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Cultural factors influencing creativity in product development: an exploratory study

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ABSTRACT

One of the challenges that influences all steps toward innovation is creativity. Human creativity is influenced by various factors, some of which fall into the category of culture. The primary goal of this contribution is to design an exploratory study that enables an initial observation and collection of parts of these influencing factors based on an existing impact model. A preliminary study with two parts, one for the participants' own perspective and one for the participants' observations of multicultural teamwork, is carried out, followed by the main study focusing on the influencing factors and barriers of culture on creativity in distributed product development teams. The results are analyzed in detail, largely confirming prior findings in the literature while also showing potential additional connections among the influencing factors. The results are used to further develop an impact model, confirming the relevance of cultural influencing factors on creativity and the need to perform further research to understand the influencing factors and their connections better.

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Creativity; cultural influencing factors; distributed product development; multicultural teams; intercultural teamwork

1. Introduction

Distributed work settings are the reality of many of today's product development teams, reflecting the broader trends of globalization, digital transformation, and the increasing complexity of engineering projects (Zukunftsinstitut, 2023). These distributed teams, often composed of members from diverse cultural, linguistic, and disciplinary backgrounds, operate across geographical and temporal boundaries. While such configurations offer numerous advantages, they also introduce a range of challenges. One major challenge is creative problem-solving (Brucks & Levav, 2022). Creativity is needed for successful engineering projects, leading to innovations and, therefore, a key driver of economic success in engineering contexts (Beuthel et al., 2002). It enables teams to generate novel ideas and solutions and adapt to changing requirements and environments. The creativity desperately needed for successful engineering projects is influenced by various factors, including aspects related to culture (Herbsleb et al., 2000). Cultural influences shape the way

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individuals think, communicate, solve problems, and collaborate, the core processes that are behind creative problem-solving. As such, understanding the cultural dynamics within distributed product development teams is essential for enhancing their creative potential (Bergström & Törlind, 2007; Landes et al., 2022; Ocker, 2005).

The factors influencing creativity in distributed product development have been categorized, and twelve factors have been identified within the culture category. Some of these factors influence creativity negatively and are therefore the barriers: language differences, different expectations, different conflict-solving, and more general cultural differences (Bastian, Kassem, et al., 2023). Language differences, for instance, hinder communication and increase the risk of misunderstandings, which can reduce team efficiency and effectiveness (Ivanaj & Bozon, 2016). This barrier is often stronger in distributed settings, where nonverbal cues, such as body language, are more difficult to interpret, further impeding mutual understanding. Conflict resolution is another area in which cultural differences can create barriers. Teams composed of members with varying approaches to handling disagreements may struggle to solve upcoming conflicts, which can delay decision-making and impede team climate (Wallace, 2019).

Despite these challenges, cultural factors can present significant opportunities to enhance creativity. The category of culture encompasses not only barriers but also a range of success factors: heterogeneity, diverse backgrounds, organizational culture, geographical distance, social and psychological dispersion, and cultural differences viewed as an advantage (Bastian, Wasserbäch, et al., 2023). Heterogeneity and diversity lead to different perspectives, which can stimulate creative thinking and, therefore, enhance the idea-generation process (Chamakiotis et al., 2010). Team members from different backgrounds bring unique experiences and cognitive frameworks, enabling richer interpretations of problems and more varied responses to creativity techniques (Bergström & Törlind, 2007). Additionally, geographical distance, often seen as a logistical challenge, can be an opportunity to access top talent internationally, thereby enriching the team's creative capacity (Walter et al., 2016).

This contribution aims to show the existence of the cultural influencing factors, both barriers and success factors, that can affect creativity in distributed product development teams that have previously been found in literature. Our findings confirm prior research while giving hints for potential new connections among influencing factors that were not previously captured in the impact model used in this study. These insights are used to refine the existing model that is supposed to be always updated and refined to show as many of the potentially relevant factors as possible. This way, it can be used by practitioners to find influencing factors to work on to potentially improve intercultural creativity in their teams. At the same time, the results indicate that further research is needed to find out more about the factors. The case study presented in this research does not aim to validate the entire impact model but rather to demonstrate the presence of some of its influencing factors in practice. The research is focused on culture-related influences on creativity. Study participants should have experience with distributed collaboration, as this is a relevant context for many product development teams. However, this study does not claim to specifically test the effectiveness of such settings. For studies on the effectiveness and targeted support of distributed settings, we refer to the state of the research in Section 2.2. Distributed collaboration is therefore treated as an

environmental factor, and experience with it is collected to ensure that participants have it.

The revised model provides a valuable starting point for organizations seeking to improve creativity in distributed teams. By identifying and addressing potential cultural barriers while highlighting cultural strengths, the model offers practical guidance for enhancing creative performance. This is achieved by providing a comprehensive set of factors that may act as barriers within an organization, or that could be enhanced to increase a team's creative potential. Moreover, the high degree of interconnectivity among the influencing factors in the culture category suggests that targeted interventions in one area may yield broader benefits across the team's creative processes. These interdependencies offer promising opportunities for strategic initiatives to improve creativity in globally distributed product development teams. To achieve the goal of the impact model, this contribution does not aim to provide comprehensive validation of the existing and newly added factors, but rather to empirically explore their presence.

2. State of the research

2.1. Creativity and innovation in product development

Innovation can be understood as the process of transforming new ideas into procedures, practices, and products, according to Anderson et al. (2014). Within their definition of innovation, the creativity needed to generate new ideas is directly linked to innovation. First, the creativity phase leads to the generation of ideas, and the innovation phase follows, in which the new ideas are transformed into procedures, practices, and products (Anderson et al., 2014). Therefore, creativity is part of a specific process step on the way to innovation.

According to Albers et al. (2018), innovation is the result of three elements: a product profile that describes the need for an invention, the invention itself, and its successful introduction to the market. Only after all three elements of the process are achieved can the outcome be considered an innovation. Therefore, it is only possible to know if something is an innovation retrospectively. Within this understanding of innovation, creativity is needed for every single element of the innovation process (Albers et al., 2018).

Creating potential innovations is the goal of product development processes. Product development comprises various activities that combine different disciplines from, for example, operations management to knowledge management and financial management (Albers et al., 2016; Browning et al., 2006). During the process, the developer needs to consider the various requirements and constraints that are often unclear at the beginning and are continuously concretized as the process progresses and information is collected (Albers et al., 2016). Product design can be seen as a combination of activities in the product development process that are focused around the customer needs and derive how the product should look based on these needs (Albers et al., 2016; Bloch, 1995). The entire product development process can be seen as a part of product engineering (Albers & Gausemeier, 2012). Product engineering describes the entire process from the product idea to the start of production and comprises the main elements: strategic product planning, product development, and production system development (Albers & Gausemeier, 2012). In this contribution, the focus is on product development, as the

state of the research it is based on has this focus. The results of this study can be considered for the entire product engineering process in further studies.

Stein (1953) offers a definition of creativity that has been widely used as the basis for further definitions. He describes creativity as the generation of something novel and recognized as useful by a group at some point in time. Novelty refers to the creation of something that has not previously existed in this form, usually arising from the recombination of existing knowledge with new elements. This process is marked by divergent thinking, which generates multiple solutions in a non-linear manner (Alahuhta et al., 2014; Elliot & Nakata, 2013; Ocker, 2005). Creativity, in its general definition, is not limited to product engineering. It serves as a catalyst for social progress and prosperity (Deigendesch, 2009; Taylor, 2021; World Economic Forum, 2021) and is shaped by cultural contexts (Kwan et al., 2018). The importance of creativity for societal development is widely accepted. For example, the European Union designated 2009 as the European Year of Creativity and Innovation to foster creativity and innovative capacity more broadly (European Parliament and Council of the European Union, 2008). Despite its widespread use and acceptance, there is no single, consolidated definition of creativity in the literature (Runco & Jaeger, 2012). Therefore, we use the widely accepted definition by Stein as the baseline for this contribution, understanding a creative outcome as a novel work that is recognized as tenable, useful, or satisfying by a group at a certain point in time (Stein, 1953). Based on this understanding, technical creativity was defined as targeted creativity to create something novel through analysis and synthesis (Albers et al., 2025). Technical creativity requires motivation, expertise, experience, and imagination. Technical creativity in product engineering refers to the analysis and synthesis used in all elements of innovation (Albers et al., 2025). Given the relevance of creativity to product development, understanding its determinants is essential for identifying effective ways to enhance it. The determinants for technical creativity, especially experience, are partially considered as tacit knowledge that can not be fully articulated or documented (Polanyi, 1967). This needs to be considered in the analysis of the results and discussion, as experience is a determinant for technical creativity that is very individual and additionally influenced by individual culture and context (Albers et al., 2025; Fuchs, 2001; Nonaka & Takeuchi, 1995; Polanyi, 1967).

2.2. Influencing factors on creativity in (distributed) product development

Creativity in (distributed) product development is influenced by a multitude of factors. *Distributed* as a description of the setting in which the product development process takes place is added in parentheses. The reason for this is that factors caused by the specific needs in distributed settings are considered additionally. To better understand this variety of influences, different categorizations have been proposed in the literature. Ocker (2005) proposes a categorization of individual and team-related factors. Abi Saad and Agogu  (2023) introduced an additional separation of the factors into leadership and technology categories. Furthermore, an organization-related category has been added (Chamakiotis et al., 2010).

In the literature-based research conducted by Bastian, Wasserb ch, et al. (2023), the categories culture and time have been added to the existing categorizations, leading to a total of seven categories mapped in an impact model (Bastian, Wasserb ch, et al., 2023).

This literature search was carried out to collect the various influences that are spread across the literature of different domains and start a model that brings the factors together, one literature review focusing on the success factors and one focusing on the barriers (Bastian, Kassem, et al., 2023; Bastian, Wasserbach, et al., 2023). The model has been developed further, and 72 success factors and 47 barriers to creativity in distributed product development have been found, with a variety of connections between individual factors and between the categories (Bastian, Kassem, et al., 2023). A total of 12 factors fall into the category of culture, making it an attractive field of influence to look into in more detail (Bastian, Kassem, et al., 2023; Bastian, Wasserbach, et al., 2023). Figure 1 shows the model impact model in its version prior to the research efforts of this contribution.

This contribution does not aim to present all 72 success factors and 47 barriers, but rather focuses on those that fall within the category of culture.

