What Do Critical Success Factors of Collaboration Really Mean in the Context of DevOps?

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***Abstract*—Collaboration is an important aspect of DevOps. However, researchers continue to report problems with collaboration between development and operations. Critical Success Factors (CSFs) may contribute to solve these problems. Prior research found CSFs of collaboration. Yet we did not find any comprehensive list of CSFs of collaboration grounded in DevOps practice by real-life examples making them meaningful in that context. Therefore, we aim to show that CSFs of collaboration found in other contexts are also recognized in a DevOps context and what previously validated generally applicable CSFs of collaboration really mean in a DevOps context. The research method comprises of a systematic literature review to find a comprehensive list of generally applicable CSFs of collaboration, a multiple case study to find on the one hand which of these CSFs were recognized in a DevOps context and on the other hand to find real-life examples, which substantiated the CSFs recognized. Finally, the aim is to develop a classification of the CSFs. Our main contribution to theory is a well-founded and structured list of CSFs meaningful for the DevOps profession. The list of CSFs can aid practitioners to have a necessarily impact on the success of collaboration.**

Keywords – adoption; classification; collaboration; critical success factors; DevOps.

I. INTRODUCTION

DevOps is a compound of development and operations [1]. Adopting DevOps improves cycle times, software processes and quality [2].

Collaboration is seen as an important aspect of DevOps. DevOps is considered as an interaction between development and operations [3] and a set of practices and mechanisms supporting their integration [4][5][6][7]. However, literature reports problems with collaboration between both. For example, Iden, Tessem, and Paivarinta [8] and Lwakatare, Kuvaja, and Oivo [9] found poor communication, Wettinger, Breitenbücher, Falkenthal, and Leymann [10] found cultural gaps, and Colomo-Palacios, Fernandes, Soto-Acosta, and Larrucea [2] and Nielsen, Winkler, and Norbjerg [11] found knowledge boundaries.

Critical Success Factors (CSFs) may contribute to solve problems with collaboration between development and operations. However, to the best of our knowledge we did not find any comprehensive list of CSFs of collaboration in a DevOps context. Yet earlier research found CSFs of collaboration validated in other contexts. However, these CSFs can be improved in terms of specializing by context, comprehensiveness and timeliness. For example, Mattessich and Monsey [12] found nineteen factors influencing the success of collaboration and Kolfschoten, De Vreede, Briggs, and Sol [13] derived three factors in an attempt to define the concept of collaboration. As these CSFs are valid in different contexts, they may also be applicable in a DevOps context. For example, Lwakatare, Kuvaja, and Oivo [9] mentioned information sharing and skill sets and Erich, Amrit, and Daneva [3] reports culture and automation. Therefore, our research goal is to show that CSFs of collaboration found in other contexts are also recognized in a DevOps context. And we will also clarify what previously validated generally applicable CSFs of collaboration really mean in a DevOps context. Clarification of these CSFs by formulating them in terms of the DevOps profession is important as it makes CSFs meaningful in that context. Meaningful CSFs of collaboration can be addressed more easily leading to performance improvements in collaboration. Prior research present CSFs often in an abstract way and expressed in general terms. That makes these CSFs difficult to interpret, apply and measure in the context of DevOps.

This research goal brings us to our research question: Which generally applicable CSFs of collaboration are recognized in the context of DevOps and how to make them meaningful in the context of DevOps? To answer the main research question, we divide it into the following three sub questions (SQs): (SQ1) What are generally applicable CSFs of collaboration? (SQ2) Which generally applicable CSFs of collaboration are recognized in the context of DevOps? SQ3: How to make the recognized generally applicable CSFs of collaboration meaningful in the context of DevOps?

We will contribute to the existing literature by adding another research context, namely the context of DevOps. This is important, because literature has given little notice to different contexts of collaboration [14], such as the DevOps context. Second, CSFs vary in terms of abstraction and explanation as we will explain in Section 2.

The outline of this article is as follows. In Section 2, we present previous research on CSFs of collaboration. Subsequently, in Section 3, we describe the research method. In Section 4, we present the results of the case study. In Section 5, we discuss the implications and limitations, and

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present suggestions for future research. Finally, we reflect on our research question and research goal in Section 6.

