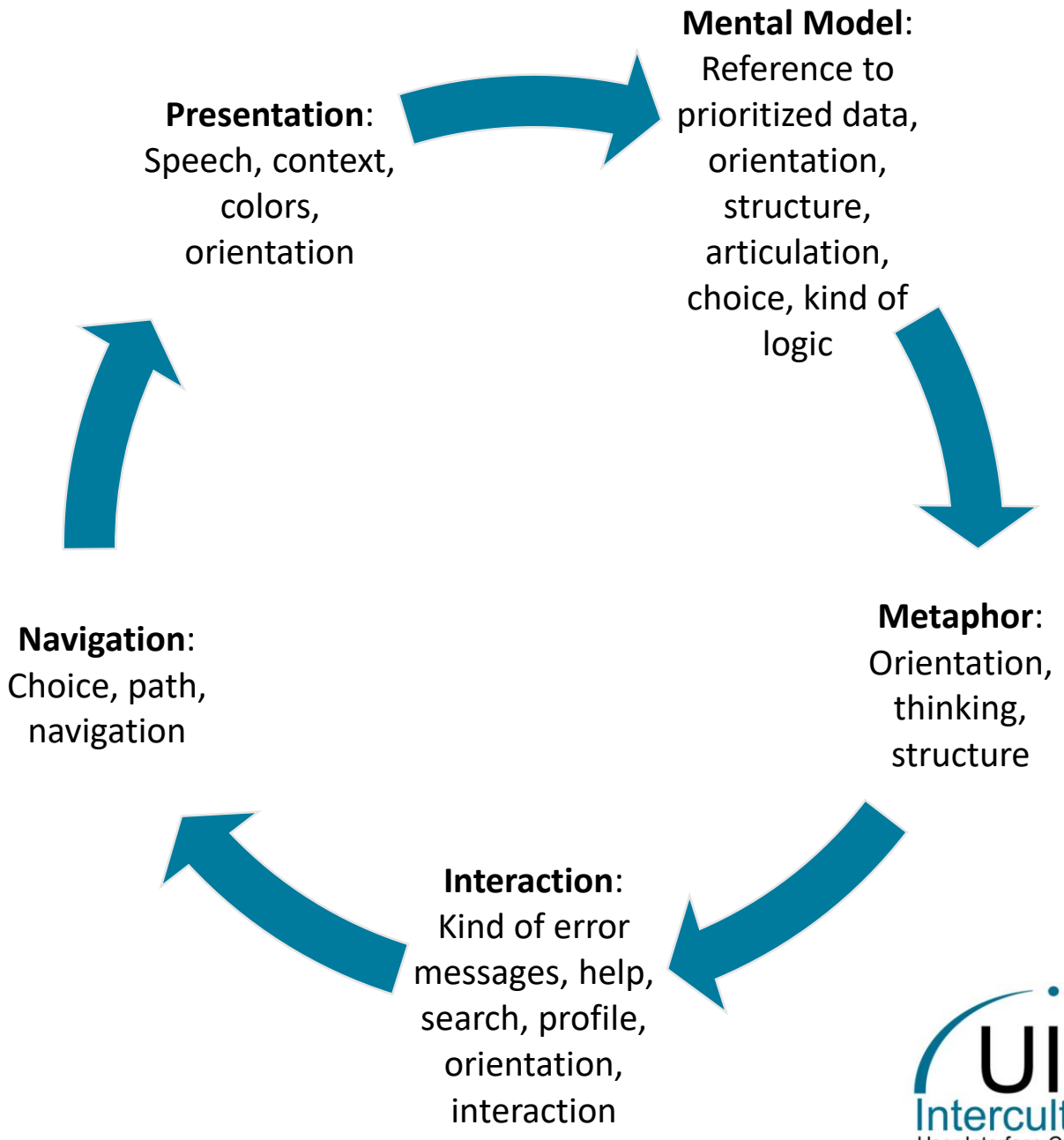


Method of Culture-Oriented Design

User Interface Characteristics



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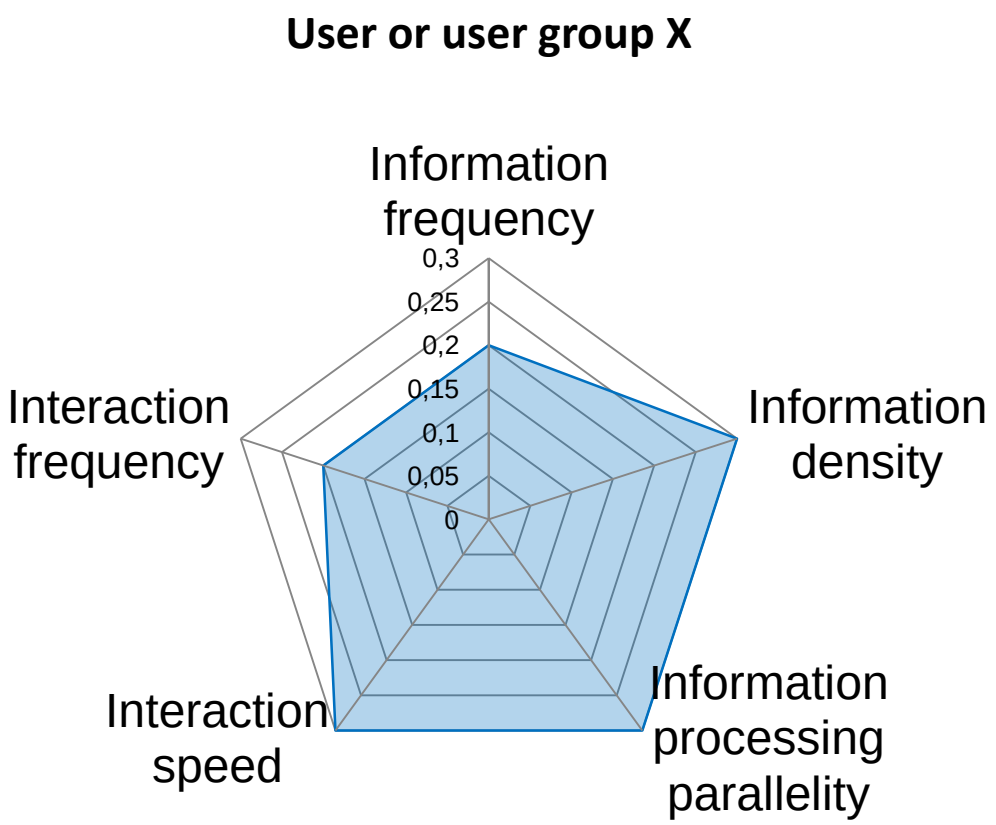
HMI Dimensions

- Describe the human machine interaction characteristics of a user or a user group (average behavior of the user(s) with machine by trend)
- Measurable and comparable by index



R. Heimgärtner, 2012, Cultural Differences in Human Computer Interaction, Oldenbourg.

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Examples of HCI Dimensions and their Variables and Metrics

HCI-DIMENSION	HCI-VARIABLE (S) (EXPRESSION (S) OF THE HCI-DIMENSION)	HCI-METRIC (S) (INDICATOR (S) OF THE EXPRESSION (S) OF THE HCI-DIMENSION)
Interaction Frequency	Number of interactions per unit of time	Mouse clicks and mouse movements per second or session
Information-Density	Number of units of information per room unit	Number of words per message or on the display
Information- / Interaction-parallelism / order	Order of appearance of information units	Number and Order of dialog steps (e.g. number of message windows for a system error)