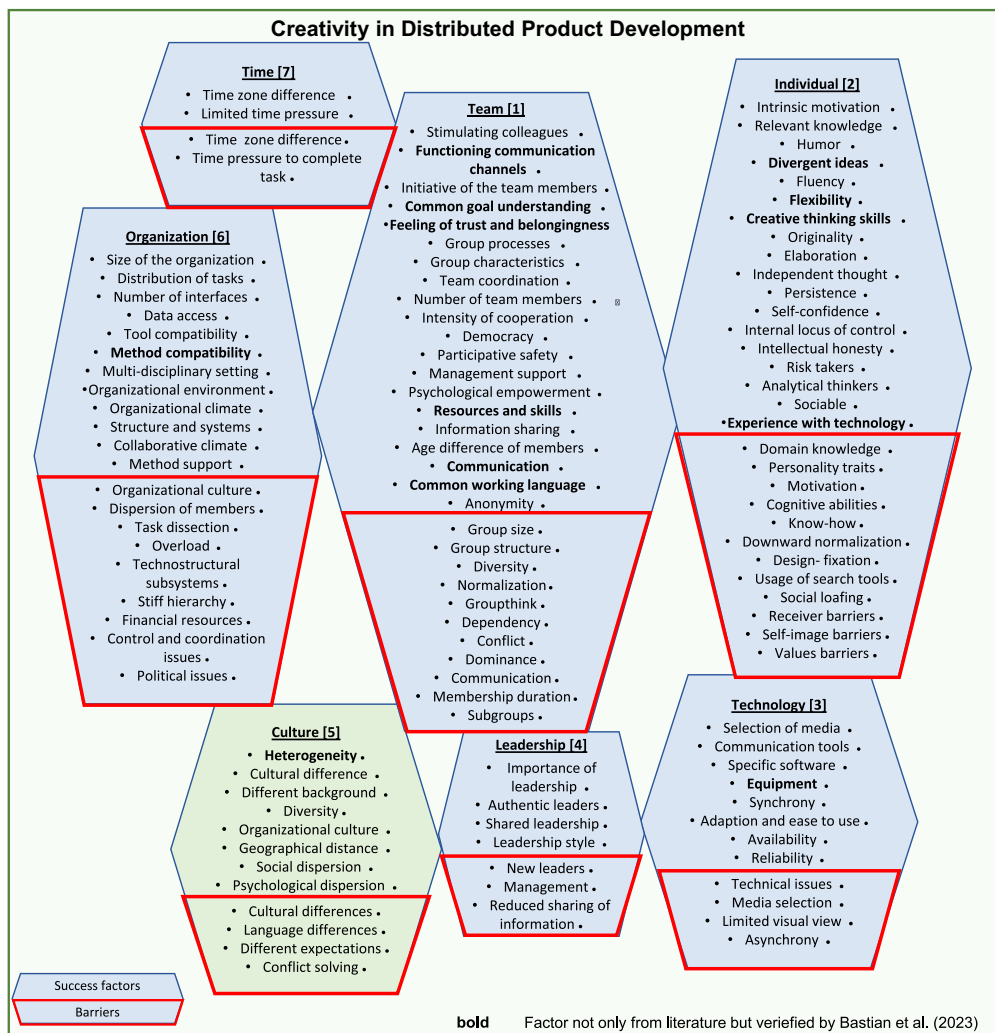


Figure 1. The impact model with barriers and success factors influencing creativity in (distributed) product development (Bastian, Kassem, et al., 2023; Bastian, Wasserbach, et al., 2023).

To ensure that the model includes all relevant influences on creativity in distributed product development, the literature must be screened continuously, and the existence of newly identified factors must be demonstrated through case studies. Without this procedure, the model's claim to collect all influences in one place cannot be fulfilled. An impact model that is updated on a regular basis can be a starting point for practitioners looking to improve the creative performance of their engineering teams.

An additional literature screening identified factors that may be relevant to the model. For this screening, current publications have been used as a basis for a snowballing procedure (Wohlin, 2014) revealing the factors, prejudices, ethnocentrism, and different time orientations. This contribution demonstrates the presence of influencing factors in the category culture in a case study and provides an initial idea of the relevance of the potential new factors for this category.

2.3. Models for understanding the concept of culture

A multitude of definitions exist for the concept of culture (Müller & Gelbrich, 2016). Williams (1976), who is now considered the founder of cultural studies, described the term culture as one of the most complicated words in the English language. Instead of providing our own definition, this contribution uses an open understanding of culture based on an analysis of various concepts of culture by Nünning (2009). This understanding encompasses the factors that influence individuals at the center of product development. Accordingly, culture encompasses the implicit assumptions people hold about what they consider self-evident. Culture is expressed in how people act and interact. Furthermore, culture encompasses collectively shared beliefs, lifestyles, and knowledge acquired through socialization and serves as the basis for a society's distinct identity.

To better understand, describe, and grasp what lies behind the term culture, different models have been developed with different approaches and different focuses (Müller & Gelbrich, 2016). Three popular models for understanding and describing cultural differences are presented in greater detail here, as they have been used to inform the questionnaires that assess the cultural factors described in Section 3. Hofstede's model of cultural dimensions is a model for describing cultural differences between countries and is based on an extensive study in which five dimensions characterize cultures: power distance, uncertainty avoidance, individualism versus collectivism, masculinity versus femininity, and short- vs. long-term orientation (Hofstede, 2001). After the initial data collection took place in the 1980s, a sixth dimension, indulgence vs. restraint, was added by Hofstede himself and Michael Minkov in 2010 (Hofstede et al., 2010).

Power distance describes the way people view power and authority (Hofstede, 1980). Cultures with low power distance allow everybody to voice an opinion and participate in discussions. In high power distance cultures, decisions are made by individuals in higher positions, and this unequal distribution of power is accepted as the norm.

The dimension of individualism versus collectivism describes whether the focus is on perceiving oneself as the central unit or perceiving the group as the central unit (Hofstede, 1980). Highly individualistic cultures prioritize personal goals and rights, whereas collectivistic cultures focus on society, loyalty to a group, and collective well-being. Examples of more individualistic cultures are the UK, the United States, Canada,

France, and Germany, and for collectivistic cultures China, Japan and South Korea (Geert Hofstede, 2021; Hofstede, 1980).

The dimension of masculinity versus femininity describes the values that predominate in a culture (Hofstede, 1980). Masculine cultures emphasize personal achievement, material rewards, and success, while feminine cultures emphasize collaboration, caring for one another, empathy, and quality of life.

The dimension of uncertainty avoidance shows how well a society deals with the unknown (Hofstede, 1980). Cultures that lean toward high uncertainty avoidance minimize risks, for example, through strict regulations and laws. Low uncertainty avoidance is characterized by accepting unknown aspects of life and valuing flexibility.

The short-term versus long-term orientation describes a society's focus on either the future or the present (Hofstede, 1980). Long-term oriented cultures think about the future, act pragmatically, and are modest. Short-term-oriented cultures respect traditions and focus on quick results. China and Russia are considered long-term oriented, while, Ghana, Nigeria, and Sierra Leone are considered more short-term oriented (Geert Hofstede, 2021).

The dimension of indulgence versus restraint shows whether a culture prefers to enjoy life freely or to limit enjoyment and follow strict social norms (Hofstede et al., 2010). Cultures oriented toward indulgence tend to fulfill their desires and enjoy life freely, whereas cultures oriented toward restraint follow strict and controlled social norms.

Through the dimensions, insight into different aspects of the value system within a culture can be gained (Hofstede, 1980). The dimensions are not to be seen as black and white, but as a spectrum on which people's behaviors can be allocated (Hofstede, 1980). The model can be used to understand cultural differences and various behaviors of people from different cultures (Hofstede et al., 2010).

Hall and Hall (2014) cultural theory is used to explain cultural differences in communication and the understanding of messages, as well as the different time and space orientations in different cultures (Lavrits, 2022). Communication types and styles that differ in different cultures are detailed by Hall and Hall (2014). The relevance of context and examples of which culture needs which amount of context or which level of direct communication is further detailed by Lerchster and Heintel (2017). In German culture, communication tends to be relatively direct and explicit, meaning that most information is conveyed within the spoken or written message itself (Hall, 1959, 1977). As a result, Germany is generally considered a low-context culture. Further examples of low-context cultures are Northern European cultures, and Northern American Cultures (Hall, 1959). In contrast, in high-context cultures such as China, communication is often more indirect, and a significant part of the message is embedded in the surrounding context, relationships, and situational cues (Hall, 1959, 1977). Further examples of high-context cultures are Japanese, Arabic, and Southern European cultures (Hall, 1959). Therefore, understanding the message correctly often requires greater awareness of the context and the communication setting. Furthermore, context matters in non-spoken communication as well (Croucher et al., 2012). The differences in communication styles and types, as analyzed by Hall and Hall (2014), can result in frequent misunderstandings and make group collaboration more difficult (Huck, 2007). Time orientation is another element considered in the cultural theory (Hall, 1977). Monochronic cultures perceive time as linear (Hall, 1977). Time can 'run out,' therefore, it needs to be used effectively.

Punctuality and meeting deadlines are considered highly relevant in monochronic cultures (Hall, 1977). Examples of monochronic cultures are Germany, Switzerland, and the United States (Hall, 1977). On the other side of the spectrum are polychronic cultures. They perceive time as cyclical and have a more flexible view of deadlines (Hall, 1977). Examples of polychronic cultures are countries in Latin America and the Middle East (Domning et al., 2009; Hall, 1977).

The Multicultural Input-Process-Output (MIPO) model by Köppel (2007) examines cultural differences at the personal rather than the national level, focusing on cultural synergies and conflict. The MIPO-model functions as a process-management instrument that reveals possible conflicts and complementary relationships within a team (Köppel, 2007). It is built on three components: external structures that provide the inputs, internal group interactions that constitute the process, and the resulting effectiveness as the output (Köppel, 2007). By cultivating psychological safety, the model creates a setting in which creativity and the sharing of ideas are encouraged. Recognizing a team's strengths and weaknesses allows for more effective task allocation and the optimal use of individual abilities (Köppel, 2007, 2020).

Culture can be understood as a dynamic construct that continuously evolves and adapts over time, for example, through interaction and contact with other cultures. Consequently, the values, norms, and behavioral patterns associated with a culture may change over time (Meyer, 2004; Samovar & Porter, 1997).

With the multitude of influences on creativity, especially in the category of culture, the focus is now on further exploring the existence of influencing factors previously found.

For this reason, the factors within the culture category of the impact model developed by Bastian, Kassem, et al. (2023), including related factors and potentially new ones, are used to initially validate and extend the existing model. Through this research, potential starting points for more detailed future studies can be identified, and the impact model can be further refined. This contributes to achieving the impact model's goal of serving as a regularly updated reference for assessing potential influences on creativity in distributed product development teams, helping to overcome barriers and support the success factors.

3. Research profile

3.1. Research goal and questions

The goal of this contribution is to explore the factors influencing creativity in distributed product development that can be attributed to the cultural category, and to propose the inclusion of additional identified factors. Therefore, a questionnaire-based study with two phases is carried out. The basis for this study is the impact model by Bastian et al. (Submitted for Publication 2026). Factors in the category culture are observed, and potential additional factors for this category are proposed and evaluated by the survey participants.

To achieve this goal, the following research questions have been derived:

- RQ1: How can the influencing factors in the category culture on creativity in product development be empirically explored?

- RQ2: Which previously identified cultural influencing factors on creativity lead to success, and which aggravate the creative problem-solving of the multicultural teams observed?
- RQ3: Can initial connections be observed between the different influencing factors in these teams?

3.2. Research approach

The research approach is based on the Design Research Methodology (DRM) by Blessing and Chakrabarti (2009). Figure 2 shows the research approach, including the tasks performed, the DRM stage, and the results achieved for each stage. Which research question is going to be answered in which stage is made clear in the results section.

Research Clarification: This stage involves establishing a fundamental understanding of the relevant concepts (see Section 2). Based on the results of the literature review, the second step involves describing the current and desired situations. This includes formulating and refining the research questions presented in Section 3.1.

