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HOW CULTURAL CHARACTERISTICS INFLUENCE DESIGN PROCESSES – AN EMPIRICAL STUDY

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ABSTRACT

Product development increasingly involves designers with different cultural backgrounds. This paper describes an investigation into the effects of these different backgrounds on the design process. An empirical study is carried out under participation of designers drawn from industrial practice in Germany, India and China. They are observed while solving a given design problem in a laboratory setting. The recorded design processes are analyzed with a focus on cultural characteristics, which were derived from literature. The paper focuses on the following design activities: analyzing problem and requirements, working on sub-functions, deriving selection criteria, and improving solutions. The results indicate that the design processes are different and that these differences can be linked to the characteristics of culture.

1 INTRODUCTION

Companies operating worldwide work with partners from different countries. In the field of product development designers are increasingly involved in intercultural cooperation, i.e., designers from different cultural backgrounds work together in one project. A study of the literature showed that so far the effects of cultural influences on the process of designing have not been studied. There is a lack of know-how about the effects of the cultural background on the individual design approach and on how to deal with these cultural influences in a design project. The key research questions described in this paper are:

- Which cultural characteristics could influence the approach used by designers?
- How do the design processes of designers from different cultures differ?

The objective of the research is to provide guidelines for designers working in intercultural design processes, i.e. processes in which designers from different cultures work together, on the basis of the results of the empirical study.

The first research question is answered using literature about cultural differences in general and literature on designing. In order to investigate whether the characteristics found in literature indeed have an effect on the design approach of an individual designer, an empirical study is carried out in 3 countries – Germany, India and China. The participants are designers drawn from industrial practice in these countries.

Details of the literature review, the employed research method and the conceptual framework for the empirical study are presented in [1]. Preliminary results of the empirical study are presented in [2]. This paper provides detailed results for the following research questions:

- What are the characteristic features of the investigated design processes?
- What are the differences in designer's approaches during designing?
- Which differences relate to the cultural background of the designers?

Section 2 presents those cultural characteristics found in literature, that we assumed potentially relevant within the design process and that relate to the findings discussed in this paper. Section 3 describes the set-up of the empirical study. Section 4 of the paper presents the results of the empirical study and shows how the cultural characteristics presented in Section 2 are related to the differences found in the investigated design processes. Reflections on the empirical study are the focus of Section 5. Section 6 presents some of the basic thoughts about the intended support for intercultural design projects. Section 7 finalizes the paper with details of ongoing and future work.

2 CULTURAL CHARACTERISTICS

Literature on cultural characteristics shows that there are basic differences in thinking of people from different cultures and these differences are reflected in their activities. Hofstede

defines culture as a sort of ‘software of the mind’ [3]. According to him, every person carries patterned ways of thinking, feeling and reacting. These are partly unique and partly shared with others. The unique part belongs to the individual’s personality level. The common part belongs to the collective level. Thomas [4] defines culture as an orientation to individual perception, thinking and acting of persons belonging to a specific social group. Such an orientation is defined with so-called ‘cultural standards’. Cultural standards are values, norms and points of reference and seen as binding and normative by members belonging to a social group. According to both definitions, culture is a collective phenomenon. The patterns and the cultural standards are shared at least partially with other people living in the same social group.

Based on these definitions it can be inferred that, if culture influences the way people think and act, it would affect the way people design and hence result in different design approaches used by people with a different cultural background.

Empirical studies have revealed many characteristics on which cultures differ. We have identified those that may be particularly relevant in the context of a design process. This section focuses on the characteristics that are relevant to the results presented in this paper. The used terminology and the definitions are based on the studies of [5], [6], [7], [8], [9] & [10].

The cultural studies, on which these characteristics are based, were conducted mainly with participants from USA, China, Korea and Japan (western and eastern participants). Kühnen and Katayama have conducted similar studies with participants from Germany and Japan [quoted in 11]. They found differences that were comparable to the differences found in earlier mentioned studies between western and eastern participants [11]. This indicates that culturally seen the participants from Germany and Japan are as different as the western and eastern participants.

Addressing situational influences

Different cultures perceive situational influences (i.e. influences which arise out of a particular situation) differently when analyzing action and behavior. People from Western cultures (Westerners) assume a stable situation to continue and the current trend to remain steady. They are likely not to consider situational influences. An action is analyzed independent of the current situation in which it is taking place, i.e. detached from the current situational context. People from Asian cultures (Easterners) tend to perceive contextual factors when analyzing action and behavior. In their perception the current trend may change its direction. They take notice of sudden changes or influences which have come up only in this particular situation.