R. Heimgärtner, 2012, Cultural Differences in Human Computer Interaction, Oldenbourg.

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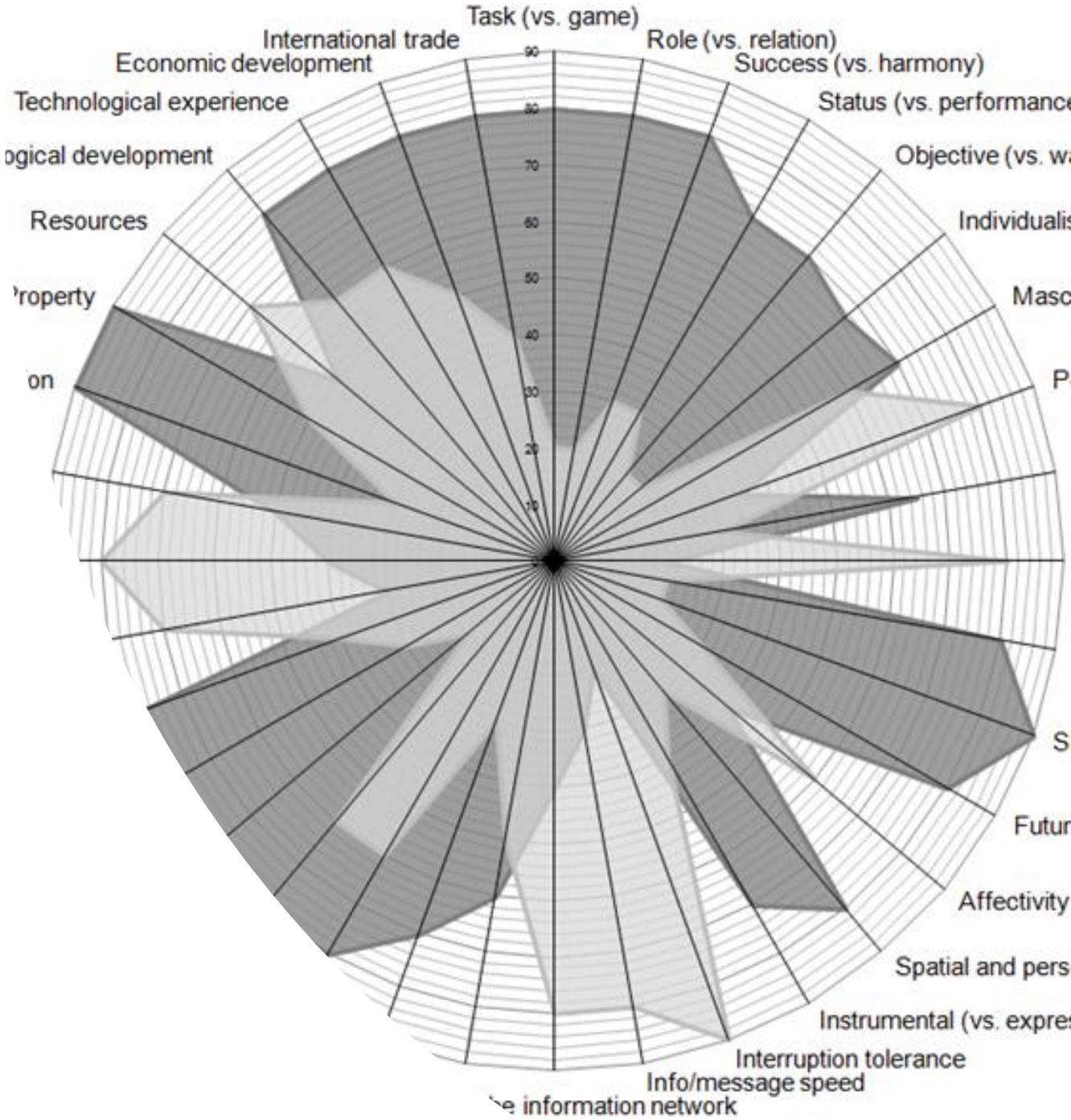
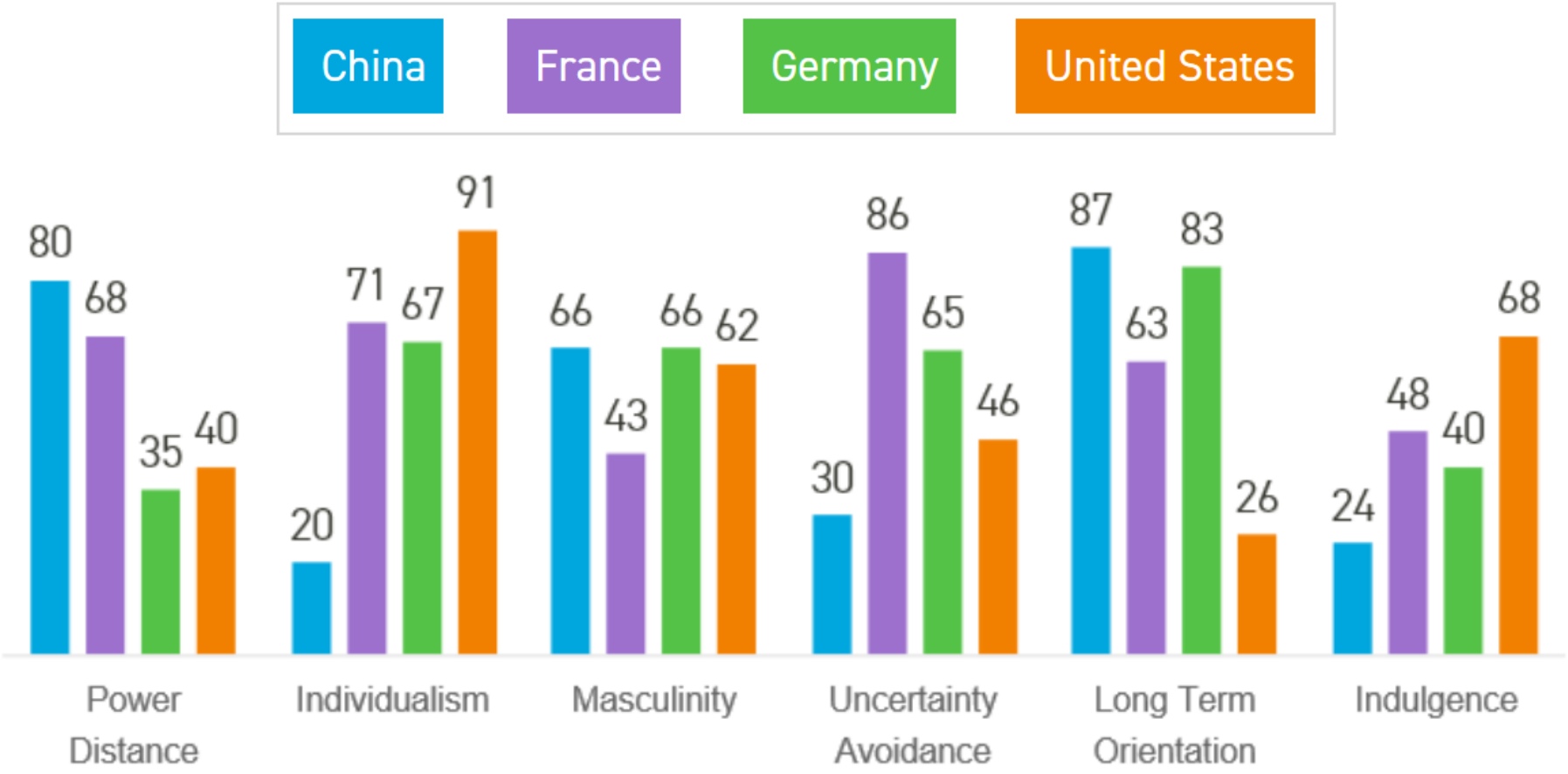
Cultural Dimensions

- Describe the cultural characteristics of a nation (average behavior of the members by trend)
- Measurable and comparable by index



Values of Hofstedes' Cultural Dimensions for 4 Countries



https://www.hofstede-insights.com/ , last access 07|17|2019

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Intercultural Variables

- Classify culturally affected HMI variables

Intercultural Variable	Localization-Level	Relationship to HCI-Design	Visibility of Variable Contents	Estimated detection / research difficulty [0 (easy) – 10 (heavy)]
Dialog design	Interaction	Direct	Hidden/over long time and deep analysis	10
Interaction design	Interaction	Direct	Hidden/over long time and deep analysis	9
System functionality	Function	Indirect	Visible/immediately recognizable	8
Service (Maintenance)	Function	Indirect	Visible/immediately recognizable	7
Technical documentation	Function	Indirect	Visible/immediately recognizable	6
Information presentation	Surface	Direct	Visible/immediately recognizable	4
Language	Surface	Direct	Visible/immediately recognizable	2
General system design	Surface	Indirect	Visible/immediately recognizable	0