Descriptive Study I: The focus of the second stage of the research process is on gaining a deep understanding of the research already performed to design a suitable research process for the contribution. The aim is to show the existence of the factors within the current impact model of cultural influences on creativity in distributed product development teams through a case study (Bastian, Kassem, et al., 2023; Bastian, Wasserbäch, et al., 2023). The study design is planned to demonstrate the influencing factors within the category culture of the model through a preliminary and main study. Furthermore, the research questions are refined, and data collection and analysis are carried out. The preliminary study, as described in Section 4, was conducted by experienced mechanical engineering students. The main study is carried out with young, promising professionals

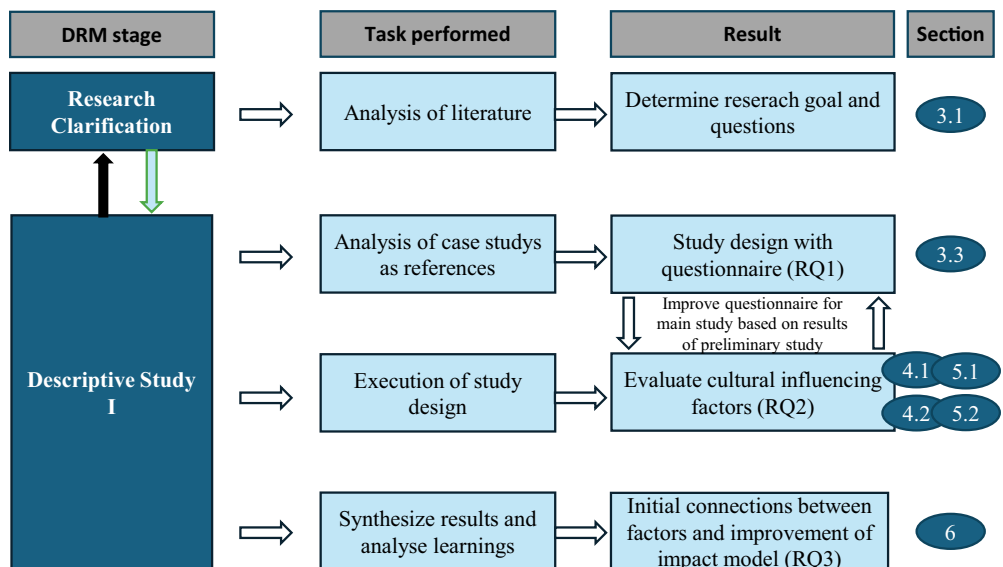


Figure 2. Research approach including task performed, DRM stage, and result for each stage.

in product engineering, all of them with a focus on product development activities (Section 5). The findings from the preliminary study are used to iteratively refine the main study design.

Finally, the results of the conducted studies are evaluated and analyzed. The findings are then summarized and documented in the final Section of this contribution.

3.3. Research environment

3.3.1. Preliminary study

The preliminary study was designed for participants studying mechanical engineering in higher semesters who work as tutors for intercultural teams in the field of product development and have above-average experience in product development. These requirements correspond to the qualifications for tutors in the course 'Mechanical Design,' which include an above-average grade in the course and completion of the basic courses in the mechanical engineering bachelor's program. The Mechanical Design course consists of lectures and practical components delivered through weekly workshops. In the practical sessions, engineering problems must be solved creatively. Students work in stable subgroups throughout the semester. These teams are supervised by the tutors. Tutors therefore have experience both as former team members and as observers and supervisors. Most tutors remain in their roles for multiple semesters.

The survey design was based on the influencing factors of the culture category identified in the impact model (Bastian, Kassem, et al., 2023; Bastian, Wasserbäch, et al., 2023). The survey began with demographic questions to capture participants' cultural backgrounds. It then consisted of two parts: the first addressed participants' experiences with intercultural collaboration in engineering and product development, and the second focused on their observations as supervisors of intercultural teams in engineering design workshops. This structure helped participants distinguish between these two perspectives. The survey used in the study is provided in Annex A.1 in the original language (German) and in Annex A.2 translated into English.

The survey was sent to 44 tutors via e-mail. In addition, a link to the survey was displayed in the tutors' meeting room during biweekly on-site meetings. A total of 26 tutors responded. Of these, 16 completed the survey in full and reported either personal experience with colleagues from different cultural backgrounds or supervision of intercultural teams. Responses were excluded when participants indicated uncertainty about the cultural diversity of the supervised teams. Therefore, only valid responses were included in the final analysis. The results are based on 12 statements regarding participants' observations and 8 statements concerning their personal experiences.

The survey required approximately 20 minutes to complete. Half of the participants were from Germany, with one participant each from Ukraine, Russia, and Iraq. In addition, one participant identified with German-Polish culture, one with German-Irish culture, and one participant grew up in China and identifies with Malaysian-German culture.

3.3.2. Main study

The participants of the main study are young, promising professionals in product development and participants in the Master's program 'Management of Product

Development’ and have at least two years of practical experience. This master’s program is designed for high potentials in companies who want to pursue further education whilst on the job. High-potential employees are selected by the employer and offered the opportunity to participate in such a program. The program not only includes theoretical courses but also company visits abroad and a team-based creative problem-solving task across the course modules. The participants have experience with teamwork in their individual roles within their companies and as a team during the course. Therefore, this study benefited from working with real teams rather than artificially composed ones, as the supervised environment enabled close collaboration. This way, the probability that participants answered with what they really think rather than what they think are the socially desired answers to a somewhat critical topic increased.

The survey begins as in the preliminary study, with a few demographic questions to ensure that participants are not all from the same culture. [Table 1](#) shows which cultures the participants identify with.

The demographic questions are followed by questions about participants’ experience in multicultural and distributed team settings to determine whether they have been part of such settings. The survey consists of two parts (see Annex A.3). The first part asks about the cultural success factors of creativity in distributed product development. The second part asks about cultural barriers to creativity in distributed product development. One notable improvement after the preliminary study was the inclusion of detailed information on previously unclear influencing factors. Additionally, the study design was consolidated into a single part, as the participants simultaneously undertake roles of supervision, participation, and management of intercultural teams in their daily tasks.

The survey was sent to all students in this Master’s program and was returned by all of them. The participants in the main study, therefore, have no overlap with those in the preliminary study. It consisted of twelve questions, four of which were closed-ended, and the rest were semi-open. For all semi-open questions, there was the possibility to write a comment or an addition. The survey took approximately 20 minutes to complete. The survey was created and conducted using the online survey tool LimeSurvey (*LimeSurvey - Free Online Survey Tool*, 2024). Since all eight young, promising professionals in product development participated in the survey and completed it in full, the following findings are based on their eight responses.

All participants reported working with colleagues from other cultures. In addition, the participants come from different countries and cultures. Four

Table 1. Participants and the culture they identify with.

Participant 1	Mexico
Participant 2	Germany
Participant 3	Europe
Participant 4	China
Participant 5	India
Participant 6	Germany
Participant 7	India
Participant 8	Europe

participants are from Europe, two are from India, and one each from China and Mexico. Furthermore, all participants stated that they work in (partially) distributed teams.

The decision to conduct both a preliminary study and a main study was driven by the limited number of potential participants for the main study. The participants in the main study represent the intended target group of users who may apply the impact model in their teams. However, this group accessible through the course consists of only eight individuals. Even if all of them participate, the sample size remains very small. Participants from company contacts will be recruited for further studies to delve into the details of the influencing factors, but were not the focus of this initial study. To make the best possible use of the insights this group could provide, we aimed to present them with a questionnaire that had already been tested. Therefore, a preliminary study was conducted. The questionnaire was distributed to tutors of the ‘Mechanical Design’ course, who may represent the target group in the future but who currently do not yet possess the same level of experience as the actual target group.

Their responses were used to (a) refine and improve the questionnaire and (b) obtain initial indications regarding the relevance of the influencing factors under investigation. Since the participants in the preliminary study have personal experience from their teamwork task within the course and experience from observing the team they are tutoring, we split the preliminary study in a part concerning their personal experience and a part concerning their experience from observing. This was not necessary for the main study.

3.3.3. Limitations

For this study, attention needs to be paid to the number of participants. In the preliminary study, there were 12 samples of participants’ observations and 8 of participants’ own experiences, out of 44 potential participants in the tutor pool. In the main study, 8 of 8 potential participants enrolled in the course for young professionals in the specific master’s program relevant to our research. Based on the discussion by Sim et al. (2018) the author team acknowledges that research efforts based on personal experiences have limited generality, meaning the transfer to future studies, even if designed similarly, is not fully possible in a new context, in our case, meaning a new test group outside of our test group’s clear boundaries. Although we recommend research in other settings, the limited generalizability should be acknowledged, given the study’s individuality. Furthermore, the diversity of the participants needs to be considered. When participants are treated as individuals taking the same course with similar practical experience, they are perceived as homogeneous, thereby requiring a smaller sample size. When considering the same participants across cultural backgrounds and differing upbringings and experiences, they can be seen as heterogeneous, thereby calling for a larger sample size. We do not want to argue that our sample size is optimal, as sample sizing for qualitative studies is a highly contentious topic. We aim to inform the reader fully, giving them the opportunity to evaluate the potential of this study independently. We consider this a starting point for further research that demonstrates the presence of cultural influencing factors in our sample within the case study, indicating that it is worthwhile to continue investigating these factors and further improving the model.

4. Results of the preliminary study

This section shows the results of the preliminary study only. The results of the main study can be found in Section 5. Section 4 is divided into three parts: Section 4.1 presents the participants' own experiences, and Section 4.2 presents the participants' observations in multicultural teams, followed by a summary.

4.1. Part I: participants' own experiences

In this part of the survey, responses from 8 participants were included, as 5 indicated they had no personal experience working with intercultural colleagues. 3 of the 8 participants stated that their collaboration in intercultural teams was partly virtual. To gain insights into the culturally influenced factors, participants were presented with a comprehensive list of different factors and their descriptions (Table 2). The factors were presented in a neutral manner, rather than as barriers or success factors. Through this approach, it was ensured that participants could make their choices without being biased by the formulation. This was important because some factors can be seen as both barriers and success factors, and some may be considered more on one side or the other due to personal experiences. In this question, we sought to ensure that participants could share their personal experiences without the influence of prior categorization of the factors. They were asked to indicate whether these factors had a positive or negative impact on their creativity when working with international colleagues. Additionally, there was a third option: 'No statement possible due to no experience with this influencing factor.' The list included 10 factors that are either directly culturally determined or closely related to culture. However, only 6 of these factors are considered below, as most participants reported no experience with *intercultural conflict* and *cultural differences*. Two additional factors, *different approaches to conflict resolution* and *different languages*, are not

Table 2. List of influencing factors shown to the participants.

Heterogeneity (Chamakiotis et al., 2010): This factor refers to differences within a community, group, or society. These differences can relate to general attitudes, political views, and personal characteristics.
Different types/styles of communication (Hall & Hall, 2014; Hofstede et al., 2010): People from different cultures communicate differently. In some cultures, communication is an indirect process based on non-verbal signals. In other cultures, communication is a direct process that focuses on words.
Diversity (Toerlind et al., 2005): The focus here is on the diversity of cultural traditions, backgrounds and gender identities.
Different leadership styles (Hofstede et al., 2010): In some cultures, managers and employees are more equal. Decisions are made at lower levels, and managers give clear instructions. Communication is direct and precise. In other cultures, the hierarchy is very pronounced. Decisions are made by managers, and employees have little influence. Managers are authoritarian, and communication is indirect and context-dependent.
Different expectations (Köppel, 2009): The cooperation of intercultural team members is influenced by different ideas and expectations with regard to aspects such as punctuality, flexibility, group harmony, leadership, and working methods.
Intercultural conflicts (Köppel, 2007): Such conflicts arise because of the different cultures and are due, for example, to cultural misunderstandings.
Different approaches to conflict resolution
Different time orientations (Hall, 1977): In monochronic cultures, time is a linear commodity that should be used efficiently. Punctuality and adherence to deadlines are important. In polychronic cultures, time is a cyclical good that can be used flexibly. Punctuality and adherence to deadlines are less important.
Different languages
Cultural differences (Hu et al., 2017; Walter et al., 2016): A certain degree of identification with the group is crucial for forming a common consensus.

considered in the evaluation due to a lack of description and source information. The missing explanation for these factors was identified only after participant feedback. These factors require evaluation in a follow-up study.