Analysis vs. holism

Views and thinking styles in cultures are basically different. In Western cultures the analytic way of thinking is predominant. Objects are seen as consisting of single entities which are unconnected. “In order to understand the world around us, it should be merely dissected into components and the rules and relationships between them discovered” [12]. In Eastern cultures the holistic way of thinking is predominant.

The environment is seen as consisting of inter-connected entities. The object and the environment in which the object is located are perceived as a whole.

Objects vs. relationships

The way we experience the world around us is different in different cultures. People in Western cultures have a relatively analytic cognitive orientation. They pay more attention to the objects and see an object independent from the context in which it is embedded. People in Eastern cultures have a relatively holistic cognitive orientation. They pay more attention to the relationships between objects and notice the context and the environment in which an object is located.

Use of logic and dealing with contradictions

There are cultural differences in the way people handle contradiction in a situation. People in Western cultures make more use of logic and avoid contradiction. When presented with contradictions, they adhere to a logical analysis and are likely to resolve the situation by deciding which of the both propositions is correct. People in Eastern cultures use dialectic reasoning in place of logic and accept contradiction. They practice dialectical thinking (cognitive tendency toward acceptance of contradiction) and when dealing with contradictions are inclined to find some truth in both propositions and embrace both.

A large number of empirical studies into the design process describe characteristics of the ways in which designers develop their products. In a design process, different phases can be distinguished. Comparing these design characteristics with the cultural characteristics suggested which cultural characteristics could have a strong effect on which activity of the design process. An empirical study was undertaken to investigate whether these effects indeed could be found.

3 EMPIRICAL STUDY AND DATA ANALYSIS

The cultural characteristics assumed to play a role in the design process and the activities in which they were assumed to play a role were combined into aspects to be investigated. Figure 1 shows the approach taken.

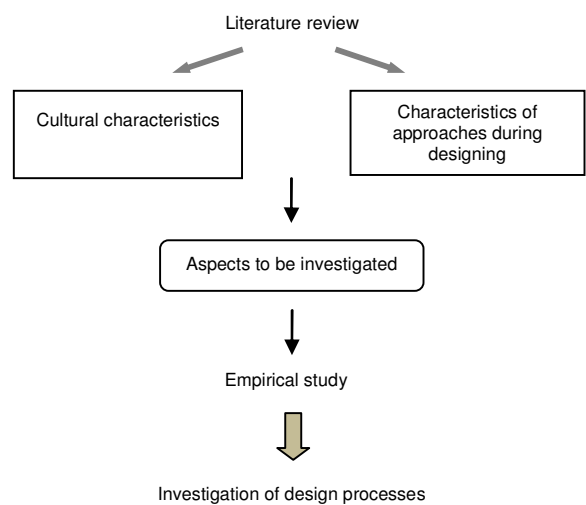


Figure 1. Approach taken to answer the questions

3.1 Details of the empirical study

In order to determine differences between design processes, the empirical study is designed to take place in a laboratory setting, which is used in each of the three countries involved: Germany, India and China. 15 design processes (cases) are captured divided over 3 countries. Each case involves a team of 2 designers who are observed while solving a given design problem. The participants are asked to develop the solution together and to voice their thoughts and exchange these with their partner. The task is to develop a device for baking of biscuits, which is suitable for household use. The design process covers the early phases of a design process – from task clarification until a rough embodiment design. Interviews are held with the participants after they finalize the task. The participants developed their solution on paper and kept on speaking out their thoughts. All cases are recorded on audio and video and subsequently transcribed for analysis.

3.2 Selection of participants

The designers who participated in the study are practicing designers. It was assumed that if designers are drawn from industrial design practice with some years of working experience, they would have a similar type of education and a similar level of design knowledge. That is, all participating designers should therefore share a similar base, which is the basic prerequisite for comparing the design processes in different cultures (see also Section 5).

The participating designers worked for national and international companies in their respective countries. In each case, both designers were from the same company and from the same hierarchical level. This means that they knew each other and could contribute to the design process free from hierarchical barriers (i.e., freely speak out their thoughts and discuss these with the partner while solving the task). The decision to choose participants with a limited number of years of working experience was based on the assumption that a longer working experience would carry the risk that the corporate culture, compared to the cultural background of the designers, may come to the fore.