II. THEORETICAL BACKGROUND

Considering the research question, we explored related work to find a comprehensive list of CSFs of collaboration which can be used in a case study to verify whether generally applicable CSFs are recognized in a DevOps context. To support this, we used the definition of collaboration defined by [15] as "An evolving process whereby two or more social entities actively and reciprocally engage in joint activities aimed at achieving at least one shared goal". In addition, we defined a CSF as a factor leading to successful outcome, which is in line with [12][16].

Although prior research views collaboration from different perspectives, reflection on CSFs found earlier is limited. In the early stages of research on collaboration in general, [12] reviews and summarizes existing research literature on CSFs which influence the success of collaboration. The researchers found nineteen CSFs of collaboration validated in health science and social science, and also in education and public affairs domains. In 2001 these nineteen CSFs were confirmed and an additional CSF was added: "an appropriate pace of development" [17]. Reference [18] studied a partnership between two organizations and found the factors of successful collaboration to be: partnership attributes of commitment, coordination, trust, communication quality, participation, and the conflict resolution technique of a joint problem. Collaboration between team members was studied by [19]. They mentioned human-related factors, such as social ties and knowledge sharing as important for collaborative work. The authors report in particular the importance of rapport and transactive memory, and organizational mechanisms creating and maintaining social ties between distributed team members. Reference [13] conceived collaboration as a process and a system. According to [13], collaborative success depends on willingness of its participants, which makes it a complex activity. The authors explained that collaboration involves individuals working together to achieve a group goal. Reference [15] focused on a multidisciplinary conceptualization of collaboration. According to [15] effective collaboration needs coordination. This was confirmed by [20][21] who consider coordination and cooperation as the most important problems that must be solved when individuals from diverse backgrounds and different organizations have to collaborate. Reference [22] studied collaboration among supply chain partners and identified the CSFs trust, commitment, mutuality and reciprocity.

Prior research not just identified CSFs but attempted to classify CSFs found as well. However, they classify CSFs differently based on various perspectives. For example, Mattessich and Monsey [12] classified the CSFs found into six groups: environment, membership, process/structure, communications, purpose and resources. Reference [15] applied an abstract classification and distinguished different characteristics. Reference [23] deduced the classification from their description of collaborative work. According to [23] aspects of collaborative work can be classified into seven main factor groups: context, support, tasks, interaction processes, teams, individuals and overarching factors. Finally, differences in grouping CSFs were also noticed by [14] who elaborated "Many studies have attempted to assess the CSFs for collaboration. In these studies, CSFs can be classified into CSFs influencing the likelihood of collaboration, CSFs influencing the performance of collaboration, and those influencing the collaboration type". However, [14] does not explain how CSFs can be classified.

Research on collaboration in a DevOps context has limitations as well. Prior research presents CSFs which are broad and not only focused on collaboration, and are limited in terms of comprehensiveness [24]. For example, Lwakatare, Kuvaja, and Oivo [9] mentioned information sharing and broadening of skill sets and relates them to the intended outcome, which is taking full responsibility for developing and operating an entire service. Reference [3] reports core parts of DevOps adoption, such as culture and a high degree of automation. According to the authors, organizations attempt to remove the cultural barrier between development and operations personnel and create a culture of empowerment. For example, by assigning more responsibilities to the DevOps team and giving team members the freedom to share what is on their mind. Reference [25] noticed in a study on DevOps maturity that the organization itself should be ready to execute work. They explain that DevOps team members should communicate, share knowledge, have trust and respect for each other, and align between internal and external dependencies to timely deploy software.

Grounding CSFs in DevOps practice makes CSFs better useful in the context of DevOps. The CSFs found were grounded in practice containing terminology common in the professional field. For example, Lwakatare, Kuvaja, and Oivo [9] mentioned monitoring information to illustrate knowledge sharing and Erich, Amrit, and Daneva [3], who noted automating the software release process, which can be considered as a form of clear rules and procedures. Therefore, a comprehensive list of CSFs grounded in a DevOps practice is needed.

In summary, research on CSFs of collaboration and research on collaboration in a DevOps context has limitations. In the first place, the lists found are limited build upon evolving literature of collaboration. Second, CSFs should be more generic in order to be useful in different contexts. Third, prior research has not resulted in a comprehensive list of CSFs grounded in DevOps practice. Therefore, a systematic literature review is needed first to find a more comprehensive and general list of CSFs, which can be made meaningful in the DevOps context.

