Association for Information Systems
AIS Electronic Library (AISeL)

BLED 2015 Proceedings | BLED Proceedings

2015

Towards an Artifact-Oriented Requirements Engineering Model for Developing Successful Products, Services, and Systems: Identification of Model Requirements

Christian Ruf
University of St.Gallen Institute of Information Management, Switzerland, christian.ruf@unisg.ch

Follow this and additional works at: http://aisel.aisnet.org/bled2015

Recommended Citation
Ruf, Christian, "Towards an Artifact-Oriented Requirements Engineering Model for Developing Successful Products, Services, and Systems: Identification of Model Requirements" (2015). *BLED 2015 Proceedings*. 10.
http://aisel.aisnet.org/bled2015/10

This material is brought to you by the BLED Proceedings at AIS Electronic Library (AISeL). It has been accepted for inclusion in BLED 2015 Proceedings by an authorized administrator of AIS Electronic Library (AISeL). For more information, please contact elibrary@aisnet.org.

BACK

28th Bled eConference

#eWellBeing

June 7 - 10, 2015; Bled, Slovenia

Towards an Artifact-Oriented Requirements Engineering Model for Developing Successful Products, Services, and Systems: *Identification of Model Requirements*

Christian Ruf

University of St.Gallen Institute of Information Management, Switzerland

christian.ruf@unisg.ch

Abstract

Despite extensive research in the domain of requirements engineering (RE), companies still struggle with this discipline. Moreover, practitioners are challenged with developing successful products, services, and systems which address the true needs of their customers. This gives rise to a new research field in the domain of RE, namely artifact orientation. According to the literature, this artifact orientation should increase the success of RE significantly. By conducting a literature review and 7 expert interviews, we identified 7 model requirements (MRs) for an artifact-oriented RE model. Furthermore, the results of this paper suggest that existing artifact-oriented RE models do not sufficiently address all identified MRs. In particular, these models lack the combination of traditional RE practices, such as goal orientation, documentation, and traceability with novel agile approaches. Furthermore, there is a need for a more holistic RE which merges the domains of product, service, and software engineering.

Keywords: *Requirements Engineering, Artifact Orientation, Software Engineering, Service Engineering*

1 Introduction

Over the past 20 years, extensive research has been conducted and the literature has shown an emphasis on the importance of requirements engineering (RE) in order to develop successful products, services, and systems (Méndez Fernández & Wagner, 2014). RE is the process of capturing, analyzing, prioritizing, negotiating, and documenting user needs or requirements (Sommerville & Kotonya, 1998). Despite the acknowledged relevance of this research domain, companies still struggle with adopting RE (Beecham et al., 2005). Only 48%

of projects are completed on time and 55% do not meet the budget plan due to insufficient RE (Kassab, Neill, & Laplante, 2014). In order to increase the successful adoption of RE practices, which will lead to more successful products and services, researchers have introduced artifact orientation (Broy, 2006b). Artifact orientation focuses on what kind of requirements the RE team should elicit, document, analyze, and negotiate. Such artifacts might include high-level customer goals or specific software specifications. Recent findings suggest that this young discipline of artifact orientation will lead to more successful RE which facilitates developing products, services, and systems that meet the needs of the relevant stakeholders and customers (Méndez Fernández & Penzenstadler, 2014). Within this article, we focus on the artifact orientation of RE and propose the following research question:

What are requirements for an artifact-oriented RE model that facilitates developing products, services, and software that meet the needs of stakeholders and customers?

In order to address this research question, we introduce and define the relevant terms and the related work in Section 2; in particular, the artifact orientation. Subsequently, we describe the research approach, including a literature review and 7 expert interviews, in Section 3. Moreover, we reveal the findings regarding the identified requirements for developing an artifact-oriented RE model in Section 4. A comparison with existing artifact-oriented models suggests potential research gaps. We discuss the implications based on these results in Section 5 and provide guidance on how to design a new artifact-oriented RE model. Finally, Section 6 elaborates on future research and limitations.

2 Related Work

In this section, three concepts are defined in further detail: (1) model requirements (MRs); (2) requirements engineering (RE); and (3) artifact orientation.