3.3 Method of data analysis

The aspects to be investigated (combinations of cultural characteristic and design activity) were operationalized, i.e. indicators were defined for the aspects to be investigated. Each recorded process was transcribed and first segmented based on the design activities undertaken, using the categories shown in Figure 2. A further segmentation was undertaken to compare envisaged design activities itself.

First the data sets within one culture were compared and checked for tendencies. Second, an inter-cultural comparison of the processes was undertaken to compare the tendencies and identify similarities and differences in designing (see Figure 3).

Analyze the task
Analyze the requirements
Identify sub-functions
Combine sub-functions into a structure
Find solutions for sub-functions
.....
Evaluate solutions
Improve solutions
Generate a concept
.....
Generate embodiment for sub-functions
Evaluate embodiment for sub-functions
Improve embodiment for sub-functions
.....
Generate rough overall embodiment

Figure 2. Coding scheme

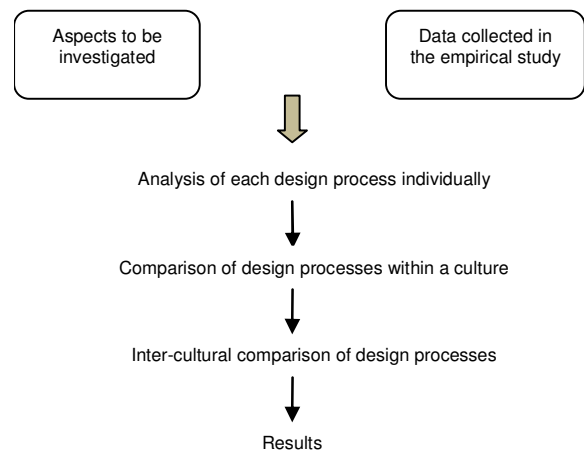


Figure 3. Approach taken to analyze the data collected

4 RESULTS OF THE EMPIRICAL STUDY

The results presented in this section are based on the analysis and comparison of 9 design processes (out of a total of 15), 3 for each country. The total duration of the 9 processes is 32 hours, the individual duration varies between 2 and 5 hours. The designers who participated in the study are denoted in the following as: G-designers (designers from Germany); I-designers (designers from India); C-designers (designers from China).

4.1 Analyzing problem and requirements

This section describes the differences that were observed when the designers analyzed the given problem and requirements. The focus is on the situational influences the designers address. The questions are:

- How do the designers analyze problem and requirements?
- Do the processes differ in the situational influences that are taken into consideration?

In all of the 9 cases, the designers analyzed problem and requirements at the beginning of the process.

In the 3 cases with G-designers the influences that were taken into consideration in this activity, were in particular the functionality the device should fulfill and the aspects pertaining to its use for a household user.

In the 3 cases with I-Designers, an additional, third aspect was discussed: the input and output of the device, i.e. the ingredients to go into the device and the form in which the device will deliver the output. The input and output of the device was also discussed by the G-designers, but at a later stage of the process. Apart from the third aspect, a comparison with the G-designers showed that there is also a difference to the I-designers in the way in which the user aspects are analyzed. The I-designers tried to put themselves in the position of the user. They tried to imagine how a user will interact with the device and how a current use situation might take place. The actual interaction between the user and the device is analyzed in more depth than the G-designers do. The influences addressed by I-designers are related to the particular use situations. The following quotes illustrate the difference. I-designer: "if you consider from the user perspective here...user will be typically like to press one button and take the biscuits"; G-designer: "...mixing parts must be easy to clean".

In all 3 cases with C-designers both aspects (functionality and use) are analyzed, however, it is not clear from the collected data how the situational influences are taken into consideration.

A comparison of the investigated design processes shows that the I-designers addressed the situational influences in more depth. The differences found between the designers when analyzing problem and requirements indicate a possible link to the cultural characteristic 'addressing situational influences' as described under section 3. This tendency leads to different priorities being set when analyzing problem and requirements in design processes.

4.2 Working on sub-functions

This section describes the differences in approaches that were observed when working on sub-functions of the given problem. The focus of attention is on how the problem is divided into sub-functions and whether the sub-functions are addressed in an analytic or holistic way. The questions are:

- How do the processes of working on sub-functions differ?
- Does the sequence in which the sub-functions are addressed differ?