The participants evaluated the factors as follows:

Heterogeneity and diversity: 4 participants reported experience with heterogeneity and noted its impact on creativity. Regarding diversity, all five participants with experience in this area reported that it has a positive impact.

Different expectations: 6 participants perceived the impact of different expectations on their creativity negatively; one participant reported the opposite; and one participant had no experience with different expectations.

Different types/styles of communication and different time orientations: Participants were asked to evaluate the influence of each factor, separately, using the descriptions provided above. However, the results of the evaluation of both factors are identical. Therefore, they are presented together here. 4 participants stated that these factors negatively influence their creativity. 3 participants had a positive effect, and one participant had no experience with either factor. The result was partly surprising, as the literature indicates that both factors can negatively influence cooperation in intercultural teams.

Different leadership styles: Half of the participants reported no experience with the influence of different leadership styles; the other half reported a positive influence.

The negative influence of prejudices and ethnocentrism was also highlighted in the literature (Köppel, 2007) but was not included in the model designed by Bastian, Wasserbäch, et al. (2023) and Bastian, Kassem, et al. (2023). Köppel (2007) explain the effect of prejudices and ethnocentrism through their effect on the team members' attitudes and behavior within the team. The behavior of considering others as outside the group and treating them differently harms team processes and hinders open communication (Köppel, 2007). Creative problem-solving processes are therefore negatively influenced by the effects of prejudices and ethnocentrism within the team. To determine whether these factors are considered relevant by the study participants and should therefore be included in the model, the following question was asked. The participants were presented with a description of the two factors and asked to express their opinions on the statements presented in the diagram below (Figure 3).

4.2. Part II: participants' observations in multicultural teams

In this section, the influencing factors were presented in more detail and with greater precision to avoid misinterpretations. A differentiation between culture-related success factors and barriers was also ensured here. In the first question in this section, 12 participants reported having managed intercultural teams on multiple occasions. In addition, participants were informed that the following questions should address their observations of professional and methodological competence, as well as skills such as creativity, teamwork, and assertiveness within these groups. To investigate observable culture-related barriers, the 12 participants were given an extensive list (Table 3) of culture-related barriers and their descriptions, developed from the literature. Descriptions of the individual barriers are presented in Table 3, along with their associated sources.

Ethnocentrism and Prejudices from the Participants' Perspective n=8



Figure 3. Impact of ethnocentrism and prejudice in multicultural teams.

The participants were asked to select the barriers that they had observed in the intercultural groups. Figure 4 illustrates the participants' responses to this question.

Subsequently, two participants highlighted the influence of language differences and noted that this affected the communication and self-confidence of the observed students, further constituting a barrier.

The question 'Which of the following ideas do you consider sensible to overcome culture-related barriers in intercultural teams?' was then asked. In response to this question, participants emphasized the importance of intercultural competence for both team members and managers. Managerial support was considered particularly important. In addition, participants emphasized the importance of language support and viewed improved handling of prejudice and ethnocentrism as beneficial.

Finally, an extensive list of culture-related success factors and their descriptions was presented to the participants to gain insights into the success factors they experienced (Table 4).

Figure 5 shows the results of the observable success factors based on the experiences of the participants.

Table 3. List of individual barriers.

Different time orientations (Hall, 1977): This could be reflected in project planning and implementation, for example. In monochronic cultures, time is a linear commodity that should be used efficiently. Punctuality and adherence to deadlines are important. In polychronic cultures, time is a cyclical commodity that can be used flexibly. Punctuality and adherence to deadlines are less important.
Different types/styles of communication (Hall & Hall, 2014; Hofstede et al., 2010): Communication styles differ considerably depending on the culture. Such differences can lead to misunderstandings and make cooperation in the group more difficult.
Different leadership styles (Hofstede et al., 2010): This could be reflected, for example, in the acceptance of feedback. In some cultures, direct feedback is rather undesirable and could be hurtful; indirect feedback is preferred.
Trust and belonging (Köppel, 2007; Werner & Steiner, 2022): Cultures give their members a sense of belonging and security (Werner & Steiner, 2022). This makes it easier to build trust between members. In intercultural groups, however, it can be more difficult to build trust and create a sense of belonging (Köppel, 2007).
Different languages (Köppel, 2009; Seus, 2020; Verburg et al., 2013; Wessely, 2012): Conflicts and misunderstandings due to differences in language, communication style, and interpretation of messages can lead to errors, delays, and lower productivity and effectiveness. As a result, essential prerequisites for creating a basis of trust, which is necessary for good creative performance, are missing.
Intercultural conflicts (Hall & Hall, 2014; Hofstede et al., 2010; Köppel, 2007): Conflicts can occur more frequently in intercultural groups. These conflicts can be based not only on different cultural values and norms but also on culture-related misunderstandings and different expectations.
Conflict solving (Hofstede et al., 2010; Köppel, 2007): Resolving conflicts in teams made up of employees from different cultures requires more time and a variety of perspectives and approaches. Depending on the culture, there are different approaches to conflict resolution. These differences can make conflict resolution more difficult.
Prejudices (Gudykunst & Kim, 1992; Köppel, 2007): Simplified ideas about a social group that refer to general characteristics or behaviors of that group. These ideas are often not complete or correct, but they can still influence perceptions and behavior toward members of this group.
Ethnocentrism (Köppel, 2007): Ethnocentrism can also lead to impaired perception and information processing. The behavior and characteristics of people from other cultures are then often misjudged, often in a negative sense. This also affects the creativity of team members.
Different expectations (Köppel, 2009): The cooperation of intercultural team members is hindered by different perceptions and expectations regarding aspects such as punctuality, flexibility, group harmony, leadership, and working methods.
Cultural differences (Hu et al., 2017): Present an obstacle to developing a shared understanding of team roles and tasks, and different group identities can clash.

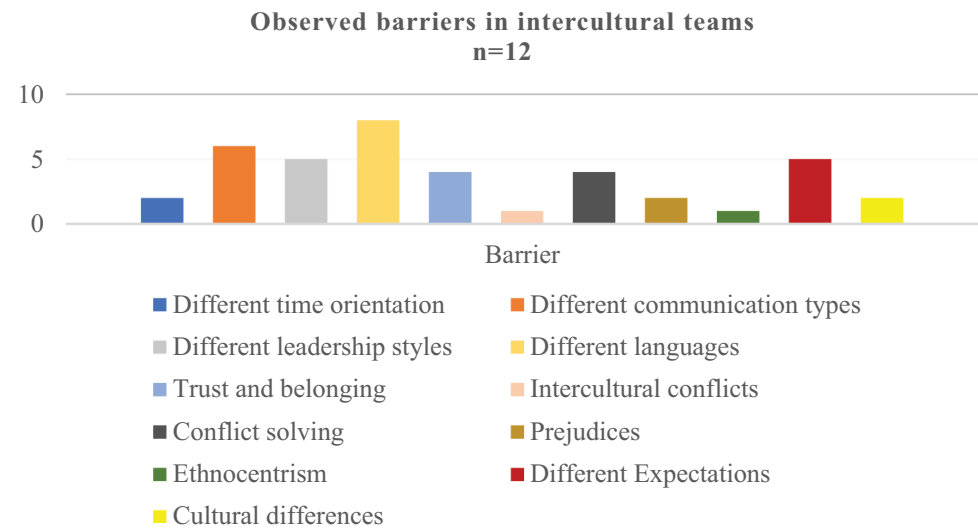


Figure 4. Presentation of results of observed barriers in the preliminary study.

Table 4. List of individual success factors.

Heterogeneity (Chamakiotis et al., 2010): The different perspectives in heterogeneous teams can increase the creative potential of a team.
Diversity (Toerlind et al., 2005): The focus here is on the diversity of cultural traditions, backgrounds, and gender identities. The different perspectives in diverse teams can increase the creative potential of a team.
Organizational culture (Andriopoulos, 2001; Chamakiotis et al., 2010): Based on the deepest level of fundamental values, with assumptions and beliefs shared by members of the culture. When individuals feel comfortable in the organizational culture, this can lead to more creativity.
Different background (Bergström & Törlind, 2007; Hu et al., 2017; Ivanaj & Bozon, 2016): Refers to the individual life paths and experiences that have shaped a person. These include origin, education, professional experience, and personal life events. People’s different backgrounds have a significant influence on their character, abilities, and social status.
Social dispersion (Ivanaj & Bozon, 2016): Refers to the diversity of the team members’ social backgrounds. Social diversity brings a broad spectrum of perspectives to a team, which expands the diversity of ideas and approaches and can, therefore, contribute to creative problem-solving approaches.
Psychological dispersion (Ivanaj & Bozon, 2016): These different perspectives, which are based on different psychological characteristics, attitudes, personality traits, and other internal aspects, can contribute to an increase in creativity within the team.
Cultural differences (Walter et al., 2016): These different backgrounds can have a positive effect on a team’s creativity, as they bring in a variety of opinions and perspectives. This results in many ideas and approaches that can lead to potential innovative solutions.
Geographical distance (Walter et al., 2016): Refers to the physical distance between different locations, especially in relation to the location of people, places, or teams. More and more specialists/experts are needed, and with distributed teams, there is the possibility of bringing them in from all over the world.

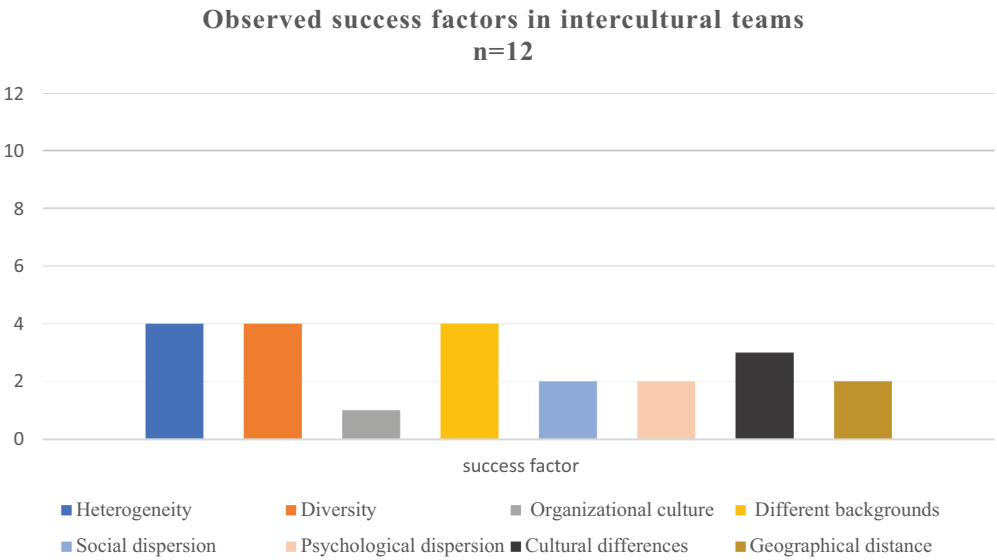


Figure 5. Presentation of results of observed success factors in the preliminary study.

