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Breaking cultural barriers: an integrated methodology for challenge-driven co-creation projects

Annika Bastian ✉, Christoph Kempf, Paulin Rudolph and Albert Albers

IPEK - Institute of Product Engineering, Karlsruhe Institute of Technology, Germany

✉ annika.bastian@kit.edu

Abstract

The fact that successful Industry-Academia Collaborations (IACs) are beneficial for the participants is widely accepted. However, without a target-oriented methodology, the chances for success are low. This paper's focus is the early phase in the creation of such a methodology which is done in a structured way. Furthermore, the goal is to understand the great influence culture plays in creative problem-solving in distributed teams in IACs.

Keywords: product development, innovation, distributed teams, cultural influence, industry-academia collaboration

1. Introduction

Integrated Circuits are the basis of nowadays advanced systems and are a prerequisite for systems and functions ranging from washing machines to autonomous driving. One development path of these chips is the reduction of their node size to develop more potent microchips that are able to solve more and more complex tasks. The production system of such chips itself is a very complex advanced system within a highly competitive market on the product side, while only few companies are able to master the challenges of such complex production systems. However, the system of the technological leading company currently on the market is able to produce "*higher-performance and more energy-efficient and cost-effective microchips than ever before in this decade and the next*" (Fraunhofer-Gesellschaft, 2023). One of the success factors is the use of the EUV (extreme ultraviolet light) lithography technology. This technology was developed collaboratively by multinational teams of the German companies TRUMPF Lasersystems for Semiconductor Manufacturing and ZEISS together with the academic Fraunhofer Institute for Applied Optics and Precision Engineering (IOF). During this collaboration, more than 2000 patents were granted, protecting the intellectual properties of the partners. In the end, the corporate partners created more than 3300 high-tech jobs and more than one billion euros in annual turnover based on this development. In 2020, the project consortium was awarded the Deutscher Zukunftspreis by the German Federal Project (Buchenau, 2020; Fraunhofer-Gesellschaft, 2023).

This example demonstrates the high complexity of advanced systems and how the expertise of academia can be incorporated in a beneficial way to create innovation. However, the successful establishment of industry-academia collaboration (IAC) is a non-trivial undertaking. Therefore, this contribution aims to support the design of IACs with a new focus: supporting cultural differences to enhance creativity in distributed teams. The following sections of the first chapter built the basis of this contribution with relevant literature in the fields of product engineering IACs, and cultural influences on product engineering. The interconnection between the fields is given and the project that provides the research environment is introduced.

1.1. Product engineering described by the system triple

To keep up with the challenges of nowadays product development, an efficient product engineering process is the prerequisite. Based on the work of Wynn and Clarkson (2018), the VDI (The Association of German Engineers) compares different process models common in product engineering (VDI Verein Deutscher Ingenieure e.V., 2019). With his stage gate process, Cooper (1994) set the foundation for engineering processes in many companies. Elements of the stage gate process were reused in many other process models. An example of a widely used model in the field of mechatronic systems is the V-model (VDI Verein Deutscher Ingenieure e.V., 2004). Albers et al. developed the iPeM - integrated Product engineering Model, incorporating process management and the engineering design process within one model. As a meta-model, the iPeM enables the description and design of specific engineering processes depending on the concrete boundary conditions and requirements (Albers *et al.*, 2016b). In its different layers, the different aspects of integrated product engineering can be modelled. The engineering process of the product generation in development (G_n), following generations (G_{n+1}, etc.) as well as the development of the according validation system, production system and company strategy can be modelled within the iPeM (Albers *et al.*, 2016b).

The iPeM is based on the system theory (Ropohl, 1975). Thus, product engineering is understood as the iterative development of the three subsystems *system of objectives*, *operation system*, and *system of objects* as illustrated in Figure 1 (Albers *et al.*, 2011). The system of objects is developed to meet the objectives as specified in the system of objectives. Both of these subsystems are evolved throughout the whole engineering project by the operation system. Within the system of objectives, all objectives, requirements, boundary conditions, and their interrelations are collected. In the system of objects, all final and intermediate results of the engineering project (e.g., prototypes or the final product) are contained. All analysis and synthesis steps of the systems of objectives and objects are carried out by the operation system. Therefore, the operation system contains all necessary resources such as engineering or creativity methods, computers, financial resources, and people (engineers), too. The systems of objectives and objects are only linked through the operation system. (Albers *et al.*, 2011)