(1) Model requirements (MRs). A requirement describes a fundamental attribute of a system along with an appropriate value statement (Grady, 2010). Hence, a requirement refers to an attribute or a characteristic of a product, service, or system. Such requirements originate from stakeholders, e.g. users, customers, or employees, and address a particular problem or need. There are three categories of requirements. Functional requirements relate to specific features that a product, service, or system possesses. Robertson and Robertson (2013) define a functional requirement as follows: *"Functional requirements are things the product must do"*. The second category of non-functional requirements describes the more general characteristics of a product, service, or system. Such characteristics might include the usability, security, or availability of a system. By constraints, a third category, the literature refers to specific limits on how products and services should be developed. Such constraints may relate to the design of a software artifact for a particular operating system (for example, Android or iOS). In this study, we identify model requirements (MRs) for an artifact-oriented RE model. These MRs incorporate one of the three requirement categories and describe how the artifact-oriented RE model should be developed.

(2) Requirements engineering (RE). RE is the process of capturing, analyzing, prioritizing, and documenting requirements. There are four common RE processes which the RE community acknowledges (Pohl, 2008). (1) Elicitation focuses on capturing requirements from different stakeholder groups. Many different techniques facilitate this first step of RE. (2) Analysis and negotiation address the resolution of conflicts between elicited requirements. The result should provide the RE team with consistent and unambiguous requirements. (3) Documentation is facilitated with natural or formal language, such as Unified Modeling Language. (4) Validation incorporates prototyping and testing. By applying such techniques, we ascertain whether the elicited, specified, and documented requirements represent customer and stakeholder needs (Sommerville & Kotonya, 1998). The output of RE should lead to the successful design of a product, service, or system (Hall, Beecham, & Rainer, 2002).

(3) Artifact orientation. Artifact orientation focuses on describing the content elements, identifying the kind of requirements the RE team should capture (Penzenstadler et al., 2013). As opposed to the artifact orientation, the activity orientation includes RE techniques and methods which advise how the team should go about the RE process (Jiang et al., 2007). Consequently, requirement categories such as goals, constraints, or specific software specifications refer to requirement artifacts, while focus groups, workshops, and process models refer to RE activities. In this study, we focus on artifact-oriented RE models (Loucopoulos & Kavakli, 1995; Méndez Fernández & Penzenstadler, 2014; Nuseibeh & Easterbrook, 2000).

3 Research Approach

We first elaborate on details with respect to the literature review and, secondly, provide more details on how we conducted the expert interviews in order to capture the MRs for an artifact-oriented RE model.

3.1 Literature Review

We followed the guidelines set by Vom Brocke et al. (2009) and Webster and Watson (2002) for conducting the literature review. We used the keyword “requirements engineering” in the databases, as summarized in Table 1, including a backwards and forwards search. We considered the following parameters in order to determine whether a given paper should be included: published after 2000; peer-reviewed; in English or German language; and an article from a journal or an A-ranked conference. The article also needed to cover MRs for the design of an artifact-oriented RE model, or it needed to introduce an artifact-oriented model and address a holistic RE. We started the literature review in October 2014 and finished in December 2014.

With respect to the included conferences, we chose the “WI-Orientierungsliste” (WKWI, 2008) as a reference and only included three A-ranked conferences; the International Conference on Information Systems (ICIS), the European Conference on Information Systems (ECIS), and

Wirtschaftsinformatik (WI). Given the mentioned restrictions, we selected 145 articles from 768 hits in the literature review.

Source	**Hits**	**Analyzed**	**Relevant**
Keyword search			
AIS Electronic Library (AISel)	16	10	6
EBSCOhost	164	21	14
Emerald Insight	26	1	0
IEEE Xplore Digital Library	282	31	18
ScienceDirect	158	7	4
Springer Link	122	14	11
Backwards and forwards search	–	*61*	*52*
TOTAL	**768**	**145**	**105***

*We present a representative sample regarding the identified articles in this research paper. A comprehensive and complete list of the identified articles can be provided on request.