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	Characteristic/value	
Variable/parameter	Germany	China
Visible Intercultural Variable (VIV)		
Color of alerts	Red	Red/Orange
Color of normal operating condition	Green	Yellow
Extent of color use	Low	High
Use touch devices	Low	High
Non-visible intercultural variable (NVIV)		
Number of units of information	Low	High
Number of system messages	Low	High
Number of mouse movements	Low	High
Number of words in messages	Low	High
Number of explanation dialogs	Very important	Less important
Argument structure	X because Y	Because Y, X

Examples of Cultural Variables and their Values for China and Germany

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Measurable intercultural variables: “Cultural HMI Indicators”

HCI-DIMENSION RELATED TO CULTURE	HCI-VARIABLE (S) (EXPRESSION (S) OF THE HCI-DIMENSION) RELATED TO CULTURE	HCI-METRIC (S) (INDICATOR (S) OF THE EXPRESSION (S) OF THE HCI-DIMENSION) RELATED TO CULTURE
Interaction frequency in culture X	Number of interactions per unit of time in culture X	Mouse clicks and mouse movements per second or session in culture X
Information density in culture X	Number of units of information per room unit in culture X	Number of words per message or on the display in culture X
Information- / Interaction-parallelism / order in culture X	Order of appearance of information units in culture X	Number and Order of dialog steps (e.g. number of message windows for a system error) in culture X

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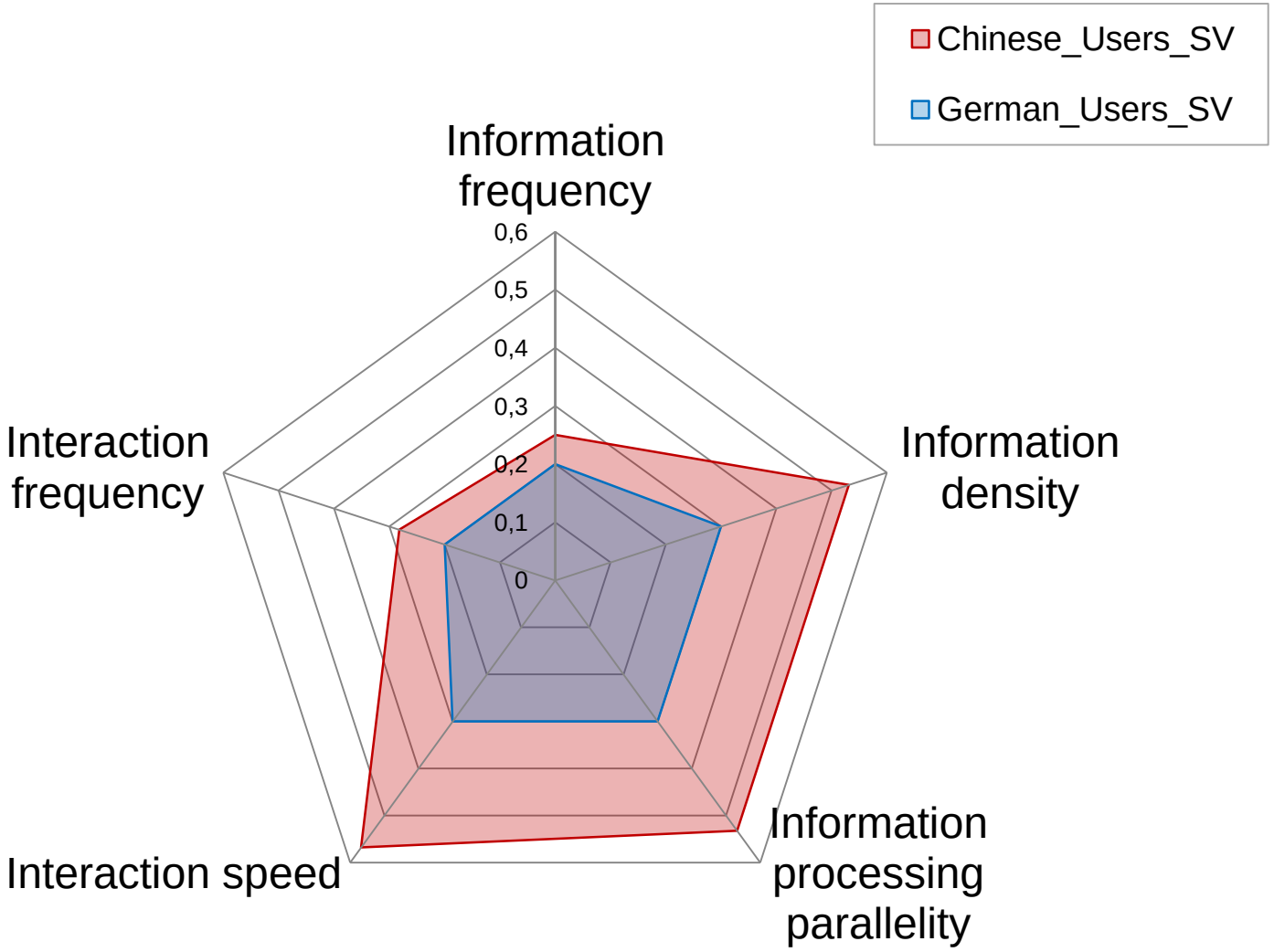
HCI Dimensions and their Values for China and Germany



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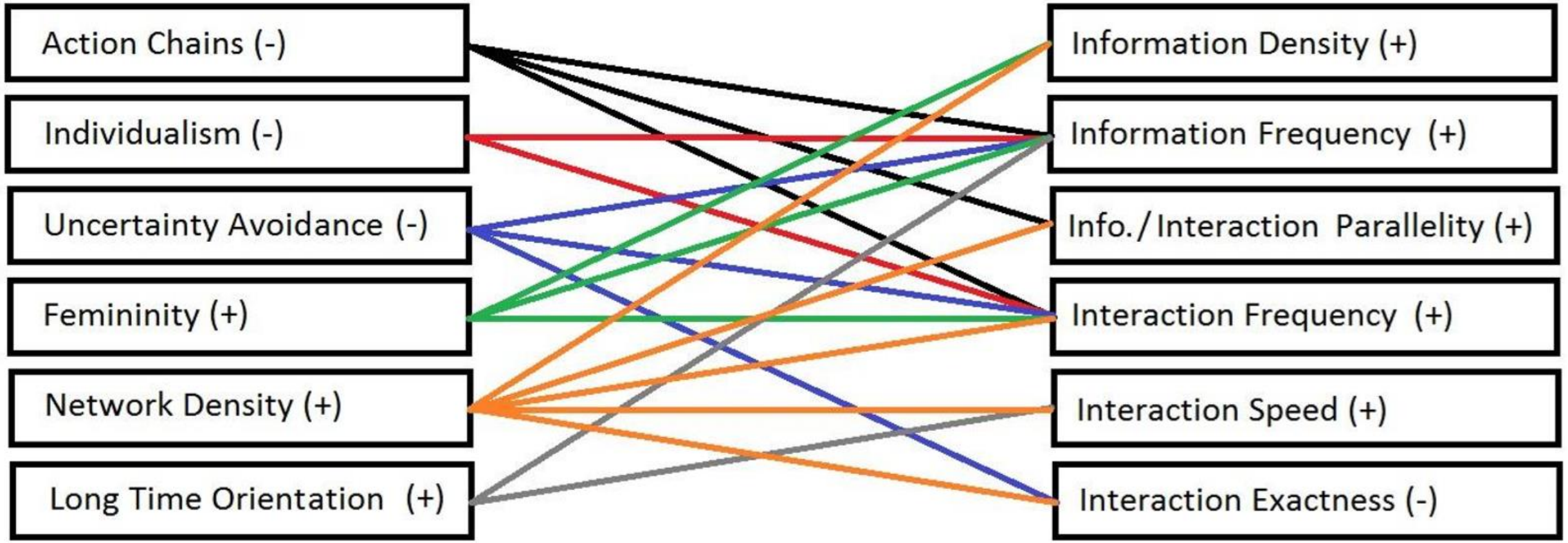
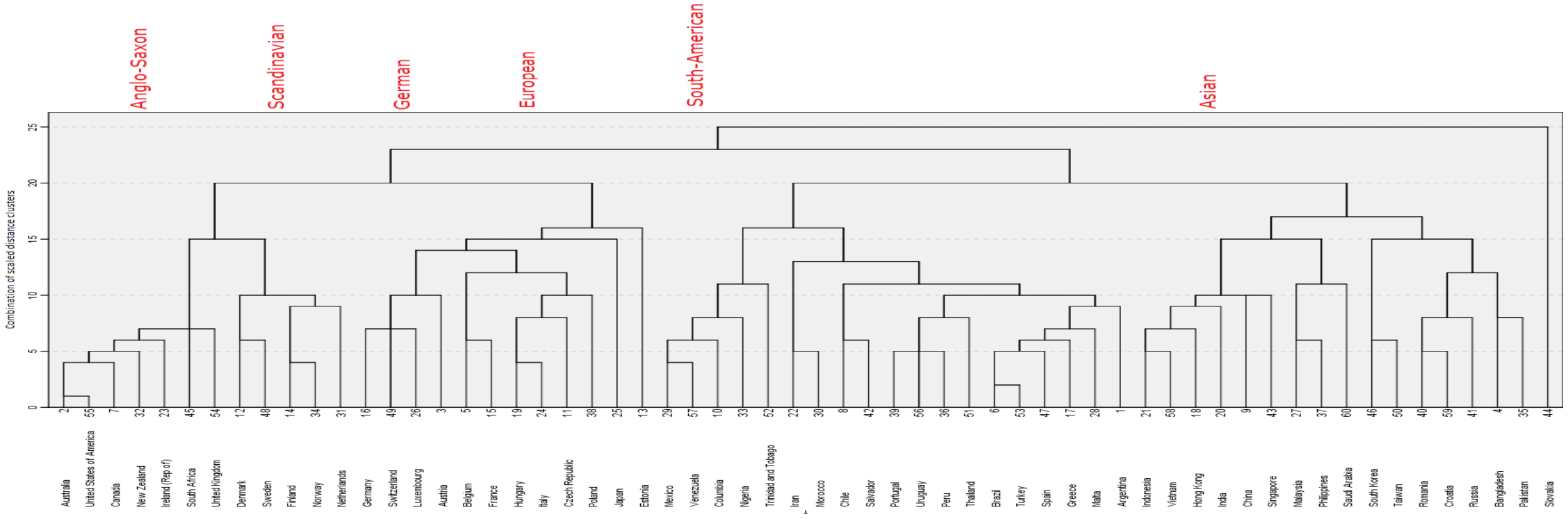