4.3. Summary of the results of the preliminary study

- Success factors fully confirmed (all participants agreed):
Heterogeneity, diversity.
- Success factors partially confirmed (parts of the participants agreed):

different backgrounds, psychological dispersion, social dispersion, cultural differences, geographical distance, organizational culture.

Barriers partially confirmed (parts of the participants agreed):

different types/styles of communication, prejudice, different expectations, trust and belonging, Ethnocentrism.

Controversial (seen as positive by some participants and as negative by others for factors that have previously not been allocated to both categories, therefore do not have a definition as barrier AND as success factor):

Different Time Orientations was perceived as a negative influence by 4 participants, as a positive influence by 3, and as having no experience with the factor by 1. Among participants observing multicultural teams, 2 identified different time orientations as a barrier.

Half of the participants rated *different leadership styles* as a positive influence based on personal experience, whereas the other half had no experience with this factor. Among participants observing multicultural teams, 5 identified different leadership styles as a barrier.

Not fully evaluated (no clear categorization can be made due to limited/ incomplete data):

Different languages, intercultural conflicts, cultural differences, and different approaches to conflict resolution (conflict-solving).

5. Results of the main study

Section 5 is divided into three parts: Section 5.1 presents the results related to the barriers in the category culture, and Section 5.2 presents the results related to the success factors in the category culture, followed by a summary.

5.1. Culture-related barriers

In this section of the survey, participants were presented with culture-related barriers and their relationships with other influencing factors. First, participants were presented with different expectations regarding the barriers. Based on their experience, participants should indicate whether *different time orientations, leadership styles, and working methods* negatively affect creativity in intercultural teams. These influencing factors from other categories of influencing factors on creativity in distributed product development (Bastian, Kassem, et al., 2023), aside from culture, were selected because a connection to culture-related factors was suspected based on the literature review. Six of the eight participants found that both *different leadership styles* and *different working methods* negatively affect creativity when working together. Furthermore, half of the respondents perceived the influence of different time orientations similarly.

Since *communication types or styles* vary considerably across cultures, the participants were then asked to state their communication type or style using a semi-open-ended question. Seven of the eight participants reported communicating directly. One participant, on the other hand, stated that his communication is rather indirect. In addition, seven of the eight participants reported that nonverbal cues, such as vocal tone, body language, facial expressions, and eye contact, play an important role in their communication.

In the next question, *ethnocentrism*, *prejudice*, *intercultural conflicts*, and *conflict resolution* were explained (Table 5), and participants were asked whether these had negatively influenced their collaboration and creativity.

The participants’ responses to this question indicate that all four influencing factors negatively affect their creativity in product development. Figure 6 illustrates these results.

According to the impact model by Bastian et al., a *feeling of trust and belongingness* is a success factor that positively influences team creativity. However, this factor can be negatively influenced by culture in intercultural teams, as cultures give their members a feeling of belongingness and security (Werner & Steiner, 2022). This facilitates the development of trust among members. On the other hand, in intercultural groups, it can be more difficult to build trust and create a sense of belonging, as Köppel (2007) analyses as a potential source of conflict based on the MIPO model. Therefore, participants were asked whether they find it easier to build trust and a sense of belonging with colleagues from the same culture as they,

Table 5. List of the explanations given to the participants.

Conflict-Solving (Köppel, 2007): Different approaches to conflict-solving can impair the actual problem-solving process. If the different approaches clash and common ground cannot be found, this barrier impairs the creative process.
Intercultural Conflicts (Hall & Hall, 2014; Hofstede et al., 2010; Köppel, 2007): In intercultural groups, conflicts can occur more frequently. These conflicts can be based not only on different cultural values and norms but also on cultural misunderstandings and different expectations.
Prejudices (Gudykunst & Kim, 1992): Simplified ideas about a social group that refer to general characteristics or behaviors of that group. These ideas are often not complete or correct, but they can still influence the perception of and behaviors towards members of this group.
Ethnocentrism (Köppel, 2007): Seeing one’s own culture as more relevant or superior to others. This can lead to impaired perception and information processing. The behavior and characteristics of people from other cultures are often misjudged, often in a negative sense, which also affects the creativity of team members (Köppel, 2007).

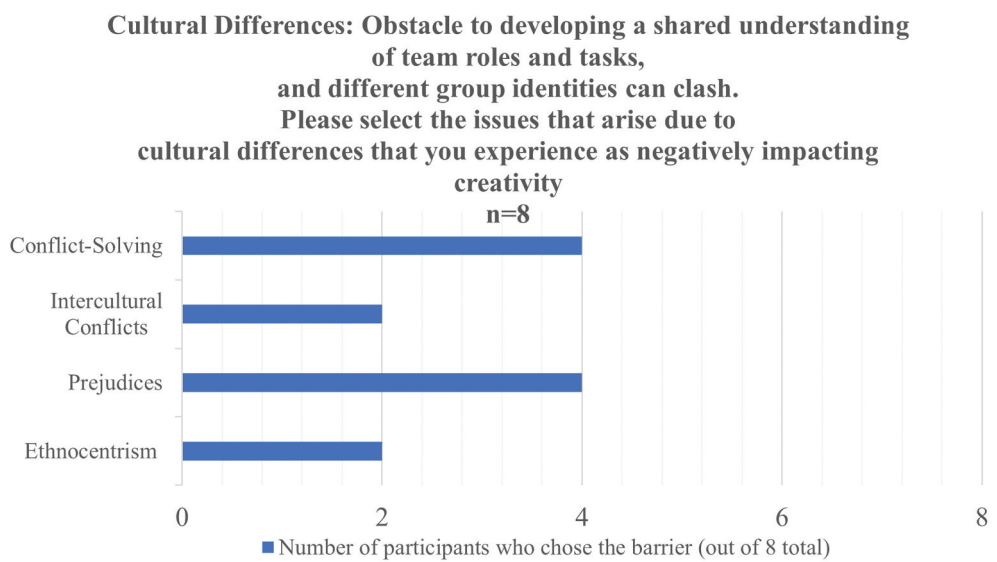


Figure 6. Other influencing factors and barriers that negatively influence the creativity of product developers.

compared with their cross-cultural colleagues. Opinions on this question were divided: half of the respondents agreed with the statement, while the other half disagreed. With the answers divided, the implications for improving process management according to Köppel (2007) The MIPO model is difficult to draw. The differences can be explained using the different dimensions by Hofstede et al. (2010). Participants from cultures with high uncertainty avoidance (Mexico) might find it harder to build trust with people from different cultures than those from countries with low uncertainty avoidance (China, India). Differences always bring uncertainty; therefore, it is more difficult for people from countries with high uncertainty avoidance to build trust with colleagues from different cultures. For participants who identified their origin as Europe rather than a specific European country, it is not possible to rank them according to the uncertainty avoidance index. Considering that they see themselves as residents of Europe, it gives the impression that they have rather lower difficulties in building trust and a sense of belonging with colleagues from other cultures (Hofstede et al., 2010).

The *Language Differences* barrier was also considered in this survey. This was explained to the participants, and they were then asked to what extent they experienced misunderstandings or conflicts arising from language differences when working with intercultural teams. Only one participant reported not having such experiences. All other participants reported misunderstandings or conflicts they experienced when working with intercultural teams due to language differences. For half of the participants, these problems occurred frequently, and for three participants, they occurred rarely. Differences in communication, under which the barrier of language differences falls, can be described using Hall's Cultural Theory (Hall, 1977; Hall & Hall, 2014). The manner in which communication is conducted and the communication channels used can be taken into account. To analyze communication differences according to Hall's model, a more thorough analysis of the team's communication would be necessary, including not only self-survey questions but also an additional observational study.

Finally, participants ranked the barriers in order of importance, starting with the one they considered most important. The answers to this question reveal substantial differences in the perceived importance of the barriers from the participants' perspective. For example, the barrier *Language Differences* was ranked as the most important barrier by two participants, whereas it was ranked as the lowest priority by two others. To determine the significance of individual barriers, the ratings of all participants for each barrier or influencing factor were summed and averaged. The average across all barriers was between 4 and 5. The average importance of the barriers indicates that, although rankings differed across individuals, the average values were very similar, suggesting that all aspects are important depending on individuals' situations and experiences. This result makes it clear that examining barriers on a situation-specific basis is important for determining, for each team, which aspects to focus on, and that generalizing the most important barriers is not possible.

Regarding the final question on additional culture-related barriers, all eight participants reported that, in their experience, there are none.

5.2. Culture-related success factors

To gain insight into the success factors presented in the impact model by Bastian, Wasserbäch, et al. (2023) and developed in the preliminary study, the participants were presented with an extensive list of these factors and their descriptions (Table 6).

The corresponding question is: ‘*In your experience, to what extent have the following success factors influenced creativity in your collaboration in intercultural, distributed teams?*’ Using this question, participants were asked to indicate the importance they ascribed to the individual success factors. The possible answers were: ‘important, rather important, I have no experience with this factor, rather unimportant, unimportant.’ Figure 7 shows the answers to this question.

Finally, participants were asked to identify additional culture-related success factors. Seven participants found the success factors explained above comprehensive. One participant added another factor that was already included in the individual category.

5.3. Summary of the results of the main study

Success factors fully confirmed (every participant answered important or rather important):

Different backgrounds.

Success factors partially confirmed (some participants answered important or rather important):

Heterogeneity, diversity, organizational culture, social dispersion, psychological dispersion, cultural differences, geographical distance.

Table 6. List of the individual success factors.

Heterogeneity (Chamakiotis et al., 2010): Refers to differences within a community, group, or society. These differences may relate to general attitudes, political views, and personal characteristics. The different perspectives in heterogeneous teams can increase the creative potential of a team.
Diversity (Chamakiotis et al., 2010): Compared to heterogeneity, the term diversity is narrower and focuses explicitly on cultural and gender differences, with differences in sexual orientation already integrated into gender differences (Toerlind et al., 2005). The different perspectives in diverse teams can increase the creative potential of a team.
Organizational culture (Andriopoulos, 2001; Chamakiotis et al., 2010): Is based on the deepest level of fundamental values with assumptions and beliefs shared by members of the culture. When individuals feel comfortable in the organizational culture, this leads to more creativity.
Different backgrounds (Bergström & Törlind, 2007): Refer to the individual life paths and experiences that have shaped a person. This includes origin, education, professional experience, and personal life events. People’s different backgrounds have a significant influence on their character, abilities, and social status (Bergström & Törlind, 2007; Hu et al., 2017; Ivanaj & Bozon, 2016).
Social dispersion (Ivanaj & Bozon, 2016): This refers to the diversity of social backgrounds of team members. Social dispersion brings a wide range of perspectives to a team, which expands the diversity of ideas and approaches and can thus contribute to creative problem-solving approaches.
Psychological dispersion (Ivanaj & Bozon, 2016): These different perspectives, based on different psychological characteristics, attitudes, personality traits, and other internal aspects, can contribute to an increase in creativity within the team.
Cultural differences (Walter et al., 2016): Refers to the many differences in values, customs, traditions, norms, and perspectives shaped by the cultural environment in which a person grows up or with whom he or she comes into contact. These different backgrounds can have a positive impact on a team’s creativity as they bring in a variety of opinions and perspectives. This results in many ideas and approaches that can lead to innovative solutions.
Geographical distance (Walter et al., 2016): Refers to the physical distance between different locations, especially in relation to the position of people, places, or teams. More and more specialists/experts are needed for today’s complex and interdisciplinary development tasks, and with distributed teams, there is the possibility of bringing them in from all over the world.