Table 1: Details of the Literature Review

3.2 Expert Interviews

In order to validate and triangulate the findings from the literature review, we also conducted 7 expert interviews between November 2014 and January 2015 (Table 2 incorporates background information regarding the expert interviews). The 7 interviewees have extensive domain experience (3 years or more) and work for multinational and Swiss companies.

Interviewee		Industry Domain	Experience
Expert 1	Senior Consultant	Consulting and Agency	5 years
Expert 2	Senior Principal Consultant	Consulting and Agency	16 years
Expert 3	Senior Consultant	Consulting and Agency	3 years
Expert 4	Senior Consultant	Consulting and Agency	4 years
Expert 5	Product Manager	IT Service Provider	4 years
Expert 6	Senior Supply Chain Director	Fast Moving Consumer Goods	10 years
Expert 7	Consultant	Consulting	4 years

Table 2: Background Information of the Experts

These interviews lasted between 35 and 58 minutes and followed a semi-structured guideline. First, the interviewer asked questions about the background and experience of each expert. Second, the expert provided details on the current RE practices in the respective organization. Finally, we were interested in how the expert would improve the RE process in the future. We put the interview transcripts in a central database. Furthermore, two researchers coded the transcripts with the coding schema independently. The coding schema entailed 7 MRs, which we identified in the literature (Table 3 in Section 4). We measured the intercoder reliability with the overall percentage agreement and the Cohen's Kappa coefficient (Cohen, 1968), two well-acknowledged indicators (Dewey, 1983). The percentage agreement between the two coders was 88% and the Cohen's Kappa result was 0.65, which is above the threshold of 0.6 as suggested by the equally arbitrary guidelines from Fleiss, Lewin, and Paik (2013). Subsequent to the independent coding process, the researchers negotiated the discrepancies in a workshop and examined each of the interviews thoroughly. Finally, they discussed whether the code matched the quotations from the interviews and consequently supported the MRs identified in the existing body of knowledge. The subsequent Section 4 highlights the results from both the literature review and the expert interviews.

4 Results

4.1 Model Requirements (MRs)

Table 3 provides a summary of the seven MRs and the respective sources (literature and expert interviews). Due to the page limit of this research paper, we only quote a representative sample of the identified articles and cite selective statements from the expert interviews here. On request, we are happy to provide the entire transcripts and results from the literature review as well as the expert interviews.

(MR1) Goal orientation: The RE model should link requirements to customer and service provider goals. The most important goal for a service provider is to address the needs of its customers and stakeholders (Berkovich, München, & Leimeister, 2009), which consequently means involving customers in the RE process. Hence, capturing customer goals is critical for an RE model. However, service providers do not pursue purely altruistic goals; they also want to benefit financially from launching products and services. Therefore, besides a strong customer orientation, the service provider goals are equally important (Nuseibeh & Easterbrook, 2000). Moreover, by linking requirements back to the overall customer and service provider goals, the RE team is able to prioritize requirements (Lee et al., 2013). A representative quote from Expert 2 also supports this first MR: *"There was a high-level goal which guided us in the requirements engineering process: with one workplace we add value to the company..."* All of the 7 experts mentioned the importance of this MR.

(MR2) Documentation and traceability: The RE model should facilitate a thorough documentation process and consequently enable traceability. Documentation and traceability describe the process of following the artifact throughout the development process (Méndez Fernández & Wagner, 2014). A quotation from Expert 4 supports the importance of (MR2): *"I find it crucial that documentation is carried out throughout the entire RE process. Sometimes our customers or project team members do not get how important documentation* *really is."* 6 out of the 7 interviewed experts also specifically mentioned the importance of documentation and traceability.