III. RESEARCH METHODOLOGY

To obtain a comprehensive list of CSFs manageable and meaningful in a DevOps context, we followed three phases. The systematic literature review was the first phase in which we obtained a more comprehensive list of generally applicable CSFs. In the second phase a multiple case study was conducted to verify recognition of the CSFs found and

to find corresponding real-life examples. The third phase concentrated on the classification of CSFs to develop a structured list of CSFs manageable and meaningful in a DevOps context. Classification was not possible until this phase because we need the real-life examples obtained in the second phase to infer what the CSFs recognized really mean in a DevOps context.

A. Systematic literature review

In order to pursue comprehensiveness, we conducted the systematic literature review in two steps applying two methods. In the first step, we conducted a literature review as described by [26] followed by snowballing in the second step. Access to digital library records was limited to the subscription of our institution. In the first step, we chose to search in the Web of Science digital library using two search strings. The first search string contained 'collaboration' in title and 'success AND factor' in all fields. As the second search string we used 'collaboration AND factor' in title. We started the search from 1992, the publication of [12]. The first search provided 205 papers and the second provided 210 papers. We removed duplicates and undertook an initial screening, which resulted in 58 papers found. Next, we assessed the remaining papers to identify papers that could be rejected based on the full text on the basis that they did not include CSFs or barriers of collaboration or on the basis of quality issues. For example, irrelevant papers or papers that contain drivers that may trigger collaboration. We found 44 papers, which included 374 CSFs.

After that, we continued in the second step our search for CSFs by applying backward snowballing and forward snowballing on the 44 papers in which we found CSFs [27]. During snowballing, 4314 papers were found. We removed duplicates and papers based on title, abstract and full text on the basis that they did not include CSFs or barriers of collaboration. This resulted in 21 papers found, which contained 198 CSFs. As we found a lot of duplicate CSFs, we did not expect to find additional CSFs by conducting more iterations of snowballing. Therefore, we stopped after one iteration. Thus, we found 572 CSFs so far.

In addition, we found 23 CSFs in the following six papers of which we were aware: [9][13][15][19][22][25]. This resulted in 595 CSFs found in total.

Because we did not yet know which CSFs would be recognized and what the CSFs found would mean in a DevOps context, we were not able to classify them. However, to be able to discuss the 595 CSFs found in the consecutive case study we grouped them according to the 20 factors found by the often-cited papers of [12][17], the ten additional factors found by [23] and the two additional factors (CSF 4 and CSF 11) found by [14][22][28]. We adopted the names of the CSFs from literature, and condensed the key findings and used them as clarifications. Thus, the results of the systematic literature review consist of a list of 32 generally applicable CSFs of collaboration.

We published the list of 32 CSFs in [24]. An example from this list is the CSF "Concrete attainable goals and objectives" described by the following clarification "Setting of clear goals (at the planning stage) [23], supplementary purposes [14] and feasible [12], based on key community issues, agreed upon [13][28][29]".

This list answers sub question SQ 1 and extended the CSFs found previously by Mattessich, Murray-Close, and Monsey [17]. However, prior research has limitations. For example, brief contextual information, limitations on definitions of CSFs and limitations on generalizability. Furthermore, we did not know whether these CSFs will be recognized in a DevOps context and whether there are more applicable CSFs. Therefore, we conducted a multiple case study.

B. Multiple case study

We consider a case study as a relevant method, because it addresses our research questions on collaboration which require to explain and describe this social phenomenon [30]. According to [23] collaboration can best be understood in terms of the context in which people are working and their interactions. Therefore, we decided to conduct a multiple case study and based the methodology on five steps proposed by [30]: (1) designing the case study, (2) preparing to collect evidence, (3) collecting evidence, (4) analyzing evidence, and (5) reporting results.

In the first step, we designed the case study to assure the data to be collected relates to our research question [30]. To validate our list of CSFs in a DevOps context we used an inductive approach. We carry out cross-sectional semi-structured interviews, which allowed us exploration of the CSFs and improvisation [31].

In the second step, we prepared the collection of evidence. We choose to collect data in organizations which experienced DevOps for several years, because we needed real-life examples to substantiate the CSFs found. Thus, we contacted gatekeepers of organizations that appear to comply to our requirement regarding DevOps experience and explain our study. We found two governmental ISPs which wanted to participate in this study, which met our criterion and experienced DevOps for several years. Both organizations studied were professional and large organizations which exist for a long time. The gatekeepers had a central role with a good overview of DevOps developments in the organization for a number of years.

We asked the gatekeepers for permission to interview employees who met our criteria of at least two years of practical and broad experience with DevOps to be able to mention and elaborate on examples.