Model of Culture-Dependent HCI

Distances Across Cultures According to Cultural Dimensions from Hofstede



R. Heimgärtner, 2019, IUID Method-Mix: Towards a Systematic Approach for Intercultural User Interface Design (IUID) . Journal of Computer and Communications, Vol.07 No.07(2019), Article ID:93721,33 pages, 10.4236/jcc.2019.77015.

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HCI Styles

HCI Style	Cultural characterization using Hofstede's Indices	Score
Asian	PDI high, IDV low, MAS middle, UAI low, LTO high	90
Indian	PDI high, IDV middle, MAS middle, UAI middle, LTO middle	70
African	PDI high, IDV low, MAS middle, UAI middle, LTO low	60
Scandinavian	PDI low, IDV high, MAS low, UAI middle, LTO low	40
Slavic	PDI high, IDV middle, MAS middle, UAI high, LTO low	30
Angle-Saxon	PDI low, IDV high, MAS middle, UAI low, LTO low	20
German	PDI low, IDV middle, MAS high, UAI middle, LTO low	10

R. Heimgärtner, 2012, Cultural Differences in Human Computer Interaction, Oldenbourg.

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Towards a IUID Toolbox

Synergy between IUID Method-Mix and Systematic Approach

- HCI Dimensions
- Cultural Variables
- Cultural Dimensions
- User Interface Characteristics
- Model of Culture-Dependent HCI
- Method of Culture-Oriented Design

Systematic Approach

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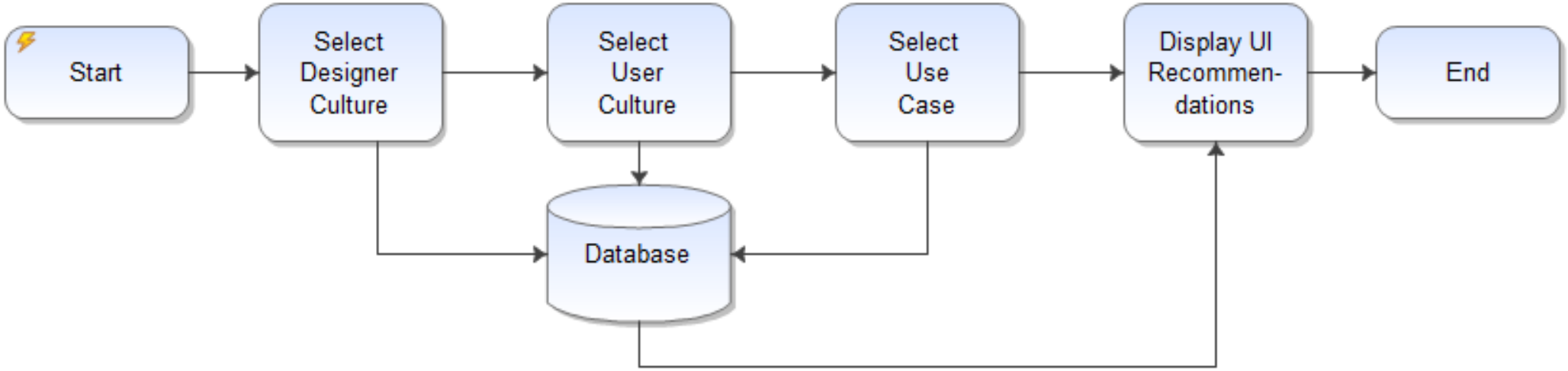
Systematic Approach

Procedure for Systematically Applying the IUID Method-Mix

- Select the application, the main application cases and the desired target cultures
- Determine the respective interface elements (e.g. layout, buttons, text fields) and map them to the category of cultural variables (direct, indirect, visible, hidden) as well as to the characteristics of the user interface (presentation, interaction, navigation, mental model and metaphor).
- Determine the affected time and space-related HCI dimensions (e.g. information density or interaction frequency).
- Use the cultural-dependent HCI model to relate the HCI dimensions to the cultural dimensions in order to derive cultural interaction indicators (e.g. the ratio of the frequency of mouse clicks between users of culture X and culture Y) and finally implicate the design recommendations for IUID.

IUID Toolbox Application



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IUID Toolbox UI

IUID Toolbox - Systematically Deriving Recommendations for Intercultural User Interface Design From Scratch in Seconds - (C) 2019 by Dr. Rüdiger Heimgärtner, IUIC

Overview | Details

Use Case Name: Word processing / Filling in a form

Use Case Description:

Culture of Designer: Germany

HCI Style Score of Designer: 41

Culture of User: China

HCI Style Score of User: 87

UI Elements

UIElementName	Button
UIElementDescrip	Space to click on it to initiate function
UIElementPurpos	Trigger an action
UIElementExamp	Ok Button

Country	PDI	MAS	IDV	UAI	LTO	IVR
China	80	66	20	30	87	24
Germany	35	66	67	65	83	40

Intercultural Variables

Direct (word length), layout
Visible (character set, buttons)
Indirect (online operating manual)
Direct, visible, surface (color, skin, language)

Intercultural Variables

Direct (word length), layout
Visible (character set, buttons)
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Direct, visible, surface (color, skin, language)

User Interface Characteristics

Presentation, Interaction
Presentation, Navigation
Interaction, Mental model
Presentation: text, character, character set, layout, skin, edit field, send button, receiver list box

User Interface Characteristics

Presentation, Interaction
Presentation, Navigation
Interaction, Mental model
Presentation: text, character, character set, layout, skin, edit field, send button, receiver list box

HCI Dimensions

Information density, Interaction frequency
Information presentation speed
Interaction speed and interaction style
Information density, interaction frequency and speed, Information and interaction parallelism, interaction exactness