Source / Model requirements (MRs)	Literature Review	Expert 1	Expert 2	Expert 3	Expert 4	Expert 5	Expert 6	Expert 7
(MR1) Goal orientation	x	x	x	x	x	x	x	x
(MR2) Documentation	x	x	x	x	x	x	-	x
(MR3) Integration	x	x	-	x	-	-	x	x
(MR4) Agility	x	x	x	x	x	-	-	x
(MR5) Adaptability	x	-	x	-	-	x	x	-
(MR6) Continuity	x	x	x	x	x	x	x	x
(MR7) Responsibilities	x	x	x	x	x	x	x	x

x = addressed, - = not addressed

Table 3: The Identified MRs from the Literature Review and the Expert Interviews

(MR3) Integration: The RE model should integrate the RE for products, services, and systems. We argue that the RE discipline should integrate three specific views – namely software, service, and product development (Grau, 2012) – into an RE process for product service systems (PSS). The literature also suggests that *"technology and service design decisions become deeply intertwined"* (Patrício et al., 2009, p. 210). Other researchers confirm the necessity of combining RE with software product line engineering (Lee et al., 2013). Hence, the (MR3) acknowledges the integration of different disciplines (Nuseibeh & Easterbrook, 2000), and particularly, RE practices from the domain of product, service, and software engineering. With such an integration, the RE process elicits and specifies requirements for PSS, or hybrid products, as suggested by the literature (Berkovich et al., 2012). Expert 1 elaborated on (MR3) with the following statement: *"We needed to change the ERP integration, the payment, customer processes and so on and so forth".* Regarding (MR3), 4 out of the 7 experts mentioned the importance of integrating product, service, and software development.

(MR4) Agility: The RE model should allow for fast throughput time. A large number of RE techniques and models visualize the RE process as a sequence or an iterative approach, but in reality, requirements are captured, analyzed, negotiated, and prioritized in a parallel order. Agility refers to a parallel RE and development process (Hickey & Davis, 2004) that results in a fast throughput time (Broy, 2006a). Expert 6 described this parallel development and RE process as follows: *"We organized workshops to validate requirements and started with the development at the same time …"* In total, 4 experts confirmed this MR.

(MR5) Adaptability: The RE model should be adaptable to different organizational and project contexts. Each organization, each business unit, and each project has unique and different characteristics. Researchers acknowledge that RE needs to be adaptive to such different contexts (Grau, 2012; Sarker & Sarker, 2009). In order to address such different project setups, establishing a shared understanding at the beginning of the project (Hanisch & Corbitt, 2007) clearly represents a success factor for an artifact-oriented RE model. Regarding (MR5), Expert 5 provided a representative quote: *"I find it very challenging to adapt the same model for different organizations with different industry backgrounds. There are so many different factors which might lead to different requirement engineering processes."* Adaptability as an MR was mentioned by three of the domain experts.

(MR6) Continuity: The RE model should provide support for the continuous evaluation of the elicited requirements throughout, and beyond, the project. Continuously evolving requirements not only require agile RE, as discussed with (MR4), but also the continuous evaluation of artifacts (Ramesh, Cao, & Baskerville, 2010). More specifically, they require multi-disciplinary teams and the evaluation of requirements on a continuous basis (Cox, Niazi, & Verner, 2009). Regardless of the chosen approach, the evaluated requirements need to comply with the IEEE recommended practice for requirements specification (IEEE, 1998). Consequently, the requirements should be correct, unambiguous, complete, consistent, ranked for importance, verifiable, modifiable, and traceable. Expert 7 gave an example regarding the continuous evaluation of requirements: *"During the development, we challenged the requirements with various iterations. Do we really need this requirement, does it really make sense?"* Apart from Expert 7, all of the other interviewees emphasized the importance of continuous evaluation processes.

(MR7) Responsibilities: The RE model should help to define responsibilities and roles throughout the RE process. RE teams and development project team members often organize themselves and are self-directing, particularly in agile project contexts. The motivation and drive of employees, along with the required skillset of team members, are prerequisites for this type of informal project organization (Pink, 2011). However, researchers also state that formal project organizations and the definition of role responsibilities are prerequisites for successful RE (Méndez Fernández & Wagner, 2014). Other researchers confirm this and elaborate that the definition of roles and responsibilities, particularly that of the requirements analyst, is critical (Klendauer et al., 2012). Expert 3 also stated the necessity of defining roles and responsibilities in an agile project: *"Our customer chose an agile Scrum process. This is quite risky, given that the project involved 16 different apps from 6 different service providers… Everything is coordinated through the product manager…"* Overall, this MR was acknowledged by all of the experts.