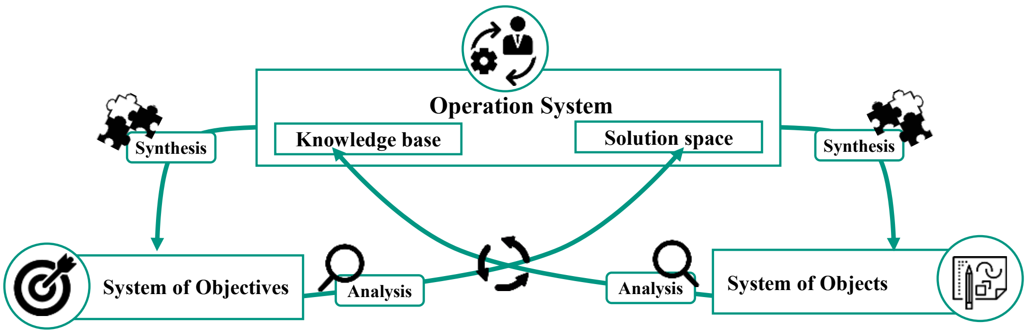

Figure 1. The extended system triple of product engineering; developing the system of objects based on the system of objectives through the operation system (Albers *et al.*, 2011)

Thus, the creation of an effective operation system is the core for enabling efficient engineering processes and collaboration with outside partners. With the understanding of the IPeM it becomes clear, that product engineering is a lot about the people involved. For successful industry-academia collaborations (IACs) the different stakeholders have to be understood especially the differences between them, which can turn into barriers. Furthermore, the cultural influencing factors due to the different individuals involved within an IAC process in multicultural teams shape the operation system and influence the problem-solving process.

1.2. Industry-academia collaboration: success factors and barriers

To make use of the knowledge and technologies from universities, many companies collaborate with academia in so-called industry-academia collaboration (IAC). The collaboration promises the possibility of a competitive advantage due to the cutting-edge technologies and knowledge gathered in research facilities (Expertenkommission Forschung und Innovation, 2022; Frank *et al.*, 2007; Wissenschaftsrat, 2007; Kempf *et al.*, 2022; Guerrero *et al.*, 2019). However, the collaboration of companies with

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academic entities is complicated. On a general level, Bruneel *et al.* (2010) distinguish *orientation-related barriers* and *transaction-related barriers*. Orientation-related barriers are barriers that are caused by the different objectives of corporate companies and academic entities, while transaction-related barriers are barriers concerning the transfer and communication between the two parties such as intellectual property rights or administrative processes. Kleiner-Schaefer and Schaefer (2022) identified a lack of financial support, unawareness of the possibility of collaborations with academia, trust issues, and skill mismatches as the main challenges.

The main success factors for successful IACs are good knowledge management, regular and effective communication, on-site collaboration, high motivation and measurable project goals (Garousi *et al.*, 2017). With their IAC model of group-specific success factors and barriers, Kempf *et al.* (2023) present 22 success factors and 22 barriers to a successful IAC. These factors are allocated within the fields of *communication and feedback*, *information and (technical) support*, *motivation and commitment*, *people and team*, and *structure and organization* (Kempf *et al.*, 2023).

IACs have advantages for companies, for students who benefit from real-world experiences during their studies, and for researchers who get the opportunity for transferring their research into practice. IACs can be a valuable addition to intracurricular live-lab projects, where the project work of students with companies is guided and mentored by scientific advisors (Albers *et al.*, 2016a; Albers *et al.*, 2018).

The people involved as part of the operation system shape the success of the IACs. Creative problem-solving processes especially are shaped by cultural influences that are brought into the operation system by the people involved, their knowledge, their experiences, and their way of thinking. Literature research results on those influences are introduced within the next subsection.

1.3. Cultural influences on creative problem-solving in product engineering

Activities involving creative problem-solving have been identified as especially challenging in distributed settings (Brucks and Levav, 2022). Given that and the intercultural context of many IACs a multitude of challenges has to be considered when building a methodology for IACs. But success factors exist as well. Kempf *et al.* (2023) found *language barriers* as a barrier to successful IACs which is due to cultural influences and *speaking the same language* and *diverse group composition* as success factors which can also be caused by cultural influences (in the sense of an individual's cultural background not the corporate culture). Furthermore, multiple difficulties of working in distributed settings were mentioned in different facets as barriers making creative problem-solving more challenging. Within the impact model by Bastian *et al.* (2023) *culture* was found as a category of influencing factors on creativity in distributed teams. Within this category are currently 12 factors and more are expected to be found in a follow-up study. Cultural influences on creativity are often are interconnected with other factors and categories. For example, *different background* within the category *culture* has also influence on *communication* within the category *team*, making the cultural influences not only versatile but also highly interconnected. (Bastian *et al.*, 2023)

The research environment in which an IAC methodology will be built and which will be the environment for investigating the cultural influencing factors further, is described in the next subsection.