HCI Dimensions

Information density, Interaction frequency
Information presentation speed
Interaction speed and interaction style
Information density, interaction frequency and speed, Information and interaction parallelism, interaction exactness

Model of Intercultural HCI

Individualism (67) ==> Information Frequency (33)
Individualism (67) ==> Interaction Frequency (33)
Uncertainty Avoidance (65) ==> Information Frequency (35)
Uncertainty Avoidance (65) ==> Interaction Frequency (35)
Uncertainty Avoidance (65) ==> Interaction Exactness (65)

Model of Intercultural HCI

Individualism (20) ==> Information Frequency (80)
Individualism (20) ==> Interaction Frequency (80)
Uncertainty Avoidance (30) ==> Information Frequency (70)
Uncertainty Avoidance (30) ==> Interaction Frequency (70)
Uncertainty Avoidance (30) ==> Interaction Exactness (30)

Cultural Dimensions

Abbreviation	IDV
Name	Individualism versus Collectivism
Description	The high side of this dimension, called Individualism, can be defined as a preference for a loosely-knit social framework in which individuals are expected to take care of only themselves and their immediate families. Its opposite, Collectivism, represents a preference for a tightly-knit framework in society in which individuals can expect their relatives or members of a particular ingroup to look after them in exchange for unquestioning loyalty. A society's position on this dimension is reflected in whether people's self-image is defined in terms of "I" or "we."

Intercultural Interaction Indicators

Average number of chars per word, page
Dialogues per minute, Number of breaks in interaction
Number of buttons presses per task
Number of pieces of information per space, Number of SMS per day, Number of saved contacts

Intercultural Interaction Indicators

Average number of chars per word, page
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IUID Design Recommendations

Resizing, calculate size of display according to language
Adapt speed of guided dialogues (wizards) and button size
Choose appropriate input method editor (IME) and sorting algorithms
Adapt system memory / Choose appropriate input method editor (IME) and sorting algorithms / allow customization of the number of entries in lists

IUID Design Recommendations

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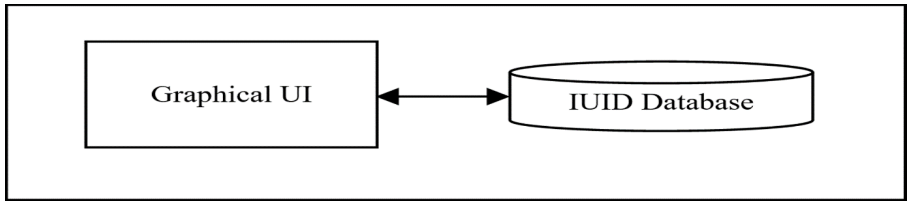
IUID Toolbox Architecture



UseCases
- ID
- Country
- Use Case Name
- Use Case Description

CulturalDimensions
- ID
- CDName
- CDDescription
- CDNameAbbreviation

IUIDRecommendations
- ID
- Country
- Recommendation

UIElements
- ID
- UIElementName
- UIElementDescription
- UIElementPurpose
- UIElementExample

UserInterfaceCharacteristics
- ID
- Country
- Metaphor
- Navigation
- Presentation
- Interaction
- Mental Model

HCIDimensions
- ID
- Country
- Interaction Frequency
- Interaction Speed
- Interaction Order
- Interaction Sequentiality
- Information Frequency
- Information Speed
- Information Order
- Information Sequentiality

InterculturalVariables
- ID
- Country
- Direct
- Indirect
- Visible
- Hidden

CulturalDimensionsCultureMatrix
- ID
- Country
- PDI
- MAS
- IDV
- UAI
- LTO
- IVR

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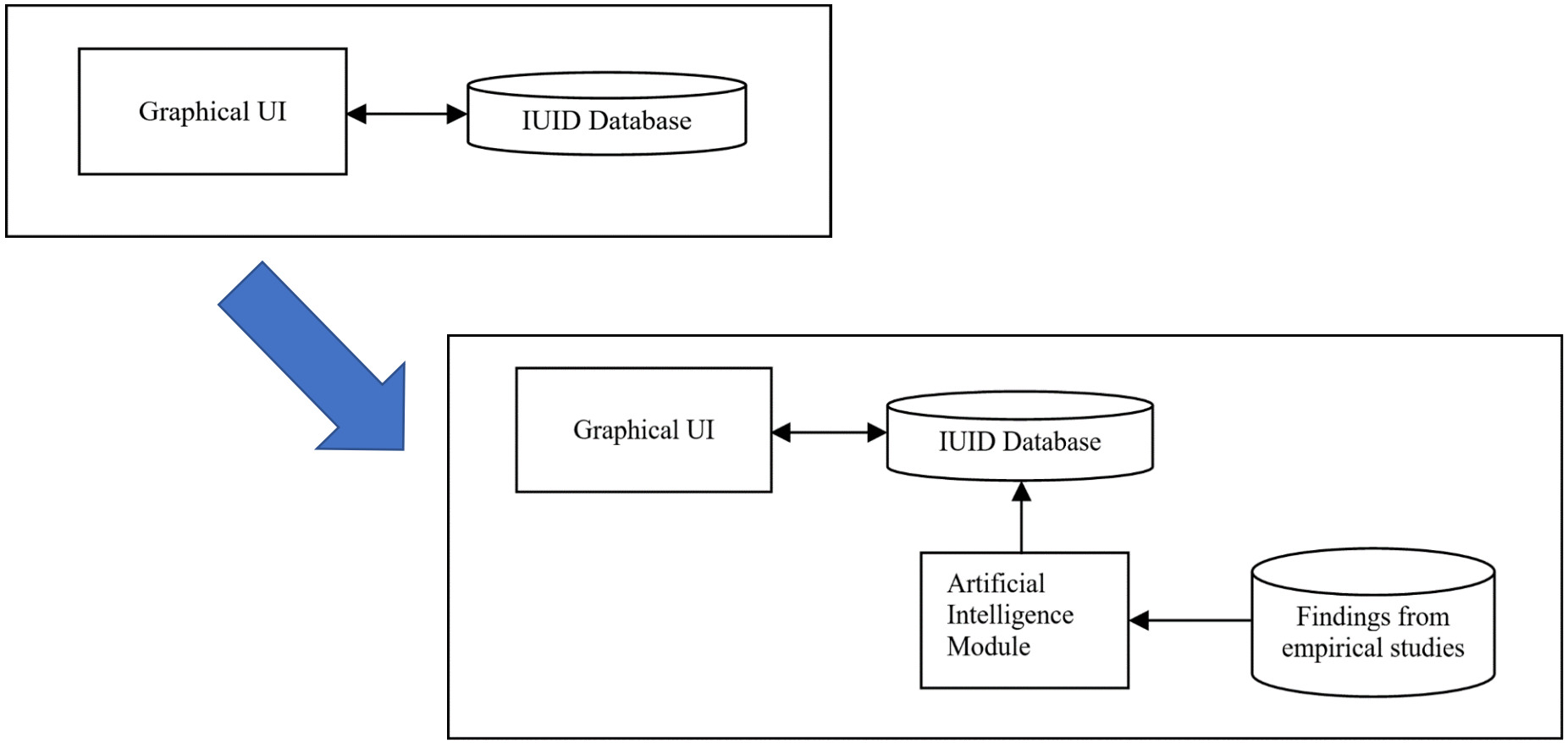
IUID Toolbox Architecture



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Application / Use Case	Cultural aspect / Cultural dimension	UI Character-istics	Cultural variable	HMI dimension	Cultural interaction indicator	IUID implication
Word processing / Filling in a form	Language / Communicat-ion network density	Presentation , Interaction	Direct (word length), layout	Information density, Interaction frequency	Average number of chars per word, page	Resizing, calculate size of display according to language
E-learning system / Learning content	Communicat-ion speed, power distance, uncertainty avoidance	Presentation , Navigation	Visible (character set, buttons)	Information presentation speed	Dialogues per minute, Number of breaks in interaction	Adapt speed of guided dialogues (wizards) and button size
Phone / Looking up, dialing via name or number	Communica-tion speed, density of the information network	Interaction, Mental model	Indirect (online operating manual)	Interaction speed and interaction style	Number of pressing buttons per task	Choose appropriate input method editor (IME) and sorting algorithms
Word processor on a mobile phone / Sending a short text message via SMS	Power distance, individualism, uncertainty avoidance	Presentation : text, character, character set, layout, skin, edit field, send button, receiver list box	Direct, visible, surface (color, skin, language)	Information density, interaction frequency and speed, Information and interaction parallelism, interaction exactness	Number of pieces of information per space, Number of SMS per day, Number of saved contacts	Adapt system memory / Choose appropriate input method editor (IME) and sorting algorithms / allow customization of the number of entries in lists