4.2 Artifact-Oriented Requirements Engineering (RE) Models

In total, we identified and validated the 7 MRs an artifact-oriented RE model needs to address. Based on the literature review, we also identified 11 already published artifact-oriented models. A comparison with the 7 MRs suggests a potential research gap and gives rise to future endeavors in this field of artifact orientation.

A domain-independent requirements engineering approach (AMDiRE). The AMDiRE artifact model builds on the REM (RE Reference Model) (Méndez Fernández & Penzenstadler, 2014). Despite addressing (MR1), (MR2), (MR5), and (MR7), the model fails to address (MR4) agile practices, (MR6) continuity and (MR3) integration.

Scenario and goal-based system development method (COSMOD-RE). The COSMOD-RE (sCenario and gOal based SysteM development methOD – RE) introduces co-design or concurrent RE and artifact development (Pohl & Sikora, 2007). Accordingly, this approach is particularly successful for developing innovative and software-intensive systems. However, the COSMOD-RE only addresses (MR1), (MR2), and (MR4).

Goal-Oriented Requirements Engineering (GORE). There are several goal-oriented modeling languages, such as KAOS (Keep All Objectives Satisfied) (Dardenne, van Lamsweerde, & Fickas, 1993) or Tropos (Bresciani et al., 2004), for example. Within our analysis, we combined these goal-oriented RE approaches because of their comparability. However, these GORE models lack the inclusion of (MR7) and hence, do not define roles and responsibilities. Furthermore, (MR4), agile practices, is not supported.

Requirements Abstraction Model (RAM). The RAM (Gorschek & Wohlin, 2006) facilitates a goal-oriented approach for capturing requirements. The authors introduced four levels in order to specify requirements on the goal, feature, function, and component levels. The model is widely acknowledged, but meets neither (MR3) integration of product, service, systems, nor (MR4) agile RE practices. The model also lacks (MR5) adaptability and does not include (MR7) responsibilities.

Requirements Data Model (RDMod). The RDMod follows an iterative process for capturing requirements for PSS (Berkovich et al., 2012). Thus, the model particularly addresses (MR3) integration. Moreover, it combines requirements artifacts from the RAM and the REM. The authors also include the four requirements abstraction levels: goals, features, functions, and components. However, as with previous artifact-oriented models, (MR4) is not addressed.

Requirements Engineering Reference Model (REM). The REM is an approach that includes various artifacts (Broy et al., 2007). Similar to the RAM, the model does not meet (MR3) and (MR4).

REMsES. The REMsES (Requirements Engineering und Management für softwareintensiver Eingebetteter Systeme) resulted from a practical engineering project in the automotive industry (Méndez Fernández & Penzenstadler, 2014). Other than agile practices (MR4), the model includes all 7 MRs.

Scrum-based model for software products. Scrum is an agile software development method that was developed together with the agile manifesto (Beck et al., 2001). Hence, it particularly addresses (MR4) agility. However, (MR3) the integration of products, services, and systems is not supported with this model.

Software and Systems Requirements Engineering (SSRE). Researchers have introduced the SSRE for analyzing different RE practices in an extensive literature review (Parviainen et al., 2003). The SSRE covers the entire RE process and suggests different artifacts throughout the development process. However, several MRs are not met, including (MR1), (MR3), (MR5), and (MR7).

Volere Model. The Volere RE Model proposes various templates for eliciting, analyzing, and documenting requirements (Robertson & Robertson, 2013). Two MRs – agile practices (MR4) and responsibilities (MR7) – are not mentioned by the Volere model.

V Model. Researchers and practitioners have discussed a particular soft- or hardware development process that includes an RE elicitation and management process in the V Model (Hoffmann, 2012). This artifact model only addresses (MR2) documentation and (MR6) continuous evaluation.

After having examined each of the identified artifact-oriented RE models, we concluded that none of the models addresses all 7 MRs. We discuss the implications of these findings in the subsequent section.