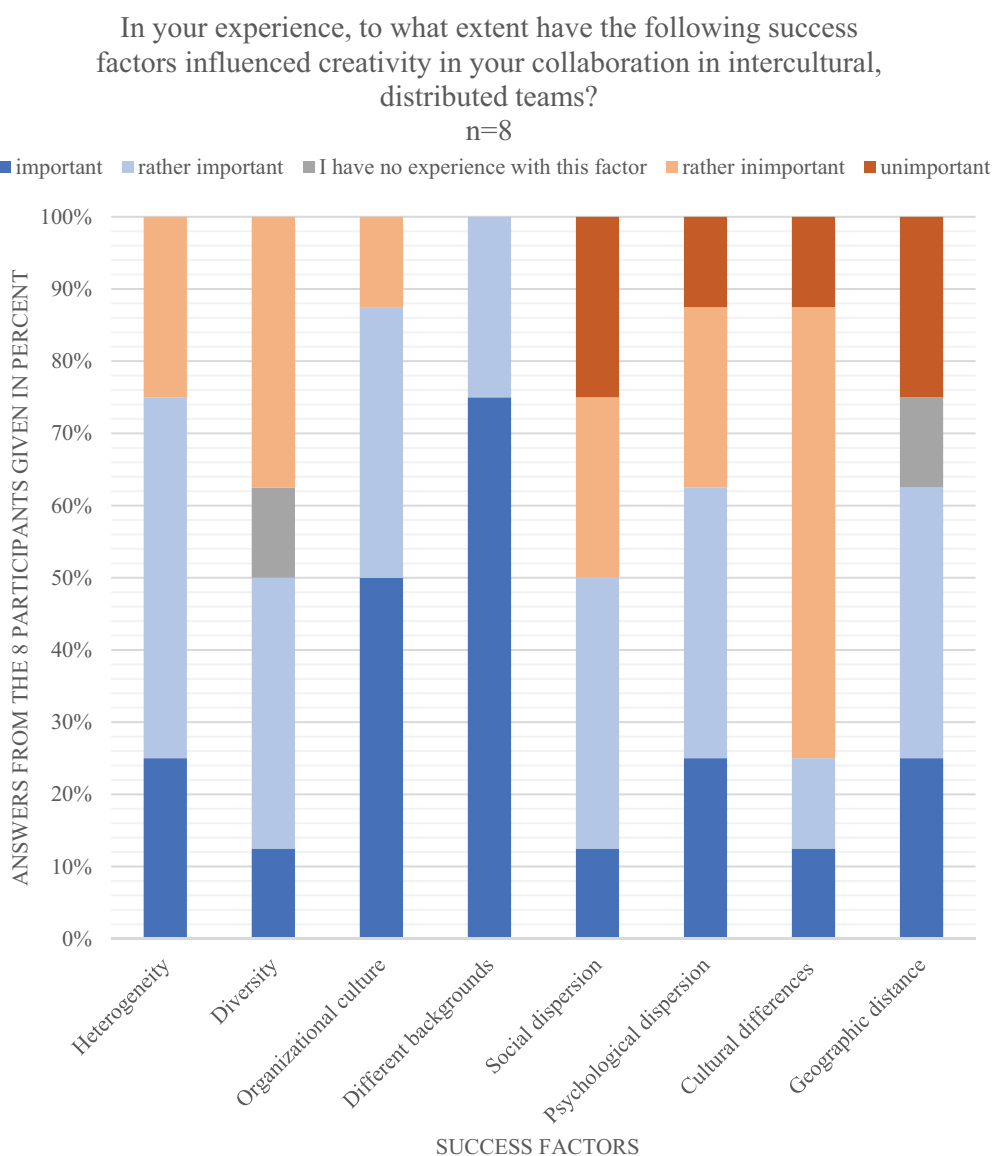


Figure 7. Evaluation of the importance of the success factors.

Barriers partially confirmed (some participants answered important or rather important):

conflict-solving, intercultural conflicts, prejudices, ethnocentrism, language differences.

Controversial:

Feeling of Trust and Belongingness.

Connections of influencing factors in other categories to the category culture were partially confirmed:

Different leadership styles, different working methods, different time orientations.

The barrier rankings showed that individual rankings varied widely, but, on average, the barriers had nearly equal values. The participants did not identify any additional barriers.

6. Discussion

In the preliminary and main study, the culture-related factors that were both worked out in the literature and presented in the impact model according to Bastian, Wasserbäch, et al. (2023) and Bastian, Kassem, et al. (2023) were empirically explored. Part I of the preliminary study not only surveyed participants based on their own experiences but also introduced the topic with a comprehensive overview of the influencing factors, particularly potential new factors, *ethnocentrism* and *prejudice*. These two factors have not previously been part of the impact model and were observed in the case study to determine whether they are relevant and therefore should be included and investigated further. Based on participants' statements regarding ethnocentrism and prejudice in Part I of the preliminary study, these two factors can negatively affect the cooperation and creativity of intercultural teams. All participants agreed that prejudice can negatively affect the wearer and lead to avoidance of contact. In addition, the negative effect of the influencing factor of *different expectations* was confirmed by the experiences of six of seven participants (one participant had no experience with this). Regarding the influencing factors of *different communication types/styles* and *different time orientations*, the majority of participants considered the consequences to be disadvantageous. Nevertheless, three participants considered the influence of these factors to be positive. Therefore, these factors were explained in more detail in the main study.

Communication types or styles shape the way people communicate with each other and are culture-dependent (Hall & Hall, 2014; Hofstede et al., 2010). These culture-dependent communication styles are closely related to tacit knowledge, as individuals develop implicit assumptions and expectations about appropriate ways of interacting through socialization and experience (Polanyi, 1967). In intercultural collaboration, communication styles therefore reflect not only conscious choices but also culturally embedded forms of know-how regarding when, how, and with whom certain information should be communicated. The way individuals express themselves, how much they say, whether individuals can address difficult topics with certain circles of people, how directly they communicate content, how important the context is, or if they try to make their point more indirectly are all elements of *communication style or type* (Lerchster & Heintel, 2017). Germans tend to communicate very directly (Lerchster & Heintel, 2017); in a project team with different communication styles, this direct communication can lead to difficulties. For example, to a Chinese person who tends to communicate more indirectly, direct feedback can sound very insensitive and impolite (Lerchster & Heintel, 2017). The relevance of the context in which people communicate is also part of the influencing factor of *different communication types/styles*, and is also culture-dependent as well as influenced by tacit knowledge which again is also culture-dependent (Fuchs, 2001; Hall, 1959; Polanyi, 1967). For individuals from so-called high-context cultures, the setting and context of a message are very important (Hall, 1977). Contextual matters concern both spoken and non-spoken forms of communication. Context dependencies are closely related to direct and indirect ways of communication (Croucher et al., 2012).

Individuals from high-context cultures tend to have a more indirect style of communication (Croucher et al., 2012). A German person (low-context) addressing an engineering problem with a Japanese colleague (high context) at lunch might make the colleague uncomfortable and prevent the colleague from generating a solution, as the setting is not conducive to discussing the topic, thereby leaving the problem unsolved. The tacit knowledge the German person might use in this scenario is his or her experience with previous successful business lunches where the focus was on the discussion topic only. On the other hand, the Japanese colleague has the tacit knowledge from experience in previous meetings with a carefully selected setting, an appropriate seating arrangement, and a certain amount of polite conversation before diving into the actual discussion topic, leading to different perceptions of the situation (Collins, 2010; Fuchs, 2001; Polanyi, 1967). Various differences in communication styles or types can stem from different tacit knowledge and can lead to misunderstandings and make cooperation in the group more difficult (Huck, 2007).

It is important to note that neither direct nor indirect communication, nor high-context nor low-context communication, can be treated as black-and-white; all gradations between the two extremes exist (Hall, 1959). Furthermore, it must be recognized that not all individuals necessarily behave in ways typical of their culture. These classifications should be understood as approaches to generalizing complex phenomena to discuss patterns. The three individuals who have viewed this aspect as positively influencing creativity may have had difficulty understanding exactly what this factor means. Therefore, a more detailed explanation has been added to the main study. If they view this influence positively, they might consider it beneficial to learn from others' communication practices to better understand one another.

Differences in time orientation can become visible in project planning and implementation. In project implementation, this might lead long-term-oriented individuals to anticipate steps to be taken to improve subsequent projects, whereas short-term-oriented individuals focus on the task at hand and view the end of the week as more salient than the end of the project. This different focus in thinking about time leads to prioritizing certain time horizons over others and can cause difficulties in reaching shared goals (Hofstede et al., 2010). Of course, the extent to which an individual is long or short-term oriented varies, and individuals cannot be classified strictly as either; the entire spectrum from strongly short-term oriented to strongly long-term oriented exists (Hofstede, 2021). It is part of an individual's tacit knowledge what he or she considers appropriate concerning time in planning and decision processes, as these are elements partially defined for an individual through social upbringing and experience (Polanyi, 1967). For time orientation to cause difficulties in project work, slight differences might already be enough. When goals are not discussed and clearly articulated, they may not be the same or may be interpreted differently, as different time horizons lead to different priorities. When planning projects, different time horizons might lead to different work approaches (Hofstede et al., 2010). Short-term-oriented individuals tend to address a problem only when it arises, whereas long-term-oriented individuals consider it in advance and plan for potential problems. The influencing factor, *time orientation*, is more complex than different time horizons. *Different time orientations* also involve how time is perceived. In monochronic cultures, time is a linear commodity that should be used efficiently (Hall, 1977). Punctuality and adherence to deadlines are important.

Individuals from monochronic cultures do their project work one thing at a time; they concentrate on the one task at hand and take deadlines and schedules seriously (Hall, 1977). In project work together with people from polychronic cultures, conflicts can arise since polychronic individuals tend to juggle multiple things at once and change from one task to the next, and back (Hall, 1977). They view a deadline as something desirable to achieve if possible. In polychronic cultures like Latin American or Middle Eastern countries, time is a cyclical commodity that can be used flexibly (Domning et al., 2009; Hall, 1977). This perception of time easily clashes with the monochronic perception of time when project deadlines come up (Hall, 1977). Three participants in the preliminary study reported a positive influence of this factor. However, it remains uncertain whether this was due to a lack of clarity regarding the factor. Consequently, a more detailed explanation was incorporated into the main study. The positive influence of varying perceptions of time might be observed in team dynamics, particularly in how team members assist one another. For instance, if a deadline is missed, an individual with a monochronic time orientation might view this as a significant setback, potentially doubting the project's overall positive outcome. Conversely, an individual with a polychronic time orientation could offer alternative solutions, analyze potential strategies for managing the situation, and help adjust to a revised timeline.