IUID Worksheet Example

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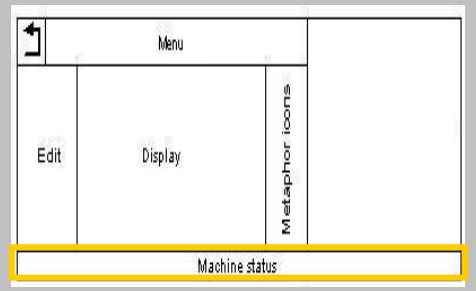
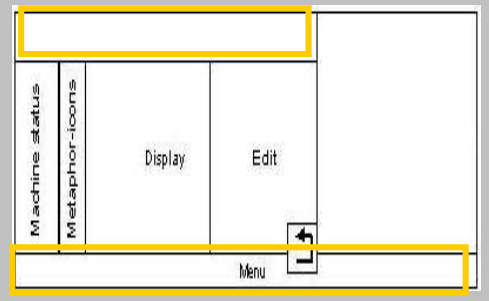
Design Recommendations Germany-China

Germany



Widget positions (position of status bar)

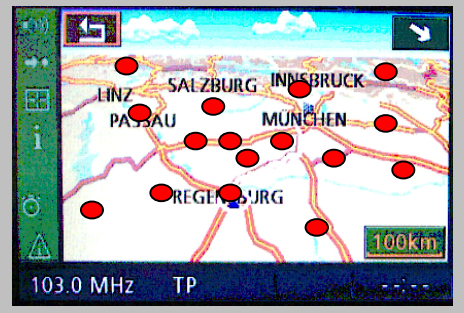
China

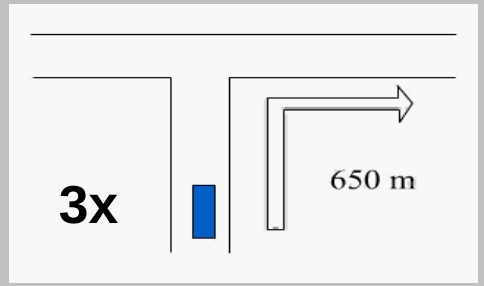


low

Information density

high

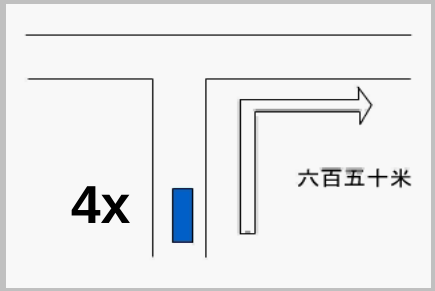




low

Information frequency

high



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Features of the IUID Toolbox

- Identifying the values of all required variables for IUID
- Deriving recommendations for intercultural user interface design
- Estimating the development expense for new IUID projects
- From manual paper version to automatically computation of all results by an expert system

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Problems and Challenges

- Different Approaches
- Missing Empirical Confirmation
- Usage of Cultural Dimensions
- High Research Effort
- Cultural Complexity

Summary

- Consider that there are different HMI styles around the world
- Take the cultural context into account in designing automotive user interfaces
- Use the IUID toolbox for intercultural automotive user interface design
- Take advantage of the experience of intercultural user interface consulting

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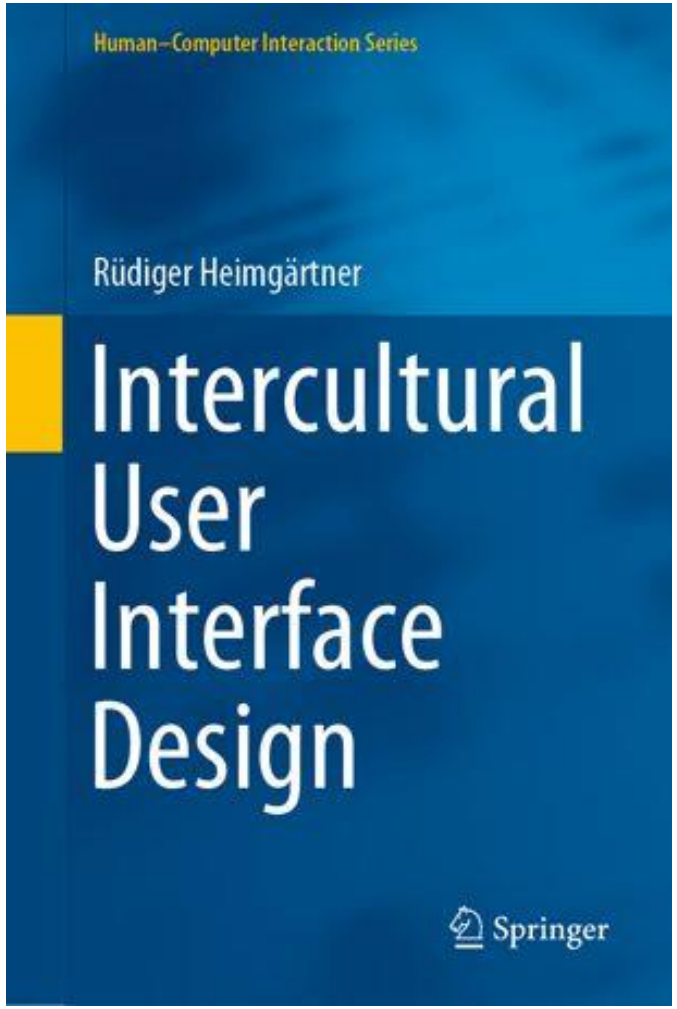
Thank you very much for your attention!



Please, contact me for further information, training or cooperation!

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Questions & Answers

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Backup

Intercultural
User Interface Design

- Adaptations in design and technology according to cultural context using a systematic method mix for intercultural user interface design