Artifact-oriented RE models / Model requirements (MRs)	AMDiRE	COSMOD-RE	GORE	RAM	RDMod	REM	REMsES	Scrum-based model	SSRE	Volere Model	V Model
(MR1) Goal orientation	x	x	x	x	x	x	x	x	-	x	-
(MR2) Documentation	x	x	x	x	x	x	x	x	x	x	x
(MR3) Integration	-	-	x	-	x	-	x	-	-	x	-
(MR4) Agility	-	x	-	-	-	-	-	x	x	-	-
(MR5) Adaptability	x	-	x	-	-	x	x	x	-	x	-
(MR6) Continuity	-	-	x	x	x	x	x	x	x	x	x
(MR7) Responsibilities	x	-	-	-	-	x	x	x	-	-	-

x = addressed, - = not addressed

Table 4: Comparing MRs with Existing Artifact-Oriented RE Models

5 Discussion

From the results in the previous section two recommendations were derived. First, we believe that (MR4) agility is a crucial requirement, which is acknowledged by both researchers and practitioners. However only a few of the artifact-oriented models truly support this requirement. In particular, the combination of traditional MRs, such as (MR1) goal orientation and (MR2) documentation and traceability, with agile RE practices seems critical. Hence, we argue that future research should address this combination of goal orientation, documentation, and traceability, with the agile domain more thoroughly.

Second, future research should address the (MR3) integration of PSS specifically. The analysis of the expert interviews supports that argument. Several consultants who work on projects that introduce new mobile applications, for example, described their projects mainly as software projects. However, implicitly, they discussed various problems with the integration of such software projects in the organizational environment. Obviously, due to the company size, communication across different departments may become a challenge. Furthermore, such software projects implicitly change business processes and legacy systems, which is not usually addressed thoroughly in the RE process. Not only practitioners, but also the existing body of knowledge only partially addresses the integration of products, services, and systems in the RE process (only 4 models meet this MR). Hence, the holistic RE approach, or combining product, service, and software engineering, poses the second major challenge that a future artifact-oriented RE model should solve.

6 Conclusions

Based on a literature review and 7 expert interviews we identified and validated 7 model requirements (MRs) for an artifact-oriented requirements engineering (RE) model that should facilitate successful product, service and software engineering endeavors. After having compared the 7 MRs with existing artifact-oriented models, we identified a potential research gap which consequently legitimates future work in this domain. In particular, the combination of agile and traditional RE practices, such as documentation, traceability, or goal orientation, is a first area of future research. The second area addresses more holistic RE which should include the domains of product, service, and software engineering. Having validated the results with 7 experts, the findings should not only contribute to the existing body of knowledge, but should also be relevant for all practitioners.

Despite promising findings and contributions, we also need to discuss some limitations. First, most of the interviewees had a background in the consulting and agency industry. Hence, the findings might be biased due to the limited variety of backgrounds in terms of positions and industry. Second, we also argue that 7 expert interviews is not a sufficient number in order to provide entirely reliable results. Consequently, we propose that despite our chosen triangulation approach with data from the literature review and the expert interviews, the results should be further validated. Third, despite having conducted an exhaustive literature review, the limited selection of databases in the field of information management and software engineering literature might present a bias. We expect that more MRs or artifact-oriented RE models might be discussed in the product engineering discipline which we only marginally addressed in our literature review. We tried to limit this bias by involving experts to triangulate the findings.

Acknowledgements

We would like to thank Alexander Müdespacher, Patrick Schenker, and Silvan Schumacher for collaborating on the research project and for supporting us in the data collection and data analysis process. Furthermore, we also appreciate the feedback from the reviewers which we tried to address in the final submission.

References

Beck, K., Beedle, M., Van Bennekum, A., Cockburn, A., Cunningham, W., Fowler, M., … others. (2001). Manifesto for agile software development.

Beecham, S., Hall, T., Britton, C., Cottee, M., & Rainer, A. (2005). Using an expert panel to validate a requirements process improvement model. *Journal of Systems & Software*, *76*(3), 251–275. Retrieved from 10.1016/j.jss.2004.06.004

Berkovich, M., Leimeister, J. M., Hoffmann, A., & Krcmar, H. (2012). A requirements data model for product service systems. *Requirements Engineering*. doi:10.1007/s00766-012-0164-1

Berkovich, M., München, T. U., & Leimeister, J. M. (2009). An Empirical Exploration of Requirements Engineering for Hybrid Products. In *ECIS 2009 Proceedings.* (p. Paper 67).