1.4. INDUSAC - INDUStry-Academia Collaborations

The research presented within this contribution was conducted in the course of the INDUSAC - INDUStry-Academia Collaborations project (European Commission, 2022). INDUSAC is a project funded under the Horizon European Research and Innovation program. The main goal of INDUSAC is the establishment of a modern "*IAC mechanism for quick, challenge-driven, human-centred co-creation*". The mechanisms shall enable European companies (small- and midsized sized enterprises mainly) to solve engineering tasks in collaboration with partners from academia. Therefore, INDUSAC supports the companies in formulating the task as an engineering challenge that teams of students and researchers can solve collaboratively with the respective companies. INDUSAC provides an online platform for the challenge promotion as well as processual and methodological support, and serves as a collaborative platform for the teams. The authors of this research effort are part of the INDUSAC team.

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2. Research profile

2.1. Research goals

To enable successful challenge-driven IAC, a methodology needs to be elaborated. Within the methodology, the process for the main stakeholders - students, researchers, companies and their interactions - need to be clearly defined and mapped out. For achieving this goal, the project consortium has agreed on using User Journeys (UJs) with swim lanes for the main stakeholders, since this method includes graphical representation and was considered understandable and easy to learn for partners in industry and academia. The representation of the users touch points in the formats of tables or continuous text was discussed but a more visual representation was asked for. The user journey needed to include not only each stakeholder's actions isolated, but all interactions between stakeholders as well, which was also seen to be difficult with other methods. Designing user journeys was set as the first goal within the research performed and builds the basis of this research effort. Furthermore, support is needed to assist the companies in the process of defining and publishing challenges. This support needs to be adjustable to the company's needs while at the same time giving a predefined structure to the challenges and making sure all relevant information is collected. Within this research, the second goal is to develop a sufficient amount of such Predefined Collaborative Approaches (PCAs) to be able to depict the mass of different real-world challenges, without having a complicated selection process for the correct PCA. A major influence is the team composition and the cultural background in specific. The third goal of this research is to get a deeper understanding of culture and its influence on creativity within such teams. Thereby, the basis for developing a support that makes overcoming cultural barriers possible while at the same time enhancing the success factors of multicultural teams is set.

2.2. Research questions

To reach the described three goals of this research, the following research questions must be answered:

1. How can a successful process for completing a challenge-driven IAC be designed from the perspective of students and researchers, and companies in globally distributed teams?
2. How does a support look like, that enables companies to define challenges according to their needs while it is universally applicable?
3. What are the influencing factors for creative problem-solving of multicultural teams?
4. What conclusions can be drawn for supporting multicultural teams in their creative problem-solving process?

2.3. Research approach

The project INDUSAC is used as the research environment for the studies within this research effort. The result of the project INDUSAC will be an online platform as well as the methodology for challenge-driven IACs for which the user stories and PCAs play a major role. The approach for answering the research questions is shown in Figure 2. Research question one (RQ1) is answered through a multi-stage process. After the decision for using user journeys was made with the project consortium and their initial definition within a creativity workshop, the user journeys are reviewed and detailed within a workshop with INDUSAC partners. Afterward, the user journeys are iteratively improved through commenting on the online whiteboard Miro. The approach to answering the second research question (RQ2) leads over the initial design of PCAs, that detail the User Journey of companies further, based on the Live-Lab experience at IPEK - Institute of Product Engineering to a workshop with method experts. The PCAs are also iteratively improved resulting in the finished templates. To answer the third and fourth research questions (RQ3, RQ4), a self-administered questionnaire in an online survey was used to collect the data. The questionnaire was distributed among the consortium partners of the INDUSAC project and contained 20 questions about cultural differences in globally distributed teams. The consortium partner institutions are from different countries across Europe and with their participation in the INDUSAC project the experience of the respondents within at least one intercultural team was ensured. With the answers provided within the questionnaire, the third research question can be answered directly and conclusions can be drawn to answer the fourth research question.