In all 3 G-design cases and in 2 I-design cases the problem was explicitly divided into sub-functions. A division is not clearly evident in the C-design cases and in the third I-design case.

The G-designers treat most of the sub-functions separately when developing solutions. However, in two instances they treated a few sub-functions together. After solutions for a first few sub-functions were found, some embodiment details were added. This partial embodiment was used as a reference point for finding solutions for further sub-functions.

In only one I-design case, the designers treated sub-functions separately when developing solutions. A difference was observed with the other two I-design cases and the two C-design cases. In these four cases the overall embodiment was generated, even though only the solutions for a first few sub-functions are found. The overall embodiment served as the first reference point for finding solutions for further sub-functions.

A comparison of the investigated design processes showed that in case of the G-designers the analytic way of working is practiced more. The holistic way of working is also present, but only across few steps in their design process (e.g. between finding solutions for sub-functions and generating partial embodiment). In case of the I-designers and the C-designers the holistic way of working is practiced more. Compared to the G-designers, they covered more steps when working holistically (e.g. between finding solutions for sub-functions and generating overall embodiment). The difference is shown in Figure 4. The 'holistic loop' in case of the I-designers and the C-designers spans across a longer range and is bigger than that of the G-designers.

In 2 G-design cases another type of holistic loop could be observed when they evaluated solutions for sub-functions. In three instances a solution for a sub-function is evaluated and a further sub-function, which is directly related in functionality, is included in the evaluation process. The evaluation of the first sub-function is used as a reference point for evaluating the second sub-function. The holistic way of working here, also observed when developing solutions, covers only few steps (i.e. between finding solutions for sub-functions and evaluating these).

The findings show a mixed picture regarding the way in which work on sub-functions takes place. The differences in the design processes of the G-, I- and C-designers are not as clear as the cultural studies described in Section 2 suggest. The cultural characteristic 'analysis vs. holism' could be found in all 3 investigated cultures, but differences were small.

4.3 Deriving selection criteria

This section describes the differences that were observed in the selection criteria chosen by the designers to evaluate their solutions. The focus of attention is on how the objects and their relationships with the environment are addressed and which of both fields (i.e. based on objects or based on their relationships with the environment) the selection criteria are drawn from. The questions are:

- How do the processes of deriving selection criteria when evaluating solutions differ?
- Do the chosen selection criteria differ and what are they derived from?

All G-designers and all I-designers try to achieve optimum fulfillment of functions, but use different approaches.