Bresciani, P., Perini, A., Giorgini, P., Giunchiglia, F., & Mylopoulos, J. (2004). Tropos: An Agent-Oriented Software Development Methodology. *Autonomous Agents and Multi-Agent Systems*, *8*(3), 203–236. doi:10.1023/B:AGNT.0000018806.20944.ef

Broy, M. (2006a). Challenges in automotive software engineering. In *Proceeding of the 28th international conference on Software engineering - ICSE '06* (p. 33). New York, New York, USA: ACM Press. doi:10.1145/1134285.1134292

Broy, M. (2006b). *Requirements Engineering as a Key to Holistic Software Quality*. (A. Levi, E. Savaş, H. Yenigün, S. Balcısoy, & Y. Saygın, Eds.) (Vol. 4263). Berlin, Heidelberg: Springer Berlin Heidelberg. doi:10.1007/11902140

Broy, M., Geisberger, E., Kazmeier, J., Rudorfer, A., & Beetz, K. (2007). Ein Requirements-Engineering-Referenzmodell. *Informatik-Spektrum*, *30*(3), 127–142. doi:10.1007/s00287-007-0149-5

Cohen, J. (1968). Weighted kappa: nominal scale agreement with provision for scaled disagreement or partial credit. *Psychological Bulletin*, *70*, 213–220. doi:10.1037/h0026256

Cox, K., Niazi, M., & Verner, J. (2009). Empirical study of Sommerville and Sawyer's requirements engineering practices. *IET Software*, *3*(5), 339. doi:10.1049/iet-sen.2008.0076

Dardenne, A., van Lamsweerde, A., & Fickas, S. (1993). Goal-directed requirements acquisition. *Science of Computer Programming*, *20*(1–2), 3–50. doi:http://dx.doi.org/10.1016/0167-6423(93)90021-G

Dewey, M. E. (1983). Coefficients of agreement. *British Journal of Psychiatry*, *143*, 487–489. doi:10.1192/bjp.143.5.487

Fleiss, J. L., Lewin, B., & Paik, M. C. (2013). *Statistical methods for rates and proportions*. John Wiley & Sons.

Gorschek, T., & Wohlin, C. (2006). Requirements Abstraction Model. *Requirements Engineering*, *11*(1), 79–101. doi:10.1007/s00766-005-0020-7

Grady, J. O. (2010). *System requirements analysis*. Academic Press.

Grau, R. (2012). Requirements Engineering in Agile Software Development. In A. Maedche, A. Botzenhardt, & L. Neer (Eds.), *Software for People SE - 6* (pp. 97–119). Springer Berlin Heidelberg. doi:10.1007/978-3-642-31371-4_6

Hall, T., Beecham, S., & Rainer, A. (2002). Requirements problems in twelve software companies: an empirical analysis. *Software, IEE Proceedings* -. doi:10.1049/ip-sen:20020694

Hanisch, J., & Corbitt, B. (2007). Impediments to requirements engineering during global software development. *European Journal of Information Systems*, *16*(6), 793–805. doi:10.1057/palgrave.ejis.3000723

Hickey, A. M., & Davis, A. M. (2004). A Unified Model of Requirements Elicitation. *Journal of Management Information Systems*, *20*(4), 65–84. Retrieved from http://search.ebscohost.com/login.aspx?direct=true&db=buh&AN=12841174&site=ehost-live

Hoffmann, H. (2012). Streamlining the development of complex systems through model-based systems engineering. *Digital Avionics Systems Conference (DASC), 2012 IEEE/AIAA 31st*, 6E6–1–6E6–8. doi:10.1109/DASC.2012.6382404

IEEE. (1998). IEEE Recommended Practice for Software Requirements Specifications. *IEEE Std 830-1998*. doi:10.1109/IEEESTD.1998.88286

Jiang, L., Eberlein, A., Far, B. H., & Mousavi, M. (2007). A methodology for the selection of requirements engineering techniques. *Software & Systems Modeling*, *7*(3), 303–328. doi:10.1007/s10270-007-0055-y