Together with the gatekeepers we selected interviewees who had a coordinating role or advisory role or developer role. Each organization provided five interviewees originating from different teams. We contacted the potential interviewees, explained our study and verified whether they were available and willing to participate.

We were able to select interviewees who had at least two years of practical experience as an advisor, developer, scrum master or manager with the application of aspects (in a broad sense) of DevOps.

In order to assure reliability, we prepared an interview protocol, which contained information on the research project, procedures for data collection and analysis, and three

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main interview questions. We asked: (1) whether and to what extent the interviewees recognized the definition of collaboration according to [15]; (2) whether they recognized each CSF and if they knew any additional CSFs; (3) per CSF for real-life examples and facts based on their own experiences. The first question was intended to introduce the concept of collaboration and to verify whether the interviewee had the same interpretation of this concept in the context of DevOps. We stored the protocol as well as the results into a database. We started the interviews with a pilot interview. According to the interview protocol, we sent the interviewee the interview questions and the appendices. Afterwards, we applied the interview questions during the pilot interview. By applying the interview protocol and interview questions in a real-life setting we learned that no improvements to our interview protocol or interview questions were necessary. Thus, we proceeded to the third step.

In the third step, we collected the evidence by conducting the other interviews. Each interview took place face-to-face. The researcher conducting the interview also took notes during the interviews, recorded each interview and transcribed each interview afterwards. Subsequently, we sent a transcription to the corresponding interviewee, which enabled the interviewee to amend the transcription.

In the fourth step, we analyzed the content. Therefore, we familiarized ourself with the content, divided the text up into meaning units and condensed these units if appropriate and formulated codes [32]. We coded our data using ATLAS.ti by reading the transcripts and adding codes to meaning units, such as feedback on the definition of collaboration, recognized CSFs, mentioned additional CSFs and real-life examples. In that way we were able to export tables of the results. Next, we condensed the meaning units if appropriate to support the classification of the results, which was particularly appropriate in the case of the real-life examples to make them more concise.

The real-life examples illustrate the recognition of experts regarding all 32 CSFs found. For example, the development of a unique product as an example of a goal, or reviewing new code before merging as an example of a rule. They also contain specific, concrete and 'richer' experience-based information on what the CSFs really mean in a DevOps context. This enabled us to refine the initial names and clarifications of the CSFs to reflect the DevOps context. Therefore, we replaced the more general concepts by concepts and descriptions based on the supporting evidence. Some parts of initial clarifications were neglected due to irrelevance or lack of evidence.

In the fifth and last step, we put the recognized CSFs, the corresponding refined clarifications and the condensed real-life examples in one table.

C. Classification of the 32 CSFs recognized

In the third phase we developed categories of CSFs by classification of the 32 CSFs recognized. Until this phase classification was not possible because we need the real-life examples obtained in the previous phase to infer what the CSFs recognized really mean in a DevOps context.

We based the classification on the metaplan-method [33]. The identification and classification of similar CSFs make the list of CSFs more manageable and provides the basis for making the CSFs measurable. As part of the classification, we could infer clarifications meaningful in the DevOps context.

During the metaplan session we stated and discussed the rationale for sorting each card, determined the name of each emerged CSF and derived the clarifications of the fourteen new emerged CSFs from the grouped CSFs. For example, we grouped CSF "Roles and responsibilities" with CSF "Rules and procedures" into CSF "Procedures and responsibilities" based on examples mentioned, such as "Members determine their own way of work" and "The whole team is responsible for everything they deliver". In the following three cases, we adopted clarifications from literature: Knowledge Management, Communication and Leadership. With the resulting fourteen CSFs, corresponding clarifications and condensed real-life examples we were able to answer the sub research questions in Section 4.

IV. RESULTS OF THE MULTIPLE CASE STUDY

In Section 3, we have found that all generally applicable CSFs found in literature were recognized, which answers sub question 2. Furthermore, we did not find additional CSFs. We also showed how recognized generally applicable CSFs of collaboration could be made meaningful in the context of DevOps, which answers sub question 3. Thus, we are now able to prove that we obtained the research goal by showing what previously validated generally applicable CSFs of collaboration really mean in a DevOps context. Therefore, we present the fourteen CSFs of collaboration in a DevOps context in Table I together with clarifications which makes the CSFs meaningful for the DevOps profession.