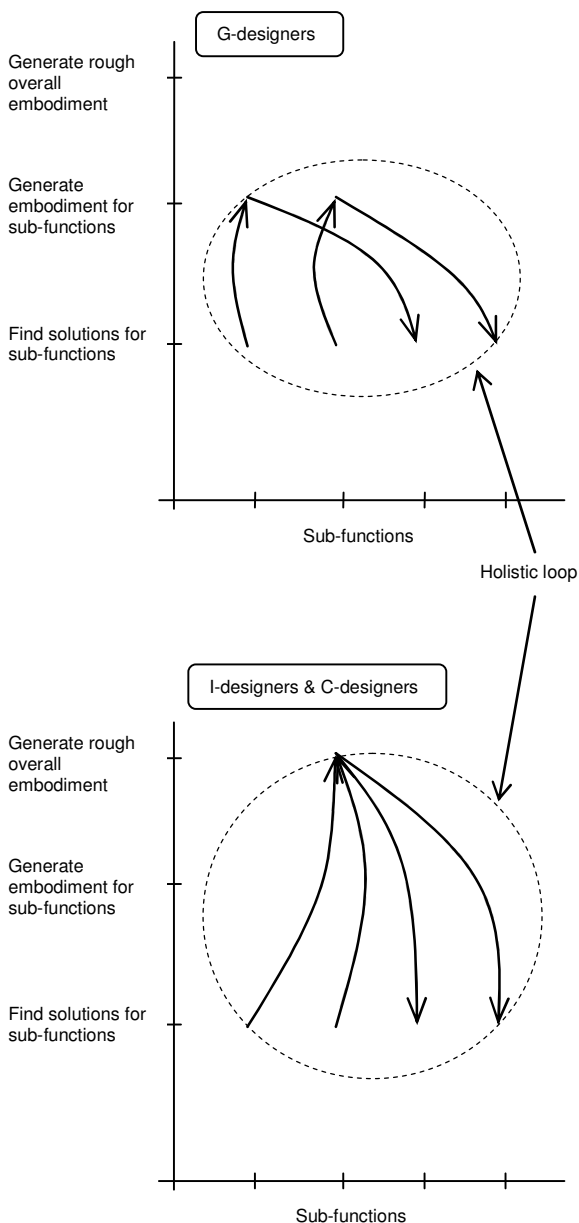


Figure 4. Differences in approaches of designers when developing solutions for sub-functions

In all 3 G-design cases the designers analyzed and checked in the conceptual phase whether the selected function carriers would fulfill their function. In the embodiment design phase, when elaborating the partial and overall embodiments, the attention remains focused on the function carriers (the parts) and their functionalities. As a result the selection criteria are derived from the discussion on function carriers and their functionalities. It is interesting that user-related aspects are recognized as possible criteria, but do not further play a role in the evaluation process.

In 2 cases the I-designers also analyze the fulfillment of the functionality, however not at the level of function carriers (parts), but at the level of the processes which the function

carriers are intended to realize. Thus the functionality here was analyzed with the help of use situations involving the function carriers and the attention focused on processes related to function carriers. While considering the use situations, the user was included in the functionality check. As a result the selection criteria were derived mainly from the discussion on use situations by the user. A few selection criteria were also derived from the discussion on fulfillment of functionality in the partial and overall embodiment. In the third I-design case, however, the selection criteria were derived not only from the discussion on use situations (as is the case with the other I-designers) but also from the discussion on function carriers and their functionalities (as the G-designers did).

In all 3 C-design cases the designers mainly analyzed the user interface with the device. As a result the selection criteria were derived from the discussion on optimizing the user interface.

A comparison of the design processes showed that the G-designers predominantly focused on the attributes of function carriers. Their selection criteria were linked to the objects, i.e. were derived from the discussions on function carriers (objects) that they are attending to at that particular moment. On the other hand, in two of the three I-design cases and in the three C-design cases the attributes of using the device (or function carriers) dominated. The attention of the I- & C-designers in these cases lay not only on the device (objects), but also on user and use situations (environment). For them the relationship of the object to its environment seems as important as the object itself. They used selection criteria that were linked to the relationship of the objects to their environment.

The tendency was observed that designers from different cultural backgrounds focused on different types of selection criteria for evaluating their solutions. The differences found between the designers when deriving selection criteria indicate a possible link to the cultural characteristic 'objects vs. relationships' as described in Section 2.

4.4 Improving solutions

This section describes the differences that were observed when the designers improved their solutions.

The evaluation of a solution may not present a clear picture of the best improvement. A contradictory situation arises when a solution for a sub-function is evaluated against two different criteria and a possible improvement of the solution undertaken based on the first evaluation criteria would mean that the solution gets worse when evaluated against the second criteria. Our focus of attention was on how the designers deal with such contradictory situations. The questions are:

- How does a contradictory situation arise when evaluating solutions?
- How a contradictory situation is dealt with and what are the differences?

In the investigated processes only very few contradictory situations arose when solutions were evaluated – two in one of the G-design cases, and one in one of the I-design cases. In

these cases an improvement to the evaluated solution was proposed after the designers had evaluated the solution against a first criterion. At this point, another criterion entered the evaluation. The evaluation of the planned, improved solution against this second criterion then presented a contradiction, i.e. the proposed improvement would improve the solution from one point of view, but worsen it from another.

When facing such a contradiction, the designers in both cases tried to avoid the contradiction and attempted to find a compromise. They achieved this by narrowing the range of the solution, either by adding a new boundary condition or by making a new assumption. In the newly defined range of the solution both criteria would not contradict one another and the designers proceeded with their solution generation process. Figure 5 shows this approach.