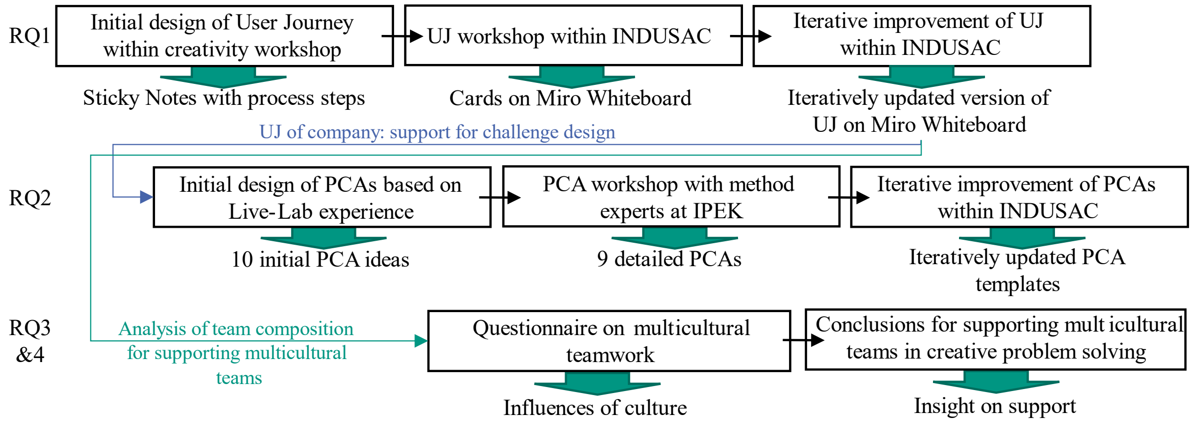

Figure 2. Research approach: methods and results

3. User journeys for IAC

The online platform resulting from the INDSUAC project will be designed for students and researchers to accomplish challenges posted by companies. As students and researchers build a team, they form one group of users and are not distinguished in the methodology. Companies are the second user group. To support both user groups in the process, user journeys have been developed as part of the INDUSAC methodology. As shown in the research approach, an iterative approach was used during the development of the user journeys, to ensure the quality of the output.

Figure 3 depicts the final version of the user journeys with the highlight showing the steps in the onboarding phase of the companies in detail. First, the process of the INDUSAC methodology was broken down into five phases that define the interactions of the user groups with the platform and each other. These phases are the *planning phase*, *onboarding phase*, *search phase*, *project phase*, and *offboarding phase*. Within the planning phase, the students/ researchers and companies need to become aware of INDUSAC and the platform. In the onboarding phase, the companies define their challenges. The search phase contains the tasks of team formation and challenge application for the students/ researchers and team selection for the companies. During the project phase, the student/ researcher teams collaboratively solve the challenges with the companies. Finally, in the offboarding phase, the students/ researchers and companies recap the overall project and feedback and evaluate the process.

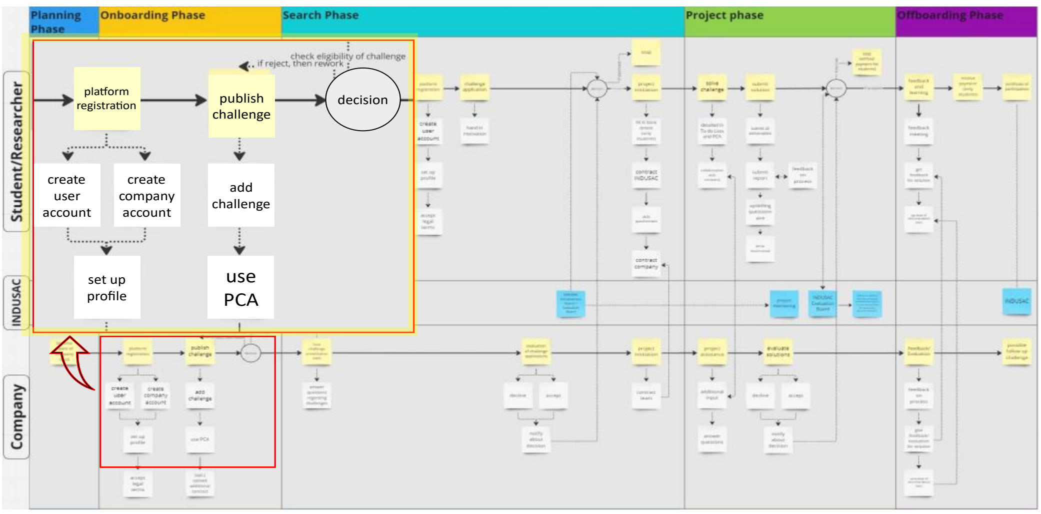

Figure 3. User journey map of the students/researchers and the companies

The user journeys assist in understanding the users' goals at each step of the process and define the core activities of the user groups. These aspects are all detailed within user guidance packages. These instructions cover several areas, including process definitions, guidelines, and user objectives at

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different phases of the process. Finally, the user journeys serve as the basis for the setup of the INDUSAC online platform and are a core part of the overall methodology.

