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Target Process Analyses for the Preparation of Software Projects

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A B S T R A C T

The subject of this paper is the application of target process analyses in requirements engineering. While target process analyses are used in practice, they are generally not a mandatory step in the standard requirements engineering process. Based on a survey, the paper first examines the use of target process analyses. Subsequently, a possible procedure for conducting such an analysis is presented. The study concludes that target process analyses must be conducted iteratively, as the resulting insights—aligned with the purpose of requirements engineering—lead to refinements of the process model. This requires a clear definition of objectives in advance. The survey revealed that this is, in fact, a key purpose of target process analysis.

Keywords: business analysis, requirements engineering, target process analysis

Introduction

Requirements engineering aims to determine how a software solution should be optimally designed to meet business needs [IEEE Std. 610.12-1990, p. 62 f. in conjunction with PR15, p. 4]. The tasks of requirements engineering have been described in various sources, such as [PR15], [Ba09], [So16], or [Hr14]. The execution of specific target process analyses is not generally prescribed as a mandatory task in requirements engineering. Hruschka equates business processes in part with functional requirements [Hr14, p. 61], which would make a target process analysis necessary.

In practice, different approaches are taken in requirements engineering to clarify the requirements for a software solution. Mainly, it is possible either (Option 1) to start with known requirements and analyze them or (Option 2) to first analyze the target process and then derive the requirements for the solution. In most projects, both a catalog of requirements and an understanding of the target process exist, making both options viable. As stated in the well-known book by Hammer and Champy (1993), we should first ask “why” we perform a process before attempting to improve it [HC93]. This argument supports Option 2. However, conducting a business process analysis at the beginning of requirements engineering can be time-consuming, and process models such as Extreme Programming (XP) advocate for an early start to software development [Ma03, p. 12 ff.]. This favors Option 1.

This study analyzes the application of target process analyses as part of requirements engineering, conducted before the actual requirements analysis. It aims to answer the following questions:

RQ1: When should a target process analysis be conducted?

RQ2: How should the target process analysis be conducted?

The next section provides a brief overview of selected related works in the fields of business process analysis and requirements engineering. Section 3 describes the methodology used in this study. Section 4 presents the research findings, which are discussed in Section 5. The study concludes with a summary and an outlook.

Related Work

According to [IEEE Std. 610.12-1990, p. 62], requirements are defined as capabilities or characteristics that a software system must fulfill. Requirements analysis is described as the process of examining user needs to define a specification for the intended system [IEEE Std. 610.12-1990, pp. 62 ff.]. These definitions neither exclude target process analysis nor explicitly designate it as a required component of requirements engineering.

The standard [ISO/IEC/IEEE 29148:2018(E)] provides details on the requirements engineering process, which includes the consideration of business processes (see pages 51 to 60). From a procedural perspective, [ISO/IEC/IEEE 29148:2018(E), p. 20] recommends implementing the "Business or Mission Analysis Process" as defined in [ISO/IEC/IEEE 15288:2023(E)]. According to [ISO/IEC/IEEE 15288:2023(E), pp. 59–62], this process clarifies the strategic problem and possible solutions.

Coskuncay et al. describe how process models facilitate requirements engineering [CAD+10]. In addition to reducing effort, they observe that process analysis leads to a more structured requirements analysis [CAD+10], which in turn positively impacts the quality of the requirements engineering outcome [CAD+10].

Panayiotou et al. highlight that the successful implementation of an ERP system depends on the extent to which the software solution effectively meets business requirements [PGE+15]. To achieve this, analyzing business processes is beneficial, as it provides a foundation for specifying needs [PGE+15]. According to Panayiotou et al., process modeling serves a coordinating function in fulfilling requirements [PGE+15].

Ghasemi demonstrates that requirements engineering benefits from the application of process mining [Gh18]. Process mining helps determine how a process is actually executed in practice, which supports the derivation of use cases [Gh18, pp. 8 ff.].

Method

To address research questions RQ1 and RQ2, a survey is conducted. The participants of the survey are dual bachelor's students from different semesters. Dual students spend part of their studies working in a business environment, gaining practical experience in the profession they are studying.