Integrating Cultural Aspects

01

Common Aspects for Intercultural UI Design

02

System Specific Cultural Aspects

03

Cultural model

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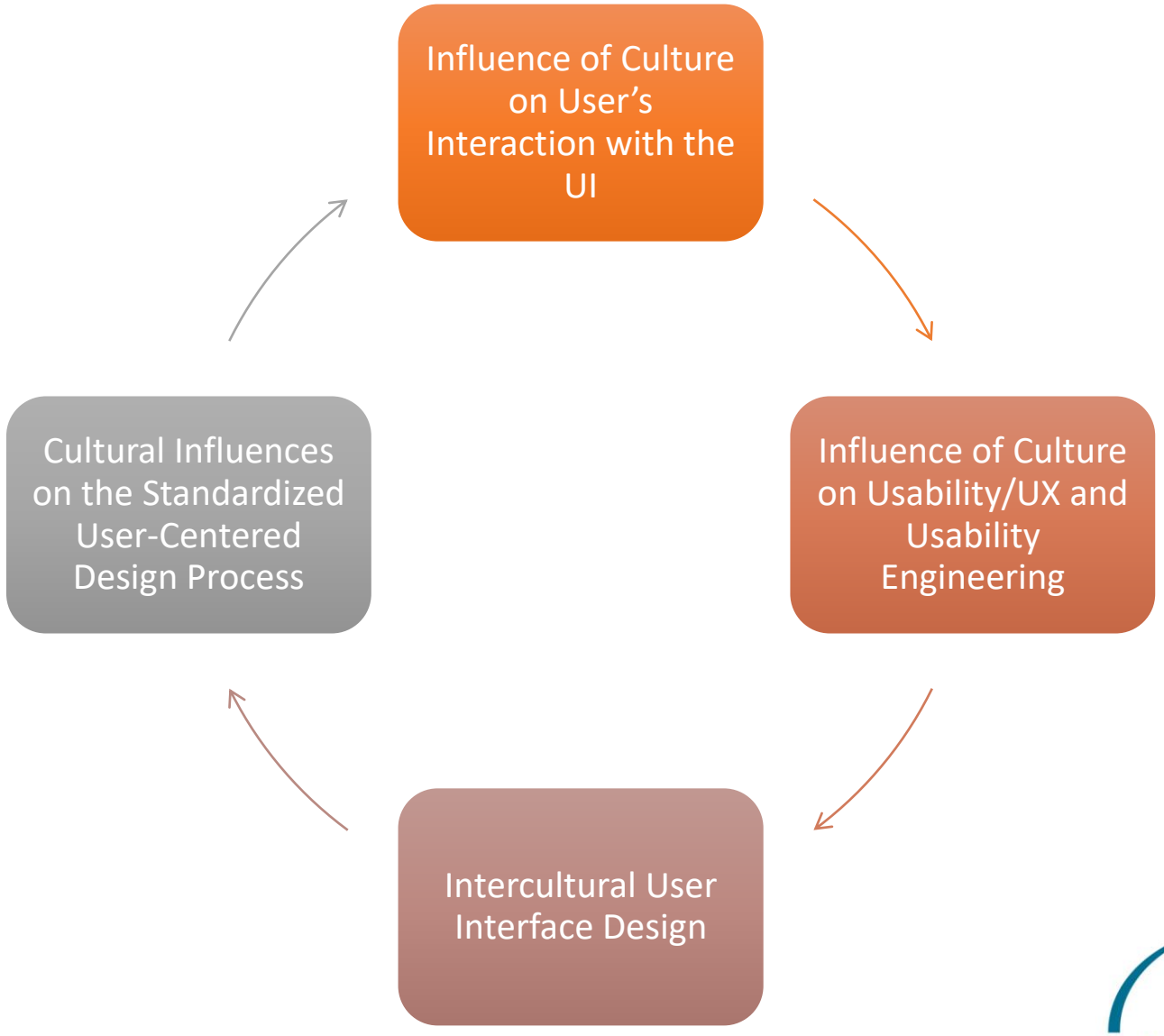
HCI and HCI Design Process Affected by Culture



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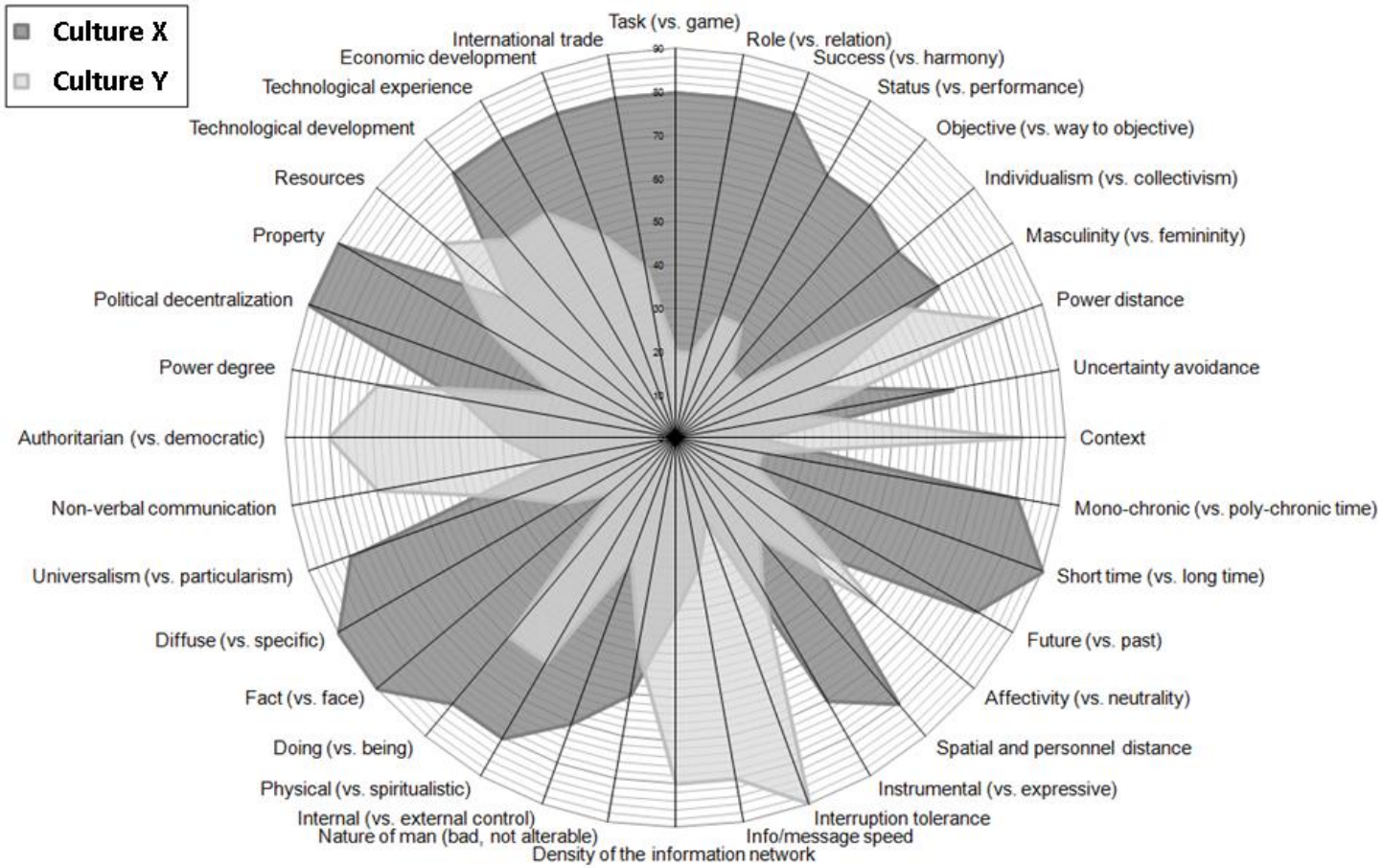
Cultural Dimensions



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Cross-Cultural Interaction Analysis © 2005 by R. HeimgärtnerIIA V1.0 (0512140100)

Task description

You want to drive on the teal road to the restaurant. Please adjust the sliders to get the pieces of information you like to see.

Choice of color

Choice of tone

Change language

Help

System messages

Show

Virt. head of testing

Show

Volume

test volume

Sound on

good test

bad test

abort test

SIEMENS VDO Automotive

Number of streets

Number of street names

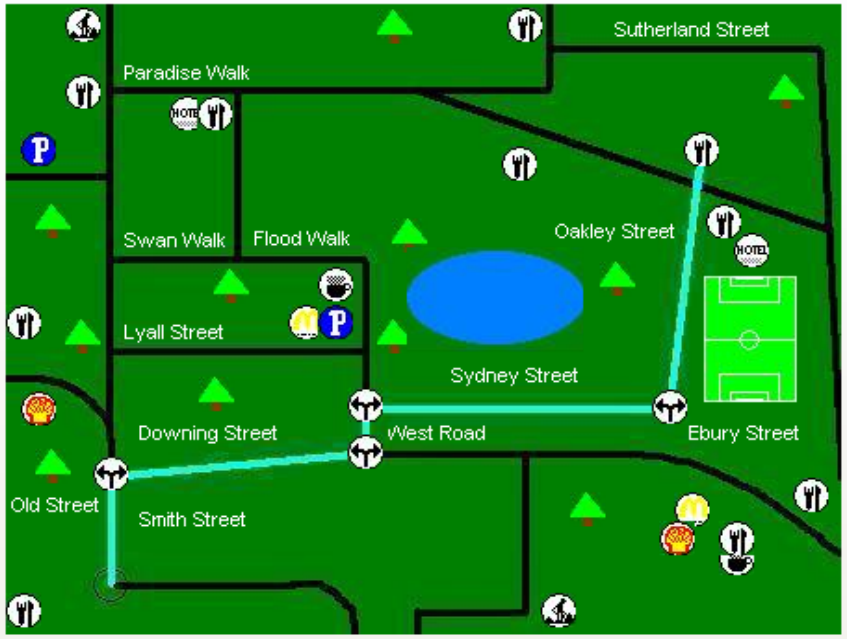
Number of restaurants

Number of maneuver

Number of environment iter

Number of poi's

Ready



Please give reasons, why you have chosen exactly this information.