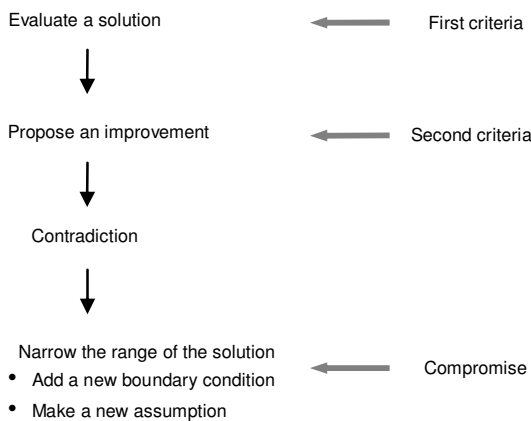


Figure 5. Approach in handling a contradiction

A comparison of the investigated design processes showed that in one G-design case and one I-design case the approach of dealing with the described type of contradiction is the same. No differences were found. Both tried to resolve the situation by creating a new situation, in which the contradiction would be avoided. The pattern, however, is not exactly in line with the definition of the cultural characteristic ‘dealing with contradictions’ as described in Section 2 because on one hand, designers try to avoid a contradiction and on the other hand, they try to find a compromise. Hence, their approach contains elements of both Western and Eastern cultures.

However, the number of instances in which a contradictory situation was observed is too small to draw firm conclusions about a possible link to the cultural characteristic ‘use of logic and dealing with contradictions’ as described under Section 2. In most evaluations, either a solution is evaluated against a single criterion or, if more than one criterion is used, these do not cause a contradictory situation.

5 DISCUSSION

The data analysis and drawing of conclusions from the findings in this kind of research incorporates to a great deal the mindset and interpretation of the person who performed it.

Possible alternative explanations of the results are discussed in this section.

The coding of the transcriptions was done by the first author. A second round of coding to be performed by another person will be undertaken to test the inter-coder reliability.

Despite the care taken that the designers had a similar level of education and at least some years of experience, they worked for different companies and had their education in different countries. Therefore, in addition to the cultural characteristics, other factors might have influenced the design processes in the empirical study: the type of education, company-specific design processes and professional experience, specifically in their current position. Information was gathered on these factors in an interview which immediately followed after the designers finished the design task, but still needs to be analyzed and linked to the findings presented in this paper.

The findings presented under section 4 and much of the literature on design show the differences in design approaches that can exist within one culture. Studies on culture in other disciplines have come to a similar conclusion. It is interesting to study such differences in the context of designing. The answers given in the aforementioned interview will be analyzed to seek a possible explanation for the differences that were observed in the approaches of designers within one culture.

A potential source of bias in analyzing the data is the cultural background of the authors itself. In this case, the authors bring a certain cultural diversity in their upbringing, education and professional positions - the first author, who analyzed the data, in India and Germany and the second author in the Netherlands, England and Germany. The different cultural backgrounds of the authors will have avoided some uni-cultural bias in interpreting the findings, although the main coding scheme (based on design activities) is strongly based on the terminology used in German design methodology literature.

6 DEVELOPING SUPPORT FOR DESIGNERS

Once all data has been analyzed, the intention is to develop guidelines for designers and project managers to support in the planning and execution of intercultural design processes. The preliminary considerations on developing the guidelines are based on two ideas.

The first is to determine how various competencies of designers can be best matched together.

The second idea is based on the thinking that designers should be allowed to follow their ‘cultural intuition’. The results of the empirical study show that designers from different cultures may act differently while solving problems. Any set of guidelines should take the different cultural emphases into consideration by retaining the basic elements of each approach. The attempt is not to restrain designers in practicing their ‘culturally influenced’ approaches. At the same time, their culturally influenced approaches should be embedded within a framework, a design methodology, to support a joint project.

7 CONCLUDING REMARKS

The results of the empirical study indicate that the approaches of designers are influenced by their cultural backgrounds, which affect the courses of their processes. It could be observed, however, that in some instances the characteristic elements of the investigated design processes in one culture are also present in that of another culture. More processes, that have already been transcribed, will be analyzed. Furthermore, the interviews will be analyzed and used to verify alternative explanations for the findings. The study provides valuable insights into design processes of designers working in Germany, India and China. The findings can be useful for companies working with designers from other cultures. There are, however, limitations regarding the number of cases which can be observed and the number of countries which can be covered within the research project. This research project is therefore intended as an exploratory study, on which further studies can build. Such further studies could also involve investigations in practice to avoid the limitations of the laboratory setting chosen thus far.

Note

The term 'culture' in this research denotes the culture of a country. Regional cultures, corporate culture or project culture are not considered.

Acknowledgements

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