The survey is conducted using [Mentimeter] during a lecture. [Mentimeter] is an online platform that allows participants to engage with interactive presentations. This includes live questions that students can answer in real time during the lecture. The participants were asked to respond to the following questions, with Q1 and Q2 specifically referring to their respective training companies.

Q1	**Question**: How do you evaluate the following statements regarding the work in your company? **Response Options**: a) At the beginning of requirements engineering, the target process is always analyzed in our company. b) The analysis of the target process is unnecessary if the requirements are already known. c) The analysis of the target process is useful but is omitted due to time constraints. d) The analysis of the target process is not requested by our customers. **Scale**: Participants rate the above response options on a scale from 0 to 10, where 10 points mean "Always applies" and 0 points mean "Never applies."
Q2	**Question**: Under what conditions does your employer regularly conduct a target process analysis? **Response Format**: Participants provide their answers in free-text format. **Evaluation**: The free-text responses are coded for further analysis. Guidelines on the coding procedure can be found in [KR24].
Q3	**Task**: Participants are instructed to form groups and complete the following task: "Discuss the analysis of the target process in relation to your upcoming exam topic. Identify the tasks that must be performed in a target process analysis." After the discussion, each group is asked to answer the following question.

	Question: What tasks must be carried out as part of a target process analysis? **Response Format**: Groups provide their answers in free-text format. The responses are independent of the participants' professional employment, meaning they should not reference a specific company. Instead, the groups are asked to consider the question in the context of their exam preparation, where they will work individually or in teams to implement a software project. **Evaluation**: The free-text responses are coded for further analysis. Guidelines on the coding procedure can be found in [KR24].

The surveys were conducted during various lectures. During these sessions, participants answered the aforementioned questions using [Mentimeter]. The responses were then downloaded from [Mentimeter] and analyzed using [Microsoft® Excel® 2019]. All responses were collected anonymously.

For question Q1, responses were received from 12 participants.

For question Q2, a total of 16 responses from 15 participants were available for analysis.

For question Q3, 16 responses were provided by 11 groups.

Results

As part of question Q1, the frequency of target process analyses and selected factors influencing this frequency were examined. The results are presented in Figure 1. Participants indicated that in more than half of all cases (= 5.75 on a scale from 0 to 10), a target process analysis is conducted at the beginning of requirements engineering in their companies (Option a). Additionally, responses to Option b suggest that in approximately half of all cases (= 5.25 on the same scale), a target process analysis is considered unnecessary when requirements are already known. This indicates that target process analyses are applied with moderate frequency in practice. When a target process analysis is omitted, the reasons are rarely attributed to time constraints (Option c with 2.92) or to customers not requesting it (Option d with 2.83).

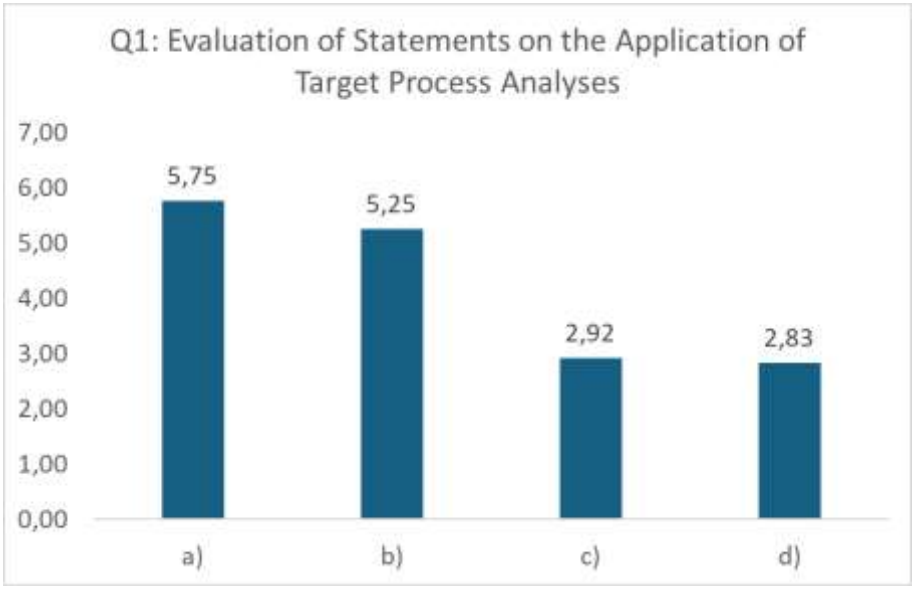

Figure 1 - Results of Q1. Own illustration, created with [Microsoft® Excel® 2019].