While the user journeys define the basis of the process of a challenge-driven IAC, the flexibility is enabled by the challenge (project) design. Nine challenge templates, so-called Predefined Collaborative Approaches (PCAs), were developed. The initial definition took place by the authors of this paper based on their life-lab experience with co-creation approaches. These PCAs define the type of the challenges by defining the type of expected results (e.g., customer-specific future robust product properties, physical prototype, service platform mock-up, marketing campaign, etc.) of the specific challenges. For developing these results, different tasks have to be done to solve the challenges of different PCAs. Thus, PCA-specific support material is provided to support the co-creation team in the definition of an adequate process and the selection of adequate methods. The initial design was discussed with nine additional product developers with co-creation experience, to iteratively improve them. Input was also collected through a workshop with partners from academia and industry to which four partners of the consortium from different countries invited co-creation specialists to get to the next iteration of the PCAs. The PCAs are designed in a way that allows the specification of challenges from a wide range of branches (e.g., automotive, medical, consumer electronics, digital service platforms, etc.). Each PCA is designed with predefined fields, suggested guiding questions and additional information to help the companies with setting up their challenges. The fields and questions are designed to make companies think about important information, but also about boundary conditions that provide important information to the co-creation teams for solving the challenge. However, the information gathered and provided through the PCAs is not meant to replace the communication of the companies with the student/ researcher teams throughout the project but is meant as a starting point only. The aspect of applicability to different sectors was validated with all consortium partners through feedback loops. The final PCAs in written and graphical format also underwent another review by all partners, and an additional round with the work package leaders to get to the current stage. Throughout the project, the PCAs will undergo additional reviews and will be continuously improved.

As explained above, the chosen PCA also determines the set of support materials provided to the co-creation teams. This additional support material is very detailed to enable the teams to follow an adequate process and to use methods and tools new to them correctly without the help of a method coach. The support material includes recommendations for the process, in the form of To-Do lists, a detailed exemplary schedule and proposed methods (e.g., creativity methods, selection/ validation methods, etc.), to which detailed explanations and templates are included as well.

With the presented results, RQ1 and RQ2 can be answered. The user journeys, including all the supporting materials (user guidance packages, methods, tools) support the co-creation teams to successfully complete challenge-driven IACs, which answers RQ1. To answer RQ2, nine different PCAs were designed as a support to enable companies to define challenges according to their needs while PCAs themselves are universally applicable. Furthermore, the PCAs define the process of the challenges, too.

4. Preliminary study on intercultural and distributed teams

4.1. Preliminary study

A detailed questionnaire was designed to get a closer understanding of the role that cultural differences play in distributed teams. The self-administered questionnaire contained 20 questions starting with questions about opportunities and barriers in general in globally distributed multicultural teams, followed by specific questions regarding experiences made during the INDUSAC project and ending with questions on the participant's socio-demographic information. The questionnaire contained partially open-ended and partially close-ended questions and was set in an online survey setting. The time estimated for answering the questionnaire was ten minutes.

Of all 28 consortium partners who received the questionnaire, 14 filled out the questionnaire. 12 of 14 questionnaires were filled out completely and were taken into account for further analysis. The representation of different sexes is given by 66,67% of female participants, 25% of male participants and 8.33% would rather not say. The participants come from different countries in Europe and belong

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to academia (4) or industry (6), where half of them (50%) have worked more than five times in multicultural teams before. Two participants did not provide valid answers to this question.

The analysis of answers is based on the impact model by Bastian *et al.* (2023). The model consists of seven different categories that contain influencing factors on creativity in distributed product development. The seven categories (*Team*, *Culture*, *Technology*, *Individual*, *Leadership*, *Time* and *Organization*) contain different success factors and barriers. Per a thematic analysis, the answers were allocated to the categories and underlying influencing factors of the impact model. The questions were separated in questions asking for success factors and questions asking for barriers to make the allocation of factors that can be barriers as well as success factors possible. The list of success factors is very comprehensive, whereas the list of barriers is only partially elaborated and is currently still research in progress. Thus, answers regarding barriers were only allocated to the existing barriers of the impact model, leaving out answers that could not yet be allocated to barriers in the seven categories. Most allocations were made to the categories *Culture* and *Team*. This is the case when looking at success factors and barriers individually as well.