TABLE I. CSFS OF COLLABORATION IN A DEVOPS CONTEXT

CSF	Clarification to make the CSF meaningful in a DevOps context
Goals and vision	Concrete, attainable and unique goals derived from a shared vision, which are mutual understood and agreed by the whole team and supported by stakeholders.
Procedures and responsibilities	Clear procedures, rules and responsibilities to structure collaboration.
Performance measurement	The performance of collaboration is measured by quantitative and qualitative measurement methods.
History	The length of time for which team members have known each other.
Workload	Feasible balance between available resources, time and required output.
Knowledge Management	Distinct but interdependent processes of knowledge creation, knowledge storage and retrieval, knowledge transfer, and knowledge application [34].
Communication	A synthesis of a selection of information, the utterance of this information and a selective understanding or misunderstanding of this utterance and its information [35].
Leadership	The ability to build and maintain a group that performs well relative to its competition [36].
Tools	Technological support for collaboration and communication.

CSF	Clarification to make the CSF meaningful in a DevOps context
Task characteristics	Recognizing relevant task characteristics.
Perceived benefits of collaboration	Collaboration is seen as valuable for the individual, team and the organization.
Team recognition	The team is perceived as a leader, at least related to the goals and activities it intends to accomplish.
Resilience	The ability to deal with changing conditions.
Team composition	Make-up of team membership.

Based on the results, we are able to discuss the implications in Section 5.

V. DISCUSSION

Our findings have several theoretical implications. First, our findings confirm that generally applicable CSFs of collaboration found in literature can be recognized in a DevOps context. These implications extent theory on CSFs of collaboration at large. It supports the statement of [17] that the CSFs they found are applicable to many different collaborative situations. It is also in line with the findings of [9][25] who studied the DevOps phenomenon. Second, we developed and validated an approach that generally applicable CSFs can be made meaningful in a DevOps context. This approach enables the operationalization of the CSFs in a DevOps context and may be useful to other contexts as well. Third, the real-life examples illustrate how the CSFs are anchored in the way team members work together. This shows that collaboration is indeed an important aspect of the adoption of DevOps. Researchers could build on these insights for future research into the DevOps phenomenon. Fourth, the findings discover additional evidence to confirm the importance of each factor previously found by [17].

The findings of our study also have implications for practitioners. First, the CSFs could aid practitioners to better understand the concept of collaboration in a DevOps context in order to have a necessarily impact on the success of collaboration. Second, the implications from this study of CSFs challenge the general view on DevOps as just an interaction between development and operations personnel [3][5][7]. As shown in the results, organizations should take into account many CSFs of collaboration. The number of CSFs requires adequate attention to let the collaboration be successful. In line with the suggestion of [17], organizations can use the list of CSFs to assess the readiness of team members to collaborate in a DevOps context or to find aspects to improve the collaboration within an existing team.

Even though our initial list of CSFs based on literature and used in our multiple case study would appear to be a strong basis, we have to mention some remarks. The CSFs found were based on earlier research conducted in different contexts and studied from different perspectives. For example, Marek, Brock, and Savla [29] studied individual coalitions and initiatives across state, regional and nationwide. Reference [13] studied collaboration from social and technical perspectives. Other examples are Yoon, Lee, Yoon, and Toulan [14], Mattessich, Murray-Close, and Monsey [17], Mohr and Spekman [18], Tsanos, Zografos, and Harrison [22], and Patel, Pettitt, and Wilson [23], who concentrate on interorganizational collaboration, which could be in the form of collaboration between team members. In short, the CSFs used in our multiple case study differ in terms of operationalization, abstraction level, validation context and research area. This could have influenced the results of this study.

Although it took some time before we could publish the results of our study, we could not find publications which present a similar list of CSFs of collaboration in a DevOps context in the meantime.

Our findings appear to be more widely useable due to the fact that the findings are based on two case organizations. However, the list of CSFs should be adapted to the local context.

According to the chosen definition, a CSF must have an impact on the success of collaboration. A study into measuring the impact may be an interesting topic. Careful and explicit research is needed to verify that the resulting model of CSFs is actually adequate. Research could validate whether a certain CSF aided in the improvement of collaboration.

When we discussed CSFs during the interviews, interviewees made some remarks on relations between CSFs confirmed. Although we did not research this aspect, we think it may contain interesting topics for future research as they may aid in understanding collaboration in a DevOps context.