Figure 2 presents the results for Q1 in the form of a box plot diagram. The visualization highlights that participants were more confident in their assessments of Options a and b, whereas responses for Options c and d exhibited greater variability and uncertainty.

The standard deviation for responses to:

- Option a is 2.83,
- Option b is 2.59,

- Option c is 3.07, and
- Option d is 2.82.

This indicates that while Options a and b received relatively consistent evaluations, Options c and d showed higher fluctuations, suggesting greater divergence in participants' perceptions.

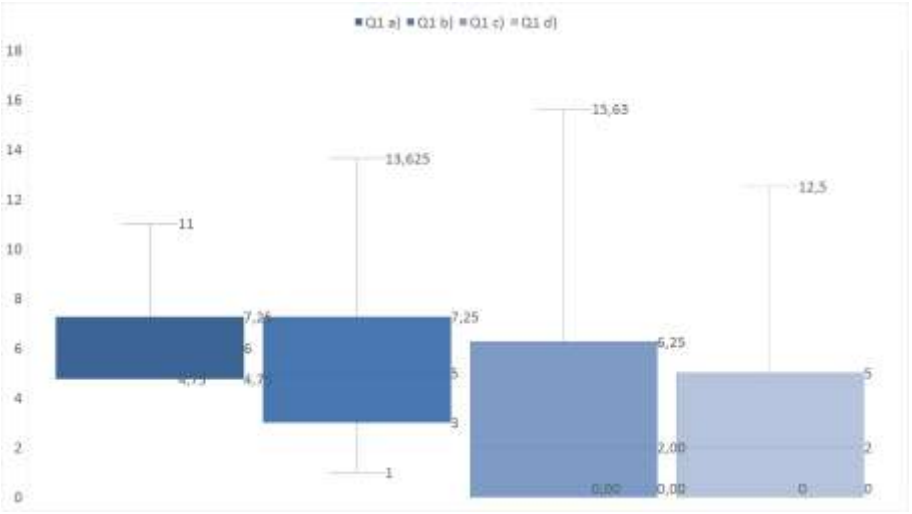

Figure 2 - Result of Q1 as box plot. Own illustration, created with [Microsoft® Excel® 2019].

As part of Q2, participants were asked under what conditions their employer regularly conducts a target process analysis. They provided free-text responses, which were then coded according to the methodology described in [KR24].

For the evaluation, the responses were assigned to the following categories:

Objective definition

Planning

Documentation

Process analysis

Process optimization

Goal achievement analysis

These categories were developed based on the given responses. Each evaluable free-text response was assigned to one or more categories. Responses that could not be evaluated were placed in a separate "Not Evaluable" category.

In total, four responses to Q2 were classified as not evaluable. Figure 3 presents the results, displaying the absolute frequency of each category mentioned by participants.