In the following, each category is described with exemplary answers representing the most mentioned influencing factors:

Team

For the participants, the most important success factors are *group processes* and *information sharing*, with statements regarding the significance of effective "*team meetings"*, "*brainstorming sessions"* and the importance of "*face-to-face meetings*". However, participants expressed their concerns about the *imposed strategy* through statements like "*different approaches to work"* or that in different cultures "*there are too many rules, if you could just do it*."

Culture

With 46% of allocations, this category is represented the most in the answers. E.g., *different backgrounds* and *social dispersion* are success factors that represent chances for multicultural teams in creative problem solving that were also reflected in the answers. One participant emphasized that teams consisting of individuals from different backgrounds offer a broader range of ideas and perspectives. Furthermore, statements about different habits, cultures, and ways of thinking can be found in the answers as beneficial. At the same time, *different background* was identified as a barrier, too. Within multicultural teams, participants highlight *different language* that can lead to misunderstandings as another barrier. A very specific answer explores barriers of this category as follows: "*Cultural background, values and beliefs, that shape individual mindsets, can influence the approaches, decision-making processes and the acceptance of new ideas*".

Technology

To successfully collaborate, *selection of media*, *communication tools* and *specific tools* are necessary success factors. However, if "*technical problems*", or the *wrong use of media* occur, collaboration is hindered. Most statements of the participants within this category could be allocated to these influencing factors.

Individual

For the participants, *intrinsic motivation* poses a great success factor. For them "*enriching the personal network*", "*learning from each other*" and "*the opportunity to work in an international group of experts*" thrive in the working environment of multicultural teams. However, hindering the success of multicultural teamwork is the barrier *domain knowledge*.

Leadership

This category has the least allocated answers overall. "*Managing people*" is one exemplary answer which was allocated to the success factor *importance of leadership*. Nonetheless, *dominance* can hinder the success of those teams.

Time

Time zone differences was mentioned as a success factor as it enables multicultural teams to "*work on an issue 24/7*", but was also mentioned directly as a barrier by a different participant.

Organization

Within this category *method compatibility* and *collaborative climate* received the most allocations. For participants, "*teamwork*" was a necessary mean to "*develop on unknown areas to build new added value*

on top of already existing methods and Open Innovation tools". On the other hand, *structured approaches* are barriers for multicultural teams.
With the influencing factors and the allocation to the categories within the impact model, the answer to RQ3 is given.

4.2. Evaluation

The preliminary study presented in the previous chapter provides insights into the various success factors and barriers to the collaboration of multinational teams in distributed settings. Granting that the result of this questionnaire is based on the answers of consortium partners of the INDUSAC project, their expertise offers a broad perspective of influencing factors in intercultural teamwork as the partners are from different European countries with a special focus on widening and associated countries (which are the ones with low participation in EU projects so far).
The importance of the *team* and *culture* categories in fostering intercultural teamwork has become clear. They offer immense opportunities for enhancing and supporting collaboration but also present significant challenges. One aspect that stood out because it was explained in much detail was how the team members expressed their concerns through e.g., different approaches to work. Whilst some work is based on regulatory processes others thrive when just working freely without any process rules. These revelations shed light on the challenges during intercultural teamwork. When presented with different approaches to work, the ability to utilize one's individual strengths and preferences can be hindered (Ocker, 2005). Addressing this barrier will be vital in creating a more collaborative and effective work environment for multinational teams. This might be an interesting factor to monitor during the INDUSAC project, as the teams are provided with To-Do lists and detailed method explanations. Some teams might thrive with creating innovative ideas, as they are able to follow the guidelines and thus explore their creativity freely without having to worry about the right process steps and what to do next after finishing one process step. Nonetheless, there might be teams who feel limited in their approach as the To-Do lists provide very explanatory recommendations.
Despite these differences, teams with diverse backgrounds offer promising opportunities for innovative performance and creative breakthroughs. However, overall language and communication barriers pose great risks in intercultural teams, as expressions and the way of sending and receiving messages can differ greatly. The risk of misunderstanding each other due to the language barrier was mentioned by participants. Hereby, some people tend to zone out during meetings as communicating in a different language demands a great deal of strength as they are not disciplined or trained enough in a different language. However, they do not think that it is necessarily always related to the ability and fluency of the English language but can also be due to different disciplines.
The influences on creative problem-solving in multicultural teams can not only be allocated to the category culture but to all categories of influencing factors on creativity in distributed product development. Cultural influences are highly interconnected with factors from the other categories but do play a major role in multicultural teams. Supporting teams to improve factors within the category culture has the potential to not only influence factors within this category but also within others and answering RQ4 with the recommendation to use culture as a starting point for supporting distributed teams.