At first glance, the participants' responses regarding the influence of *different leadership styles* appear surprising. Although such differences are considered critical and disadvantageous in intercultural teams in the literature, four participants stated that this factor has a positive influence. Possible reasons for such a positive impression may depend on the leaders' origins and the description. Unfortunately, the countries of origin of the leaders were not surveyed. Therefore, a conclusive statement cannot be made about this. Nevertheless, it should be mentioned that according to Hofstede et al. (2010), in the most individualistic societies (e.g., the UK, U.S.A., Canada, France, and Germany), leadership styles can vary slightly, but such deviations may not lead to different expectations, as these societies are similar in many respects. It is also worth noting that the three participants who viewed the factor of different leadership styles positively reported that *diversity* and *heterogeneity* had a positive impact on their experience. In addition, all four participants agreed that different expectations negatively affect creativity in intercultural teams, based on their experience. As a result, a clear distinction between the factors of *different leadership styles* and the different expectations they can bring was ensured in the main study.

In Part II of the preliminary study, participants' responses to questions about observable barriers and success factors indicate that all culture-related factors were perceived by participants. However, it should be noted that both some barriers (e.g., *different languages*, *different communication types or styles*, as well as *different expectations* and *different leadership styles*) and success factors (such as *different backgrounds*, *diversity*, and *heterogeneity*) were observed, and perceived by most participants, while other influencing factors (such as *ethnocentrism*, *prejudice*, *intercultural conflicts*, and *organizational culture*) were observed less frequently. In summary, the two parts of this study complement each other. In Part I, difficult-to-observe influencing factors, such as *ethnocentrism*, *prejudice*, and *intercultural conflict*, were endorsed by most participants. In Part II, influencing factors, such as *different leadership styles*, were more clearly and

precisely recognized and perceived by the participants because of their explicit descriptions.

The limitations related to the limited sample size need to be considered (please compare the sub-section on limitations in [Section 3](#)).

The participant's responses to the questions about the culture-related success factors in the main study ([Figure 7](#)) can be attributed to the fact that, according to experience, all factors except *cultural differences* have been shown to positively impact creativity in product development. This was confirmed by the majority of the participants. The importance of the success factor of *different backgrounds* was particularly emphasized. The unanimous responses of all eight participants confirmed this.

In the questions on culture-related barriers in the corresponding section of the main study, participants agreed that most of these barriers hinder the collaboration and creativity of product developers. When asked about *communication types or styles*, seven out of eight participants reported communicating rather directly. In addition, seven participants emphasized that nonverbal signals are of great importance in their communication styles. This result seems to contradict the studies of Hall and Hofstede at first glance. The participants' experience in intercultural cooperation and their intensive contact with other cultures could provide a fundamental justification for the results. Their tacit knowledge of what enhances communication or what helps communication succeed might have changed through a variety of experiences in different cultures from their native one. Culture is dynamic and adaptable, changing over time in response to environmental conditions or contact with other cultures. These changes can affect the values, norms, customs, and traditions (Meyer, 2004; Samovar & Porter, 1997).

The eight young, promising professionals in product development brought specific experiences and cultural backgrounds that significantly influenced their survey responses. Cultural background is highly individual, and responses to our questions can vary based on recent experiences. For instance, if an individual recently encountered a cultural barrier that negatively affected a creative process, their response to a related question might differ from the answer that the same person, who had a positive prior experience, would have given. Despite potential variations in responses, we consider the insights valuable and informative. While cultural influences are highly individual, having a broader range of opinions would have expanded our perspective. It remains unclear whether additional factors would have emerged, given that previous literature and observational results have shown consistent patterns. Accordingly, we plan to continuously test the model's influencing factors to ensure it remains up to date and to include more perspectives.

Although most participants engaged in similar forms of communication, two participants differed in their communication. One participant reported communicating indirectly, whereas the other downplayed the importance of nonverbal signals in communication. These differences may seem minor, but they could make communication between team members more difficult and lead to misunderstandings.

In summary, all barriers examined in the culture category, as well as other factors negatively influenced by culture, were confirmed by the participants. Barriers or influencing factors, such as *ethnocentrism* and *intercultural conflict*, were confirmed by two participants. Other factors, such as *different leadership styles*, *working methods*, time orientation, and *conflict resolution methods*, as well as *language differences* and *prejudices*,

on the other hand, were confirmed by most participants. The fact that all questions were based on participants' own experiences explains why not all barriers could be identified by every participant. After all, it is possible that not all participants have encountered all culture-related barriers.

In addition, the participants' responses to the question about the prioritization of culture-related barriers support this interpretation. The figure above (Figure 6) shows that although the priority of the barriers varies widely across participants, the average relevance of each barrier is similar across participants. This suggests that support for these teams in addressing all culture-related barriers should not be underestimated in order to promote their creativity. A factor that may not be very important in one team can be crucial in another, as influences on creativity depend not only on the individuals in the team but also on the situation and tasks at hand. This does not mean that the collection of influencing factors fails to achieve its goal; rather, it indicates that these factors can serve as starting points for improvement and further support the creative problem-solving of intercultural product development teams.

The participants' attitude that no further additions to the barriers are necessary suggests that the study provides a comprehensive representation of the main culture-related barriers to creativity in intercultural teams based on the experience of the participants. Further factors could be found with other participants in follow-up studies. To substantiate the study's findings, a more comprehensive follow-up study should be conducted, including a larger sample size, particularly from countries not yet represented.

Based on these results from the two studies, Bastian's impact model was expanded. This extension builds on the properties developed in the literature and confirmed in the two studies. The original impact model, integrated with three additional factors, is highlighted in yellow in Figure 8: *different time orientations*, *ethnocentrism*, and *prejudice*.

In addition, an initial examination of culture-related barriers (e.g., cultural differences) was presented through twelve new connections among the model's individual influencing factors to better clarify the complexity of these relationships. The barrier of *cultural differences* influences, for example, *team member communication*, *conflict*, *trust*, *prejudice*, and *information sharing*. *Different types of communication* caused by *cultural differences* can complicate communication and lead to misunderstandings. *Intercultural conflicts* can also increase the likelihood of conflict in these teams due to differences in norms, values, and behaviors. Additionally, cultural differences reduce trust between team members, as each culture provides its members with security, belonging, and guidance (Werner & Steiner, 2022). *Prejudices* arising from cultural differences also negatively affect participants' creativity. The barrier of *different expectations* is also related to other influencing factors. *Different leadership styles*, *time orientations*, and *working methods* that may arise in intercultural teams can lead to *different expectations* within the team. Such different expectations increase the potential for conflict. *Language differences* can not only lead to *misunderstandings* but also make *communication* more difficult and affect the *self-confidence* of the team members. Favoring one's own culture in *ethnocentrism* can lead to the formation of *subgroups*. Figure 9 shows the extended impact model with the additional interconnections found. Since it is a very complex model with all the factors and connections, this figure does not include the

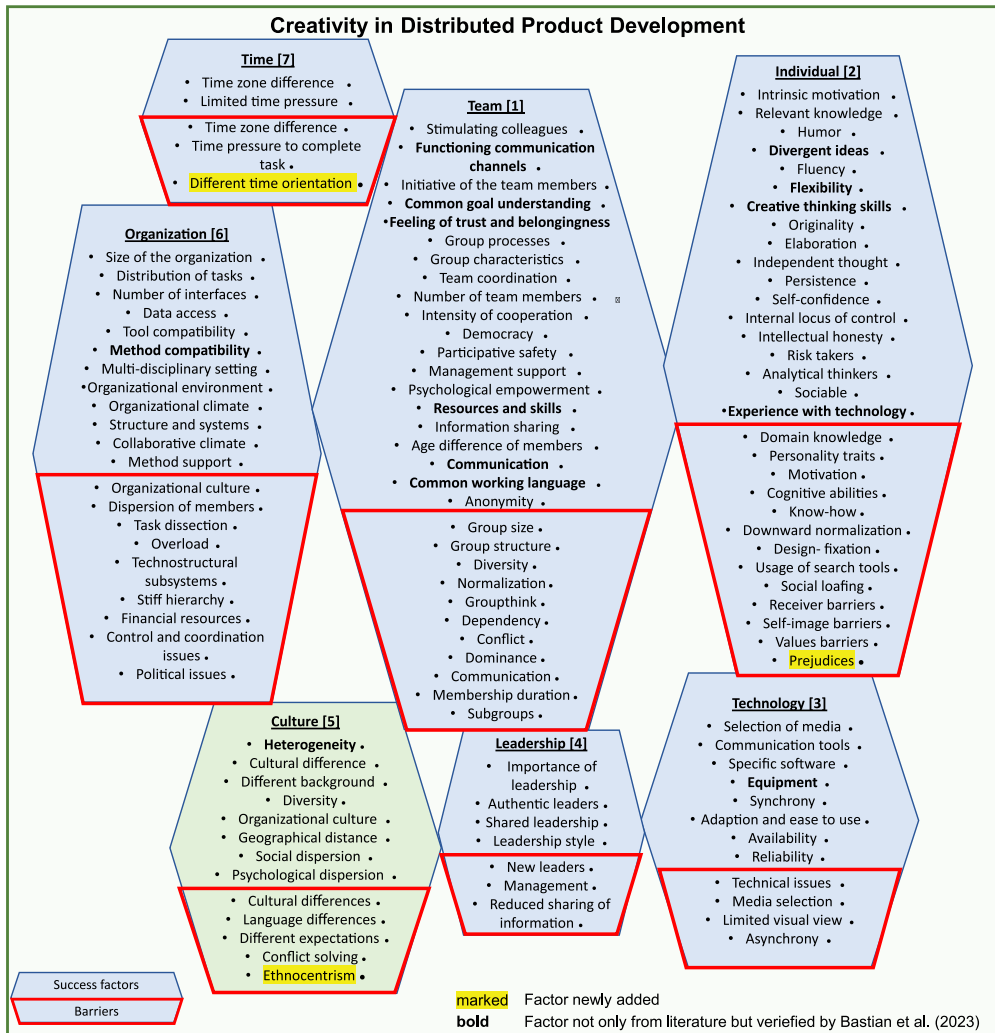


Figure 8. Expanded impact model without interconnections based on Bastian, Kassem, et al. (2023).

interconnections that have already been previously found by Bastian, Kassem, et al. (2023) and Bastian, Wasserbach, et al. (2023) but only the ones that have been found through the research in this contribution and that should be that basis for further research.

Tables 7–9 show the categories, the new interconnection, and give the sources.

The study relies on self-reported data, which may be problematic, as participants may respond in ways they consider socially desirable. To obtain information on participants' personal experiences and the factors that influence them, other options are not feasible, since the consequences of these factors and the factors themselves cannot always be observed. For factors within the team category, an observational study would be recommended. For the factors within the culture category, we rely on self-reported data and recognize that these data may reflect personal bias and socially desirable reporting.