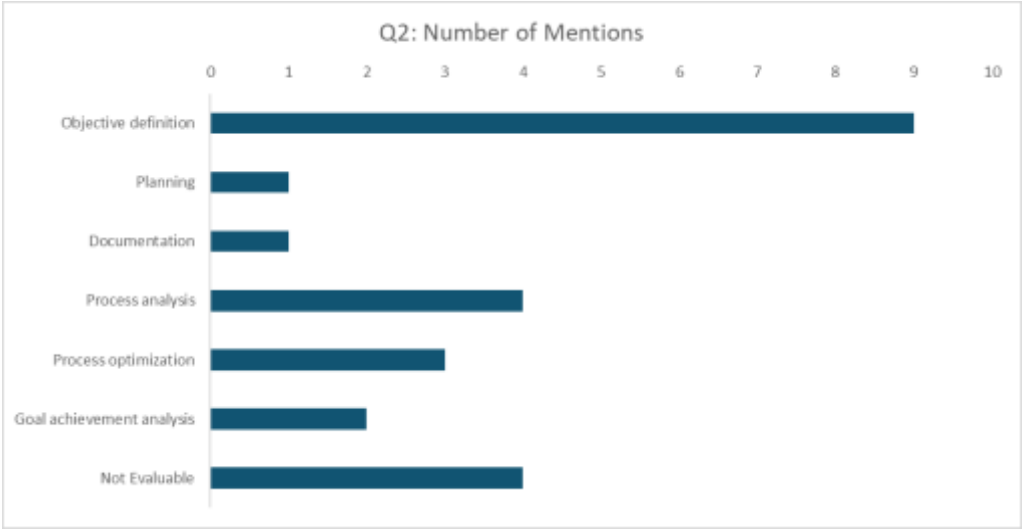

Figure 3 - Result of Q2: total number of mentions. Own illustration, created with [Microsoft® Excel® 2019].

The visualization in Figure 3 shows that target process analyses are most frequently conducted to support goal definition (9 mentions). They are also commonly performed for process analysis (4 mentions). In contrast, target process analyses are rarely conducted to support planning or documentation (1 mention each).

The responses to Q3 provide insights into RQ1. The results suggest that target process analyses are primarily conducted to refine objectives and plan process improvements.

To answer Q3, participants first completed a group exercise, where they defined the tasks involved in a target process analysis. Their responses were not related to their professional experience but rather aimed at exam preparation. In the exam, participants are required to implement a software project.

Following the exercise, each group provided a free-text response to Q3. These responses were coded in the same manner as Q2. Responses that could not be evaluated were categorized as "Not Evaluable". In total, 5 responses were assigned to this category.

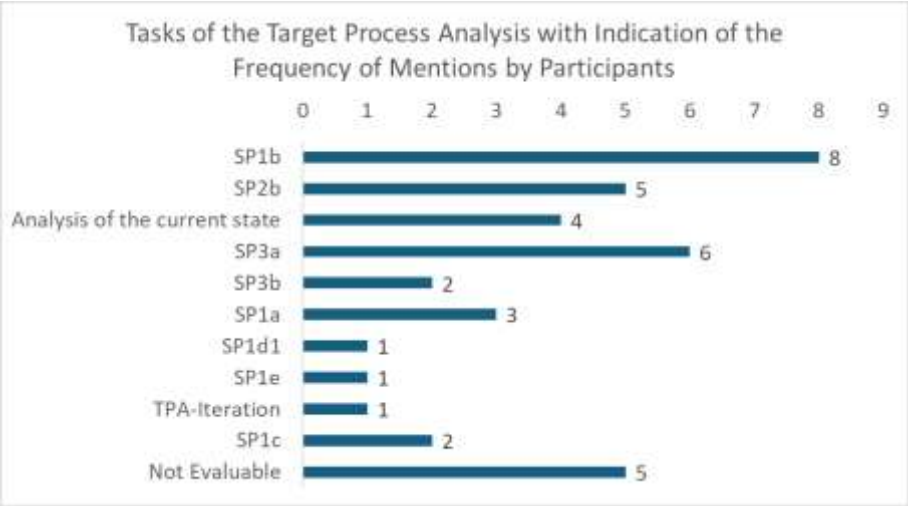

Figure 4 - Result of Q3. Own illustration, created with [Microsoft® Excel® 2019].

Each category into which the responses to Q3 were classified corresponds to an activity that can be performed as part of a target process analysis. Similar to Q2, an open-ended response that can be evaluated may be assigned to one or more categories, depending on how many tasks were mentioned. The naming of the categories into which the responses to Q3 were classified aligns with the process proposal in Figure 5. This process proposal illustrates, in the form of a UML activity diagram, how a target process analysis can be conducted.