5. Conclusion and outlook

Working collaboratively in globally distributed teams entails bringing together a group of people with different backgrounds, cultures and various individual characteristics. Especially in the IAC environment, many different experiences come together from experts in the field to students just learning new methods. Various influencing factors have impact on the success of IACs: some specific to IACs, some specific to the multicultural team setting. To enable teams to successfully complete challenge-driven innovations, two user journeys were established, including support material (user guidance packages, methods, tools, PCAs), to assist all stakeholders during the process and to achieve the first research goal. The user journey for companies was detailed further through the development of support for posting challenges on the platform. The support in the form of nine predefined collaborative

approaches enables companies to adjust the PCA with the goal they want to achieve to their specific needs. With the creation of the support research goal two was reached.
To accomplish the last research goal RQ3 and RQ4 were answered: the different influencing factors on intercultural teamwork were elaborated, categorized and conclusions drawn for supporting intercultural teams. The success factors and barriers provide deep insights into the importance of team composition and cultural effects on teamwork, as well as the need for support that helps teams with cultural aspects. The user journeys and PCAs will be validated through the first phase of the INDUSAC project, where feedback is collected, and the methodology will be adjusted accordingly. Within the INDUAC project and specifically during the preparation of the next version of the methodology closer attention will be drawn to cultural aspects of teamwork to improve cooperation to enable the co-creation teams to be as successful as the co-creation team that invented the lithography technology.
The allocation of the answers to the questionnaire to the existing barriers within the impact model used within this contribution was challenging, as certain factors were still missing in the model. By differentiating the barriers more finely, with the answers to this questionnaire and additional questionnaires, a more profound base could shed more light on the challenging side of multinational teamwork. This could facilitate the analysis and allow for a more precise attribution of factors.
Nevertheless, the identified barriers can be used as valuable insights to engage in further research and deepen the understanding of the complexity and dynamics of multinational teams working in IACs. In connection with the opportunities and success factors, great working environments can be designed to foster intercultural teamwork in globally distributed teams, especially in the IAC environment.
Furthermore, it can be concluded that the multicultural team of INDUSAC partners that participated in the questionnaire is composed quite similar to the co-creation teams later on in the INDISAC process, making the transfer of the results obtained in this contribution to the future teams possible. The teams that will be solving the innovation challenges are required to build themselves with team members from three different countries, with a focus on widening and associated countries. The consortium partners are from seven different countries with widening countries represented as well. Furthermore, the consortium partners are diverse concerning their sexes, which is also a requirement for the teams solving the innovation challenges in the INDUSAC project. The results of the questionnaire show, that some of the consortium members do have a lot of experience in multicultural teams whilst others do not. The same will be the case for the teams later on in the process. With these parallels in mind, the insight collected can be transferred to the multicultural teams in the process of the INDUSAC project, as well as to other multicultural and diverse teams.
The following steps include further research on the barriers to creative problem-solving in distributed teams with a focus on the category culture. Furthermore, monitoring of the user journeys and PCAs to improve especially cultural aspects of teamwork will be carried out. The preliminary study sets the base for creating a research environment to further elaborate and gain insights into influencing factors, especially barriers, to intercultural teamwork and highlighted how highly interconnected the influencing factors within the category culture are.

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References

Albers, A., Bursac, N., Walter, B., Hahn, C. and Schröder, J. (2016a), “ProVIL – Produktentwicklung im virtuellen Ideenlabor”, in Stelzer, R. (Ed.), Entwerfen Entwickeln Erleben 2016: Beiträge zur virtuellen Produktentwicklung und Konstruktionstechnik, 30.06.-01.07., Dresden, TUDpress, pp. 185–198.

Albers, A., Lohmeyer, Q. and Ebel, B. (2011), “Dimensions of objectives in interdisciplinary product development projects”, International Conference on Engineering, ICED'09.

Albers, A., Reiss, N., Bursac, N. and Richter, T. (2016b), “iPeM – Integrated Product Engineering Model in Context of Product Generation Engineering”, Procedia CIRP, Vol. 50, pp. 100–105. https://doi.org/10.1016/j.procir.2016.04.168.

Albers, A., Walter, B., Wilmsen, M. and Bursac, N. (2018), “Live-Labs as Real-World Validation Environments for Design Methods”, in Marjanovic, D., Storga, M., Skec, S., Bojčetić, N. and Pavkovic, N. (Eds.), Proceedings of the DESIGN 2018 15th International Design Conference, 21.-24. Mai, Dubrovnik, Kroatien, The Design Society, Dubrovnik, Kroatien, pp. 13–24.