Classification of CSFs into CSFs of collaboration in a DevOps context influencing the likelihood of collaboration and CSFs influencing the performance of collaboration may be a topic for further research. Knowing which CSFs play a role during the beginning of a collaboration could ease decision-making by management [37].

Although we conducted two case studies, we recommend more case studies conducted in a DevOps context, which will enrich the list further. Future research could focus on the validation of certain CSFs with more concrete real-life examples.

Finally, future research could apply the developed approach to make generally applicable CSFs meaningful in specific context.

VI. CONCLUSIONS

Research into the effectiveness of integrated corporate functions is relevant, such as research on DevOps. Collaboration is an important aspect of DevOps, which should contribute to the effectiveness of DevOps. Therefore, reported problems with collaboration should be solved. CSFs of collaboration may contribute to solve problems with collaboration. This study found generally applicable CSFs of collaboration and provides insight into the way two case organizations addressed these CSFs in a DevOps context. We used this insight and made the generally applicable CSFs meaningful in a DevOps context.

This knowledge adds to existing theory on collaboration by providing a comprehensive list of CSFs meaningful in a DevOps context. Furthermore, our study validated an

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approach by which generally applicable CSFs of collaboration could be made meaningful in a certain context. The CSFs confirmed could aid practitioners to better understand the concept of collaboration in a DevOps context in order to have a necessarily impact on the success of collaboration. Organizations could use the CSFs to assess the readiness of team members to collaborate or to find aspects to improve the collaboration within existing DevOps teams.

All data emerged during the research process are available on request.

REFERENCES

[1] I. M. Sebastian et al., "How Big Old Companies Navigate Digital Transformation," MIS Quarterly Executive, vol. 16, pp. 197–213, 2017.

[2] R. Colomo-Palacios, E. Fernandes, P. Soto-Acosta, and X. Larrucea, "A case analysis of enabling continuous software deployment through knowledge management," International Journal of Information Management, vol. 40, pp. 186–189, 2018.

[3] F. M. A. Erich, C. Amrit, and M. Daneva, "A qualitative study of DevOps usage in practice," Journal of Software: Evolution and Process, vol. 29, 2017.

[4] G. G. Claps, R. B. Svensson, and A. Aurum, "On the journey to continuous deployment: Technical and social challenges along the way," Information and Software Technology, vol. 57, pp. 21–31, 2015.

[5] C. Ebert, G. Gallardo, J. Hernantes, and N. Serrano, "DevOps," IEEE Software, vol. 33, pp. 94–100, 2016.

[6] M. Hüttermann, DevOps for developers. Apress, 2012.

[7] A. Wiedemann, "IT Governance Mechanisms for DevOps Teams - How Incumbent Companies Achieve Competitive Advantages" The 51st Hawaii International Conference on System Sciences, 2018, pp. 4931-4940, ISBN: 978-0-9981331-1-9

[8] J. Iden, B. Tessem, and T. Paivarinta, "IS development/IT operations alignment in system development projects: a multi-method research," International Journal of Business Information Systems, vol. 11, no. 3, pp. 343–359, 2012.

[9] L. E. Lwakatare, P. Kuvaja, and M. Oivo "Dimensions of devops" The 16th International Conference on Agile Processes in Software Engineering and Extreme Programming Springer International Publishing, May 2015, pp. 25-29

[10] J. Wettinger, U. Breitenbücher, M. Falkenthal, and F. Leymann, "Collaborative gathering and continuous delivery of DevOps solutions through repositories," Computer Science - Research and Development, vol. 32, pp. 281–290, 2017.

[11] P. A. Nielsen, T. J. Winkler, and J. Norbjerg, "Closing the IT Development-Operations gap: The DevOps knowledge sharing framework" The 16th International Conference on Perspectives in Business Informatics Research (CEUR), 2017

[12] P. W. Mattessich and B. R. Monsey, Collaboration--what makes it work: a review of research literature on factors influencing successful collaboration. St. Paul, Minn: Amherst H. Wilder Foundation, 1992.

[13] G. L. Kolfschoten, G. J. de Vreede, R. O. Briggs, and H. G. Sol "Collaboration 'Engineerability'," Group Decision and Negotiation, vol. 19, pp. 301–321, 2010.

[14] C. Yoon, K. Lee, B. Yoon, and O. Toulan, "Typology and Success Factors of Collaboration for Sustainable Growth in the IT Service Industry," Sustainability, vol. 9, 2017.