The representation in Figure 4 shows the results of Q3, displaying the frequency of mentions for each category. The participant groups most frequently indicated that defining process objectives is part of the target process analysis (SP1b, with 8 mentions), that the quality of the target process must be evaluated (SP3a, with 6 mentions), and that the process model must be described (SP2b, with 5 mentions). Regarding the latter, most participant groups considered modeling the target process to be essential.

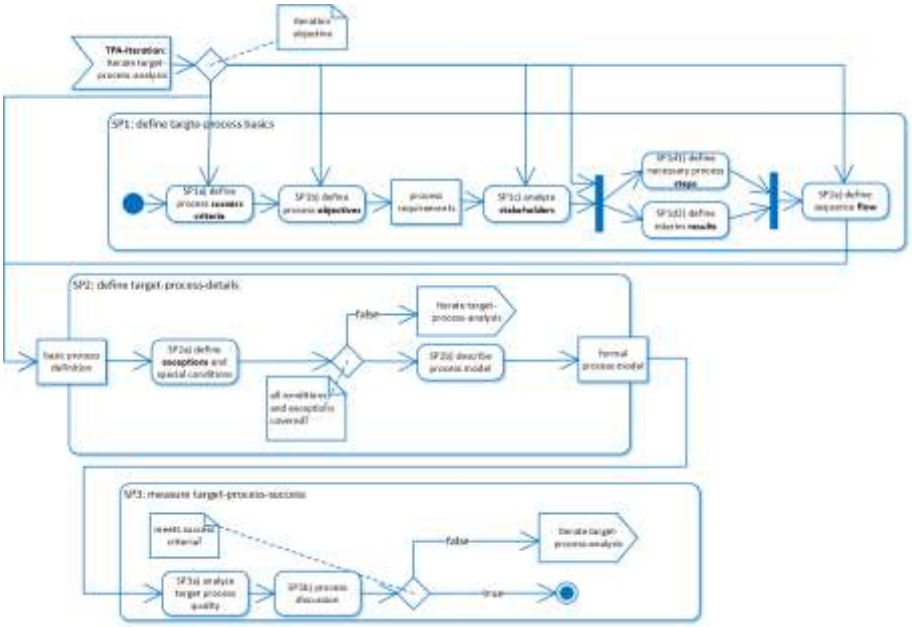

Figure 5 - Process of a target-process-analysis. Own illustration, created with [Microsoft® Visio® 2021].

The participant groups most rarely stated that the target process analysis is iterative and that the process steps and process flow need to be defined (each mentioned once).

The representation in Figure 5 illustrates a model of the sequence of a target process analysis. Various model elements can also be found in [ISO/IEC/IEEE 29148:2018(E)]. The sequence depicted in Figure 5 answers RQ2. The analysis begins with the definition of goal achievement criteria, process objectives, and an analysis of the involved stakeholders. These steps align with the typical process of requirements engineering, as seen in [PR15, pp. 4 ff.] or [So16, pp. 111 ff.]. Based on this, process steps, interim results, and process flow can be described, forming the basic definition of the target process. In the second main process (SP2), this basic definition is further detailed, particularly considering exceptions and conditions. This corresponds to [ISO/IEC/IEEE 29148:2018(E), p. 60], where the targeted consideration of business rules and conditions is also delineated as part of the business process definition. SP2 results in a formal process model, which can be evaluated in the third main process (SP3). This involves assessing the extent to which the process model meets the objectives and fulfills the requirements defined in SP1a and SP1b. This aligns with [ISO/IEC/IEEE 29148:2018(E), p. 60], according to which the operational quality of the business process must be defined.

Discussion

The explanations in the previous section present the survey results and propose a possible sequence for a target process analysis. The results for Q3 indicate which tasks a target process analysis should perform. Comparing the process model from Figure 5 with the results from Figure 4 shows that almost all steps in the sequence of a target process analysis were identified as tasks by the participant groups. The only steps not mentioned were SP1d2 (definition of interim results) and SP2a (definition of exceptions and conditions). In this regard, it can be noted that not every process necessarily needs to consider interim results and that the definition of exceptions and conditions can also be addressed in step SP1e (definition of sequence flow).