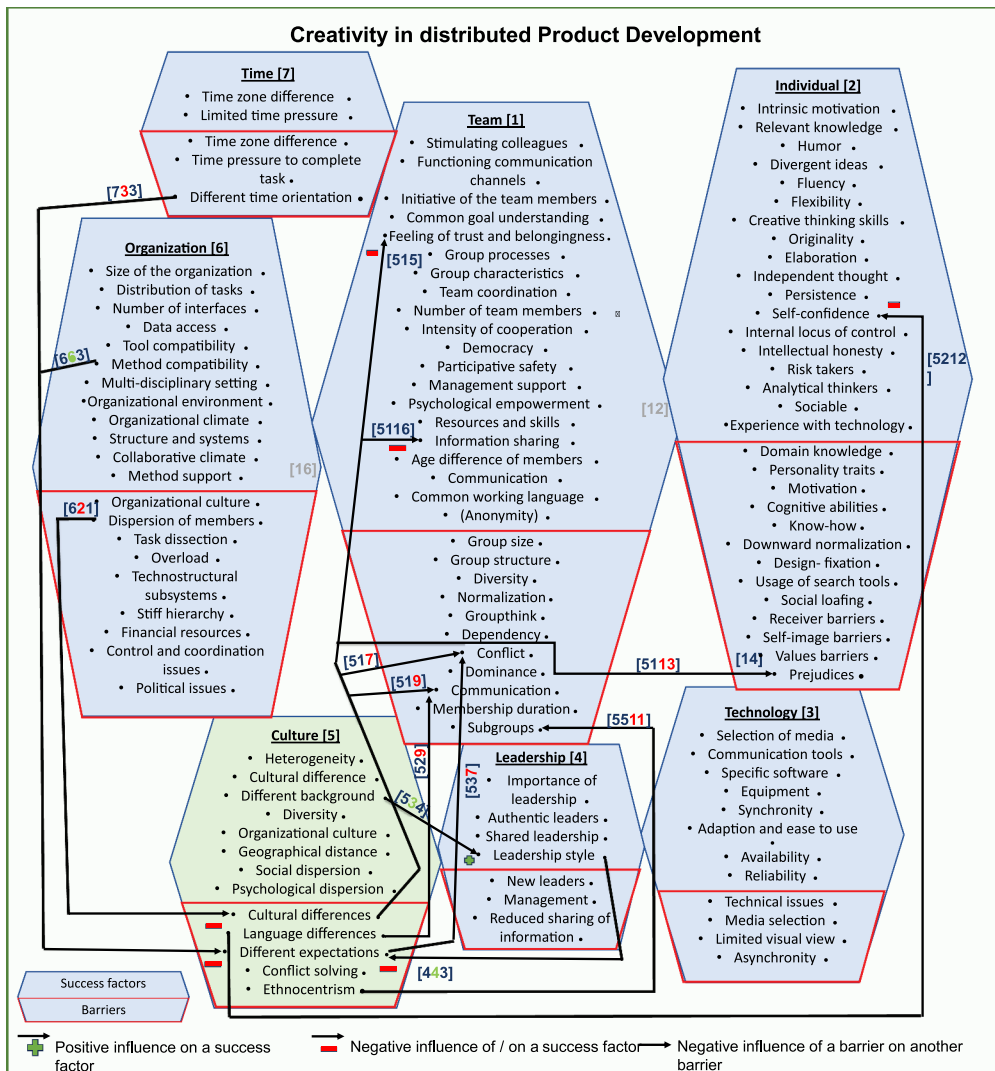


Figure 9. Expanded model based on Bastian, Kassem, et al. (2023).

An additional limitation of the study is that it does not capture the full complexity of cultural interactions that emerge during the product development process. Cultural influences are highly contextual and can not be fully represented through the methodological approach adopted here. Future research should therefore employ qualitative case studies of product development processes involving intensive intercultural collaboration to explore these dynamics in greater depth. Such studies could reveal the mechanisms through which cultural differences influence creativity, communication, and collaboration, thereby complementing the findings of the present research. With such an approach not only the existence of the influencing factors could be shown, but the mechanisms behind them to allow for more detailed recommendations to support such teams.

Table 7. Influences and sources for the categories of influencing factors.

Part 1: the number refers to the reference in which the category has been found

Source	No.	cluster	Type of interconnection	
Hubounig et al. (2013)	[1]	Team	influences	Creativity in distributed product development
Abi Saad and Agogu� (2023)	[2]	Individual	influences	Creativity in distributed product development
Abi Saad and Agogu� (2023) & Brucks and Levav (2022)	[3]	Technology	influences	Creativity in distributed product development
Abi Saad and Agogu� (2023)	[4]	Leadership	influences	Creativity in distributed product development
Seus (2020)	[5]	Culture	influences	Creativity in distributed product development
Ocker (2005) & Brucks and Levav (2022)	[6]	Organization	influences	Creativity in distributed product development
Seus (2020) & Ocker (2005)	[7]	Time	influences	Creativity in distributed product development

Table 8. Newly found interconnections from barriers in the category of culture.

Part 2: the number starts with 5 for category culture, the second number stands for the order number of the influencing factor (if it's the first barrier in the category culture 1) the one factor that is not a barrier but a success factor is marked green, and the third number stands for the order number of the factor it influences (if the factor is red, it's a barrier)

Source	No.	Influencing factor	Type of connection	Influencing factor
Main study, preliminary study, (Hofstede et al., 2010; K�ppel, 2007)	[517]	Cultural differences	Has an influence on	Conflict
Main study, preliminary study, (K�ppel, 2007)	[5113]	Cultural differences	Has an influence on	Prejudice
Main study, preliminary study, (Hall & Hall, 2014; Hofstede et al., 2010)	[519]	Cultural differences	Has a negative influence on	Communication
Vorstudie & (K�ppel, 2007)	[5116]	Cultural differences	Has a negative influence on	Information sharing
Main study, preliminary study, (K�ppel, 2007; Werner & Steiner, 2022)	[515]	Cultural differences	Has a negative influence on	Feeling of trust and belongingness
Hofstede et al. (2010); K�ppel (2007)	[537]	Different expectations	Has an influence on	Conflict
Triandis (1990); Sinkovics (1999); Brewer and Campbell (1976)	[5511]	Ethnocentrism	Has an influence on	Subgroups
Preliminary study, (Hofstede et al., 2010)	[534]	Different background	Has an influence on	Leadership style
Main study, preliminary study	[529]	Language differences	Has a negative influence on	Communication
preliminary study	[5212]	Language differences	Has a negative influence on	Self-confidence

To increase the likelihood that participants reported their opinions, we worked closely with participants in the main study to ensure they felt safe and able to report honestly. Follow-up studies, with interviews to delve deeper into the factors and their connections, are planned.

Table 9. Newly found interconnections to the category culture.

Part 3: the first number stands for the category in which the influencing factor is, the second number stands for the order number of the factor (if it's the first barrier in category 1 and red, if it's the first success factor in category 1 and green), and the third for the order number of the barrier being influenced

Source	No.	Influencing factor	Type of connection	Influencing factor
Main study, preliminary study, (Hofstede et al., 2010; Köppel, 2007)	[443]	Leadership style	Has a negative influence on	Different expectations
Main study, (Hofstede et al., 2010; Köppel, 2007)	[663]	Method compatibility	Has a negative influence on	Different expectations
Main study, preliminary study (Hall & Hall, 2014)	[621]	Dispersion of members	Has a negative influence on	Cultural differences
Main study, preliminary study (Hall & Hall, 2014)	[733]	Different time orientation	Has a negative influence on	Different expectations

7. Conclusion and outlook

Creativity is needed throughout the entire process of developing products with high innovative potential (Albers et al., 2018). Human creativity is influenced by a multitude of factors (Bastian, Wasserbäch, et al., 2023). This study has once again shown the extent of the influences on creativity and their high interconnectedness. Not only within certain categories but also between categories, and at the individual factor level. This contribution focused specifically on the culture category, as it has not yet been the focus of much engineering research. Additionally, this category is highly interconnected with others and encompasses numerous factors. Proving once more that it is an interesting path to pursue for designing further creativity support for product development.

To answer research question one, with the focus on finding out how the influencing factors in the category culture on creativity in product development can be empirically explored, two studies have been designed and carried out. The preliminary study was divided into two parts to provide insight from two perspectives: Part I, the participant's own experience, and Part II, the participant's observations of multicultural teams. The participants selected for the preliminary study are future experts in product development, currently in training, who have demonstrated expertise in the course 'Mechanical Design' and are now tutoring this course. Furthermore, in both parts of the study, only responses from participants who reported having the appropriate experience were evaluated. For the first part of the study, experience with working in multicultural teams, and for the second part, supervising multicultural teams. The data were collected via a survey distributed to potential participants; completion took approximately 20 minutes.

The main study consisted of a single part, designed based on the findings of the preliminary study. It was distributed as a survey to a different cohort of young, promising professionals in product development from diverse cultural backgrounds who had formed their own team. All selected young, promising professionals in product development have at least two years of practical experience; all eight responded in full, and their responses have therefore been taken into consideration. Answering the main study took approximately 20 minutes; four questions were closed-ended, and eight were partially open-ended.

To answer the second research question, which asks about the cultural factors influencing creativity that lead to success and those that aggravate creative problem-

solving in multicultural teams, the survey results have been analyzed. The separation of success factors and barriers from the literature has been used as a basis, with the factors in the category culture from Bastian, Kassem et al. (2023) as well as potential additional factors from the literature. Sections 4 and 5 present the preliminary and main studies in detail, including the results obtained. The critical analysis of the results is presented in Section 6. It is important to note that the participants considered all factors relevant, but ranking them is not possible because individuals perceive different factors as more relevant. This is because cultural influences are not only team-specific but also situation-specific across different product development tasks and creative problem-solving contexts. The collection of influencing factors offered by the extended impact model in this contribution provides a starting point for examining potential factors, but it does not imply that all factors apply to every team or to every creative problem-solving process. The factors surveyed that have not yet been part of the impact model have been considered relevant and are therefore added to the model and subject to further research.

The third research question, which asks about connections among the different influencing factors, is addressed in the discussion in Section 6, particularly through the further development of the impact model. The model now shows indications for additional connections among multiple barriers across categories as indicated by the participants' experiences. These connections have to be evaluated further in follow-up studies and are currently nothing more than initial indications of connections between factors that others might or might not experience as well. Whenever an influencing factor within a team causes difficulties, connections to other factors can be traced; these may serve as starting points for improving intercultural creative teamwork, or addressing them may help the aspect currently problematic.

This study did not validate the impact model per se, but demonstrated the presence of many of its influencing factors through an exploratory study.

To validate the results, a quantitative study is recommended as the next step. Culture is a category within which a multitude of factors influencing creativity in distributed product development fall. Moreover, the factors are highly interconnected, as the studies in this contribution show. Therefore, intensifying research in this direction is highly recommended to support practitioners in product development with culturally sensitive support for creative problem-solving.

The educational potential of understanding the factors influencing creativity has not yet been explored. The findings of this study could be integrated into the creative teamwork tasks that students in the master's program complete each semester, enabling knowledge that fosters more effective creative collaboration. To support such integration, a longitudinal study covering the entire duration of the master's program would be valuable, allowing the investigation of both the development of student teams over time and potentially finding new influencing factors and connections. Based on these findings, strategies for applying the model and its implications could be developed to support students' creative problem-solving processes while further refining the model itself.

Furthermore, it is of interest to see whether the same factors are relevant in the entire product engineering process or only in product development. A study with engineers in strategic product planning and production system development could give insight.

The next steps include designing support that helps overcome barriers, specifically within the category culture, and enhancing success factors to improve creativity and, consequently, positively influence innovative potential.

Author contributions

CRedit: **Annika Bastian**: Conceptualization, Data curation, Formal analysis, Investigation, Methodology, Validation, Writing – original draft, Writing – review & editing; **Nazir Kazmouz**: Data curation, Formal analysis, Visualization, Writing – original draft; **Jakob Willerscheid**: Writing – review & editing; **Albert Albers**: Supervision.

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