[15] W. L. Bedwell et al., "Collaboration at work: An integrative multilevel conceptualization," Human Resource Management Review, vol. 22, pp. 128–145, 2012.

[16] J. Ram, D. Corkindale, and M. L. Wu, "Implementation critical success factors (CSFs) for ERP: Do they contribute to implementation success and post-implementation performance?," International Journal of Production Economics, vol. 144, pp. 157–174, 2013.

[17] P. W. Mattessich, M. Murray-Close, and B. R. Monsey, Collaboration What Makes It Work. Saint Paul, MN: Fieldstone Alliance, 2001.

[18] J. Mohr and R. Spekman, "Characteristics of partnership success: Partnership attributes, communication behavior, and conflict resolution techniques," Strategic Management Journal, vol. 15, pp. 135–152, 1994.

[19] J. Kotlarsky and I. Oshri, "Social ties, knowledge sharing and successful collaboration in globally distributed system development projects," European Journal of Information Systems, vol. 14, pp. 37–48, 2005.

[20] J. Söderlund, Theoretical Foundations of Project Management. Oxford University Press, 2011.

[21] J. Iden and B. Bygstad, "The social interaction of developers and IT operations staff in software development projects," International Journal of Project Management, vol. 36, pp. 485–497, 2018.

[22] C. S. Tsanos, K. G. Zografos, and A. Harrison, "Developing a conceptual model for examining the supply chain relationships between behavioural antecedents of collaboration, integration and performance," The International Journal of Logistics Management, vol. 25, pp. 418–462, 2014.

[23] H. Patel, M. Pettitt, and J. R. Wilson, "Factors of collaborative working: A framework for a collaboration model," Applied Ergonomics, vol. 43, pp. 1–26, 2012.

[24] M. van Belzen, D. de Kruijff, and J. Trienekens, "Success Factors of Collaboration in the Context of DevOps, " The 12th International Conference Information Systems IADIS, 2019, pp. 26–34, ISBN: 978-989-8533-87-6

[25] R. de Feijter, S. Overbeek, T. van Vliet, E. Jagroep, and S. Brinkkemper, "DevOps Competences and Maturity for Software Producing Organizations," Enterprise, Business-Process and Information Systems Modeling, vol. 318, pp. 244-259, 2018.

[26] B. Kitchenham et al., "Systematic literature reviews in software engineering – A tertiary study," Information and Software Technology, vol. 52, pp. 792–805, 2010.

[27] S. Jalali and C. Wohlin, "Systematic literature studies: database searches vs. backward snowballing" The ACM-IEEE international symposium on Empirical software engineering and measurement (ESEM) ACM-IEEE, Sep. 2012, pp. 29-38, ISBN: 978-1-4503-1056-7

[28] C. A. Olson, J. T. Balmer, and G. C. Mejicano, "Factors Contributing to Successful Interorganizational Collaboration: The Case of CS2day," Journal of Continuing Education in the Health Professions, vol. 31, pp. 3–12, 2011.

[29] L. I. Marek, D. J. P. Brock, and J. Savla, "Evaluating Collaboration for Effectiveness: Conceptualization and Measurement," American Journal of Evaluation, vol. 36, pp. 67–85, 2015.

[30] R. K. Yin, Case study research and applications: design and methods. Los Angeles, CA: SAGE, 2018.

[31] P. Runeson and M. Höst, "Guidelines for conducting and reporting case study research in software engineering," Empirical Software Engineering, vol. 14, pp. 131-164, 2009.

[32] C. Erlingsson and P. Brysiewicz, "A hands-on guide to doing content analysis," African Journal of Emergency Medicine, vol. 7, pp. 93–99, 2017.

[33] E. Schnelle, The Metaplan-Method communication tools for planning and learning groups. Quickborn, Metaplan, 1979.

[34] M. Alavi and D. E. Leidner, "Review: Knowledge Management and Knowledge Management Systems:

Conceptual Foundations and Research Issues," MIS Quarterly, vol. 25, no. 1, pp. 107-136, 2001.

[35] N. Luhmann, "What is Communication?," Communication Theory, vol. 2, pp. 251–259, 1992.

[36] R. Hogan and R. B. Kaiser, "What we know about Leadership," Review of General Psychology, vol. 9, pp. 169–180, 2005.

[37] C. Bai and J. Sarkis, "A grey-based DEMATEL model for evaluating business process management critical success factors," International Journal of Production Economics, vol. 146, pp. 281–292, 2013.

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