Beyond the model-based sequence of a target process analysis shown in Figure 5, the responses to Q3 indicate that participant groups consider an analysis of the current state (IST analysis) to be part of the target process analysis. Figure 5 shows that four participant groups view the step "Analysis of current state" as a task within the target process analysis. Typically, this IST analysis aims to capture the current process sequence so it can be compared with a potential target process. In this regard, reference is made to [HC93]. There is a risk that a strong focus on the existing process may obscure the perspective needed to define a new, optimal target process [HC93, pp. 32, 131 & 202-209]. For this reason, the IST analysis is not integrated as a step in the target process analysis model. However, it should be noted that such an analysis may be useful in cases where the new process is not expected to differ significantly from the existing one.

The results for Q2 show that a target process analysis should lead to reliable outcomes that support the achievement of objectives. Therefore, the frequent mention of activities SP1b in connection with SP3a in Q3 appears logical. When defining the sequence of a target process analysis according to Figure 5, the iterative nature of the process should be emphasized. Only by allowing multiple iterations can the results of a goal achievement analysis be used to refine or adjust the model. This aligns the sequence in Figure 5 with the requirements of [ISO/IEC/IEEE 29148:2018(E), p. 60], which states that the desired quality level of the business process must be examined in advance.

A critical point to note is that the sequence of a target process analysis described in Figure 5 does not explicitly and directly support planning and documentation, which were identified in Q2 as motivations for conducting the target process analysis. In practice, the benefits of a well-developed model describing the target process have been observed in supporting planning and facilitating documentation. However, the sequence in Figure 5 does not

include separate steps to enrich target process models with information that would be helpful for subsequent planning or documentation. Given the frequency with which planning and documentation were cited as prerequisites for the target process analysis in Q2, this seems acceptable. It is assumed that the target process itself requires little additional information to be useful for project planning. However, it should be noted that an extension of the sequence in Figure 5 may be necessary, with additional steps incorporated accordingly. Practical application may reveal that further detailed information needs to be gathered to enhance planning and documentation.

Conclusion

In this study, the target process analysis was examined as part of the requirements analysis. Empirical research was conducted to investigate the extent to which target process analyses are used in practice (Q1), the conditions under which they take place in practice (Q2), and the tasks that need to be performed in the course of a target process analysis (Q3). The study found that target process analyses are conducted with moderate frequency at the beginning of requirements engineering and are likewise considered dispensable with moderate frequency when the requirements are already known (see Figure 1). In practice, target process analyses are primarily used when the objectives require further clarification or when processes need to be analyzed and improved (see Figure 3). This answers RQ1. Consequently, a valid target process analysis must include steps to fulfill analytical tasks. In response to RQ2, a possible sequence for a target process analysis was presented and discussed. The sequence proposed in Figure 5 structures the process into subprocesses for creating a basic model, detailing the model, and evaluating the model. The process is designed to be iterative so that insights into unmet quality objectives can lead to further adjustments of the model.

Further research is needed to assess the quality of the proposed sequence. Such investigations could be conducted through simulations, case studies, or comparative analyses. Additionally, an experiment could be carried out to examine the effect of the proposed sequence. This could also provide insights into the benefits that target process analyses offer for the quality of requirements engineering. Furthermore, practical testing of the proposed process will reveal the circumstances under which the target process analysis may need to be adapted.

References

[Ba09] Balzert, Helmut (2009): Lehrbuch der Softwaretechnik. Basiskon-zepte und Requirements-Engineering. 3. Auflage. Heidelberg: Spektrum Akademischer Verlag (=Lehrbücher der Informatik). Springer. [ISBN 978-3-8274-1705-3].

[CAD+10] Coskuncay, Ahmet / Aysolmaz, Banu / Demirors, Onur / Bilen, Omer / Dogani, Idris (2010): "BRIDGING THE GAP BETWEEN BUSINESS PROCESS MODELING AND SOFTWARE REQUIREMENTS ANALYSIS: A CASE STUDY". Mediterranean Conference on Information Systems, MCIS 2010 Proceedings. 20. Association for Information Systems AIS Electronic Library (AISeL). https://aisel.aisnet.org/mcis2010/20

[Gh18] Ghasemi, Mahdi (2018): "What Requirements Engineering can Learn from Process Mining". In: Proceedings 2018 1st International Workshop on Learning from other Disciplines for Requirements Engineering. The Institute of Electrical and Electronics Engineers, Inc. Los Alamitos: IEEE Computer Society. [DOI: 10.1109/D4RE.2018.00008].