Bastian, A., Wasserbäch, M. and Albers, A. (2023)“Influencing factors on creativity in distributed teams - systematic literature review”.

Brucks, M. S. and Levav, J. (2022), "Virtual communication curbs creative idea generation", Nature, Vol. 605, pp. 102-112, https://doi.org/10.1038/s41586-022-04643-y

Bruneel, J., D’Este, P. and Salter, A. (2010), “Investigating the factors that diminish the barriers to university–industry collaboration”, Research Policy, Vol. 39 No. 7, pp. 858–868. https://doi.org/10.1016/j.respol.2010.03.006.

Buchenau, M. (2020), “Zukunftspreis geht an Entwickler von Fertigungstechnik für Mikrochips”. [online], Available at: https://www.handelsblatt.com/technik/forschung-innovation/euv-lithografie-entwickler-von-zeiss-trumpf-und-fraunhofer-erhalten-deutschen-zukunftspreis/26659346.html (accessed 24.04.23).

Cooper, R.G. (1994), “Third-Generation New Product Processes”, Journal of Product Innovation Management, Vol. 11 No. 1, pp. 3–14. https://doi.org/10.1111/1540-5885.1110003.

European Commission (2022), “Quick Challenge-driven, Human-centered Co-Creation mechanism for INDUStry-Academia Collaborations”. [online], European Commission, Available at: https://cordis.europa.eu/project/id/101070297 (accessed 25.07.23). https://doi.org/10.3030/101070297.

Expertenkommission Forschung und Innovation (EFI) (2022), Report on Research, Innovation and Technological Performance in Germany 2022, EFI, Berlin.

Frank, A., Meyer-Guckel, V. and Schneider, C. (2007), Innovationsfaktor Kooperation.

Fraunhofer-Gesellschaft (2023), “ZEISS, TRUMPF and Fraunhofer research team awarded the Deutscher Zukunftspreis 2020 for the development of EUV lithography”. [online], Available at: https://www.fraunhofer.de/en/press/research-news/2020/november/zeiss-tumpf-and-fraunhofer-research-team-awarded-the-deutscher-zukunftspreis-2020-for-the-development-of-euv-litography.html (accessed 19.04.23).

Garousi, V., Eskandar, M.M. and Herkiloğlu, K. (2017), “Industry–academia collaborations in software testing: experience and success stories from Canada and Turkey”, Software Quality Journal, Vol. 25 No. 4, pp. 1091–1143. https://doi.org/10.1007/s11219-016-9319-5.

Guerrero, M., Urbano, D. and Herrera, F. (2019), “Innovation practices in emerging economies: Do university partnerships matter?”, The Journal of Technology Transfer, Vol. 44 No. 2, pp. 615–646. https://doi.org/10.1007/s10961-017-9578-8.

Kempf, C., Hellwig, I., Bastian, A., Ritzer, K. and Albers, A. (2023), “Success Factors and Barriers in Industry-Academia Collaborations - A Descriptive Model”, in Proceedings of the ASME 2023: International Mechanical Engineering Congress and Exposition (IMECE 2023), New Orleans, Louisiana, US.

Kempf, C., Rapp, S. and Albers, A. (2022), “Potentials and Needs of Research References in Corporate Product Engineering”, in ISPIM Connects Athens - The Role of Innovation: Past, Present, Future, 28-30 November, Athens, LUT Scientific and Expertise Publications.

Kleiner-Schaefer, T. and Schaefer, K.J. (2022), “Barriers to university–industry collaboration in an emerging market: Firm-level evidence from Turkey”, The Journal of Technology Transfer, Vol. 47 No. 3, pp. 872–905. https://doi.org/10.1007/s10961-022-09919-z.

Ropohl, G. (Ed.) (1975), Systemtechnik, Carl Hanser Verlag, München.

VDI Verein Deutscher Ingenieure e.V. (2004), VDI 2206: Entwicklungsmethodik für mechatronische Systeme, Beuth, Berlin.

VDI Verein Deutscher Ingenieure e.V. (2019), Entwicklung technischer Produkte und Systeme: Modell der Produktentwicklung No. VDI 2221 Blatt 1, Beuth, Berlin.

Wissenschaftsrat (2007), Empfehlungen zur Interaktion von Wissenschaft und Wirtschaft, Oldenburg.

Wynn, D.C. and Clarkson, P.J. (2018), “Process models in design and development”, Research in Engineering Design, Vol. 29 No. 2, pp. 161–202. https://doi.org/10.1007/s00163-017-0262-7.