I like to be informed about the most important things along my route.

Ready

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Cultural Interaction Indicators

Parameter	Ratio (C : G)
Number of error clicks	2 : 1
Number of simultaneous tasks	2 : 1
Speed of mouse moves	1,6 : 1
Number of mouse moves	1,3 : 1
Number of left mouse clicks	1,2 : 1
Interaction breaks with mouse > 10s	1 : 1,22

(Heimgartner 2007)

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HCI Styles Around the World

- Our globally connected world demands for global standards to some extend: HCI dimensions and HCI styles around the world

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Old IUID-Method-Mix Worksheet

Appli-cation(s) / Use Case(s)	Culture	Cultural Dimension(s)	User Interface Characteristics	Intercultural Variable(s)	HCI Dimension and their relationship to cultural dimension(s) according to culture-dependent HCI Model	Cultural Interaction Indicator(s)	IUID imply-cation(s) / recommend-dation(s)

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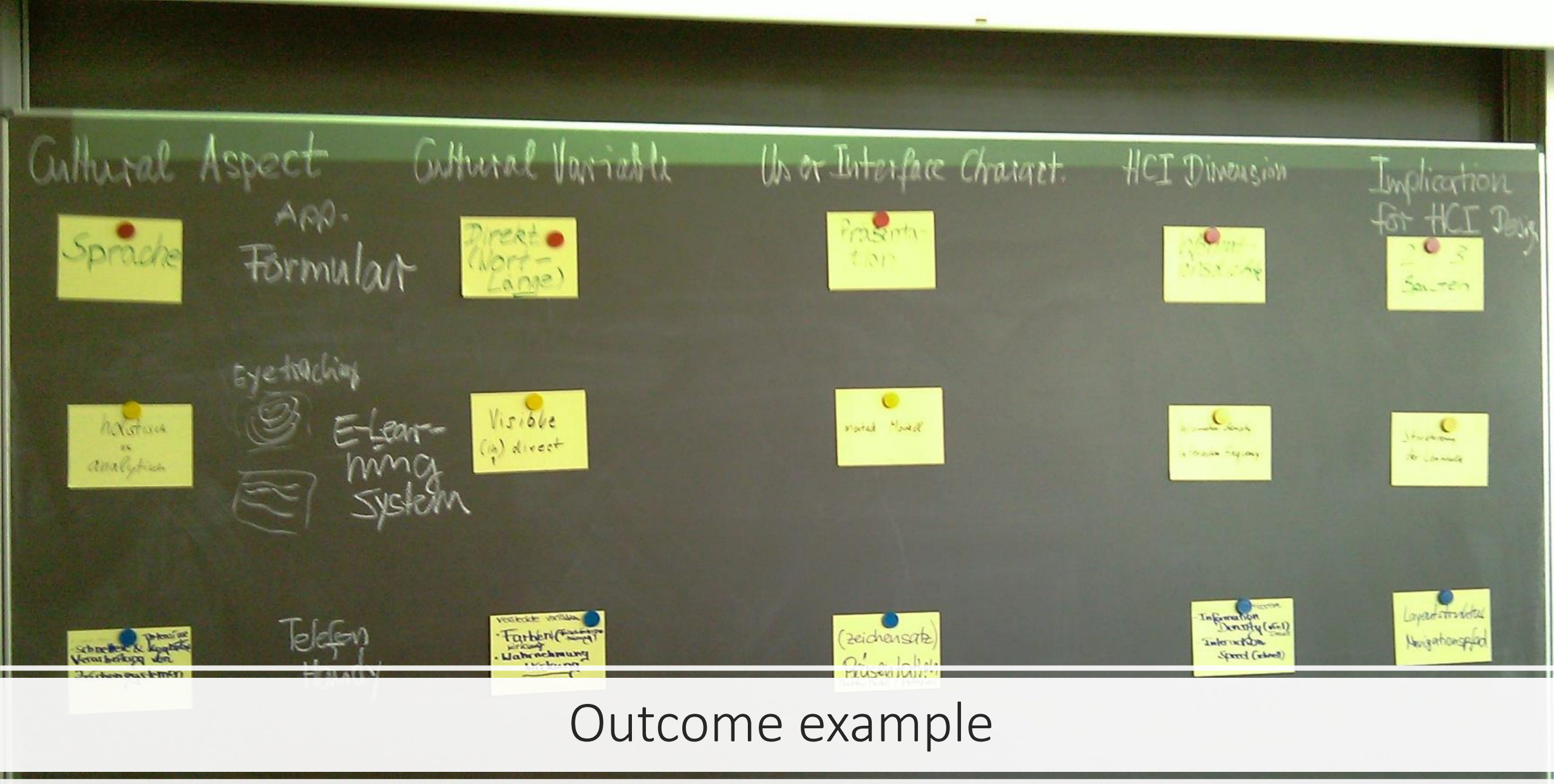

Outcome example

Findings by Applying the IUID Method-Mix

Groups had different approaches to solve the task

- Analytically think about a solution – after selecting a use case, easy to find and relate the items to the categories
- Identify examples for the categories and concepts in the internet by comparison
- Look at an application to identify examples for the categories and concepts

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New IUID-Method-Mix Worksheet

Use Case	Culture	Cultural Dimension	Relationship from culture-dependent HCI Model	HCI Dimension	User Interface Characteristics	Intercultural Variable(s)	Recommendation(s) for IUID

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Produkte müssen gebrauchstauglich und benutzungsfreundlich sein. Für jeden. Weltweit.

Wir zeigen Ihnen,
wie Sie Ihre Produkte benutzungsfreundlich machen.
wie Sie Produktentwicklungsprozesse prüfen und optimieren.
wie Sie weltweit Mensch-Maschine-Schnittstellen für alle entwickeln.

Forschung

Kontinuierliche Literaturrecherche und Mensch-Maschine-Interaktionsforschung garantieren Ihnen ein exklusives, wissenschaftlich gesichertes Expertenwissen auf dem neuesten Stand.

Schulung

Seminare und Workshops vermitteln allen an der Produktentwicklung Beteiligten (Management, Marketing, Design, Produktion, Vertrieb) fundierte Kenntnisse in Sachen Gebrauchstauglichkeit.

Beratung

Die intensive Begleitung bei der Entwicklung gebrauchstauglicher Produkte und Prozesse auch im interkulturellen Kontext befähigt Ihr Untenehmen weltweit zu maßgeschneiderten Lösungen.

Wir leben Usability.
Wir prüfen Prozesse.
Wir begreifen Kulturen.

IUIC in Science and Industry - Since 2003

lity Professionals Association – GI Gesellschaft für Informatik – Deutsche Gesellschaft für Qualität GPM Deutsche Gesellschaft für Projektmanagement – Österreichische Computergesel

- Acknowledged

upa VDI acm German Chapter GI GPM VDMA DGQ

- Working at current research status

JUS IEEE GERMANY SECTION HCI 2013 INTERNATIONAL mensch computer

- Tasks are clarified and tackled

Recognized Training Provider 2018 UXQB

DIN CeBIT

- References

FRESENIUS KABI UR

- Network

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Research

- With IUIC you have access to the current state of research in the field of development of usable products and human-machine interaction, especially for the intercultural context.
- IUIC transforms the latest scientific findings from research cooperation's and committee work into action-relevant knowledge for practice.

Training

- IUIC conducts seminars according to the CPUX curriculum of the UXQB with accredited certification possibilities of the German Usability Professional Association (German UPA).
- IUIC also offers training for process testing based on the ISO 15504 international standard.
- The methods for optimizing the usability of products and processes are conveyed in seminars regarding other cultures (IUID).
- Project-accompanying coaching serves the correct application of the learned in practice.

Consulting

- IUIC accompanies you in the development of products and processes suitable for use from the idea to the market introduction also in the intercultural context.
- We review the relevant processes for product development in your company (based on the standard ISO 33000).
- We show you which aspects of the user interface design are important for other cultures and how development guidelines or customized solutions are generated for your company.

Contact

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