[HC93] Hammer, Michael / Champy, James (1993): Reengineering the Corporation. A Manifesto for Business Revolution. New York: HarperBusiness a division of HarperCollinsPublishers. 1993. [ISBN 0-88730-687-X].

[Hr14] Hruschka, Peter (2014): Business Analysis und Requirements Engineering. Produkte und Prozesse nachhaltig verbessern. München: Carl Hanser Verlag. 2014. [ISBN 978-3-446-43807-1].

[IEEE Std. 610.12-1990] IEEE Standards Board (1990): "IEEE Standard Glossary of Software Engineering Terminology". New York: The Institute of Electrical and Electronics Engineers. IEEE Std. 610.12-1990. URL: https://ieeexplore.ieee.org/stamp/stamp.jsp?tp=&arnumber=159342, accessed 2025-03-06.

[ISO/IEC/IEEE 15288:2023(E)] ISO/IEC/IEEE (2023): "Systems and software engineering - System life cycle processes". Second edition 2023-05. Geneva: ISO copyright office, New York: Institute of Electrical and Electronics Engineers, Inc. [DOI: 10.1109/IEEESTD.2023.10123367].

[ISO/IEC/IEEE 29148:2018(E)] ISO/IEC/IEEE (2018): "Systems and software engineering - Life cycle processes - Requirements engineering". Second edition 2018-11. Geneva: ISO copyright office, New York: Institute of Electrical and Electronics Engineers, Inc. [DOI: 10.1109/IEEESTD.2018.8559686].

[KR24] Kuckartz, Udo / Rädiker, Stefan (2024): Fokussierte Interviewanalyse mit MAXQDA. Schritt für Schritt. 2. Auflage. Springer VS, Wiesbaden: Springer Fachmedien Wiesbaden GmbH. [DOI: 10.1007/978-3-658-40212-9].

[Ma03] Martin, Robert C. (2003): Agile Software Development. Principles, Patterns, and Practices. Upper Saddle River, NJ USA: Prentice Hall, Pearson Education, Inc. [ISBN: 0-13-597444-5. Robert C. Martin with contributions by James W. Newkirk and Robert S. Koss].

[Mentimeter] Mentimeter AB Tulegatan 11 in SE-113 86 Stockholm Sweden. Verfügbar unter URL: https://www.mentimeter.com/ (Stand: 07.10.2021).

[Microsoft® Excel® 2019] Microsoft Corporation (2019): "Microsoft® Excel®. Microsoft Office Home & Business 2019."

[Microsoft® Visio® 2021] Microsoft Corporation (2021): "Microsoft® Visio® 2021 MSO. Visio Standard. Version 2308 Build 16.0.16731.20052, 64 Bit.

[PGE+15] Panayiotou, Nikolaos A. / Gayialis, Sotiris P. / Evangelopoulos, Nikolaos P. / Katimertzoglou, Petros K. (2015): "A business process modeling-enabled requirements engineering framework for ERP implementation". In: Business Process Management Journal, Vol. 21, Nr. 3, 2015. Emerald Group Publishing Limited. pp. 628 - 664. [DOI: 10.1108/BPMJ-06-2014-0051].

[PR15] Pohl, Klaus / Rupp, Chris (2015): Basiswissen Requirements-Engineering. Aus- und Weiterbildung nach IREB-Standard zum Certified Professional for Requirements-Engineering Foundation Level. 4., überarbeitete Auflage. Heidelberg: dpunkt.verlag GmbH. [ISBN: 978-3-86490-283-3].

[So16] Sommerville, Ian (2016): Software-Engineering. Tenth Edition. Bos-ton, Columbus, Indianapolis u. a.: PEARSON. Harlow: Pearson Education Limited. 2016. [ISBN-13: 978-1-292-09613-1].