Kassab, M., Neill, C., & Laplante, P. (2014). State of practice in requirements engineering: contemporary data. *Innovations in Systems and Software Engineering*, *10*(4), 235–241. doi:10.1007/s11334-014-0232-4

Klendauer, R., Berkovich, M., Gelvin, R., Leimeister, J. M., & Krcmar, H. (2012). Towards a competency model for requirements analysts. *Information Systems Journal*, *22*(6), 475–503. Retrieved from 10.1111/j.1365-2575.2011.00395.x

Lee, J., Kang, K. C., Sawyer, P., & Lee, H. (2013). A holistic approach to feature modeling for product line requirements engineering. *Requirements Engineering*, *19*(4), 377–395. doi:10.1007/s00766-013-0183-6

Loucopoulos, P., & Kavakli, E. (1995). Enterprise Modelling and the Teleological Approach to Requirements Engineering. *International Journal of Cooperative Information Systems*, *04*(01), 45–79. doi:10.1142/S0218843095000032

Méndez Fernández, D., & Penzenstadler, B. (2014). Artefact-based requirements engineering: the AMDiRE approach. *Requirements Engineering*. doi:10.1007/s00766-014-0206-y

Méndez Fernández, D., & Wagner, S. (2014). Naming the pain in requirements engineering: A design for a global family of surveys and first results from Germany. *Information and Software Technology*. doi:10.1016/j.infsof.2014.05.008

Nuseibeh, B., & Easterbrook, S. (2000). Requirements Engineering: A Roadmap. In *Proceedings of the Conference on The Future of Software Engineering* (pp. 35–46). New York, NY, USA: ACM. doi:10.1145/336512.336523

Parviainen, P., Hulkko, H., Kaariainen, J., Takalo, J., & Tihinen, M. (2003). Requirements engineering inventory of technologies. *VTT PUBLICATIONS*.

Patrício, L., Falcão e Cunha, J., & Fisk, R. (2009). Requirements engineering for multi-channel services: the SEB method and its application to a multi-channel bank. *Requirements Engineering*, *14*(3), 209–227. doi:10.1007/s00766-009-0082-z

Penzenstadler, B., Mendez Fernandez, D., & Eckhardt, J. (2013). Understanding the Impact of Artefact-Based RE -- Design of a Replication Study. *Empirical Software Engineering and Measurement, 2013 ACM / IEEE International Symposium on*. doi:10.1109/ESEM.2013.46

Pink, D. (2011). *Drive: The Surprising Truth About What Motivates Us*. Riverhead Books.

Pohl, K. (2008). *Requirements Engineering: Grundlagen, Prinzipien, Techniken* (Vol. 2). dpunkt Verlag GmbH.

Pohl, K., & Sikora, E. (2007). COSMOD-RE: Supporting the Co-Design of Requirements and Architectural Artifacts. *Requirements Engineering Conference, 2007. RE '07. 15th IEEE International*. doi:10.1109/RE.2007.25

Ramesh, B., Cao, L., & Baskerville, R. (2010). Agile requirements engineering practices and challenges: an empirical study. *Information Systems Journal*, *20*(5), 449–480. Retrieved from 10.1111/j.1365-2575.2007.00259.x

Robertson, S., & Robertson, J. (2013). *Mastering the Requirements Engineering Process - Getting Requirements Right* (3rd ed.). New Jersey: Addison-Wesley.

Sarker, S., & Sarker, S. (2009). Exploring Agility in Distributed Information Systems Development Teams: An Interpretive Study in an Offshoring Context. *Information Systems Research*, *20*(3), 440–461. doi:10.2307/23015474

Sommerville, I., & Kotonya, G. (1998). *Requirements engineering: processes and techniques*. John Wiley & Sons, Inc.

Vom Brocke, J., Simons, A., Niehaves, B., Reimer, K., Riemer, K., Plattfaut, R., & Cleven, A. Reconstructing the Giant: On the Importance of Rigour in Documenting the Literature Search Process (2009). ECIS.

Webster, J., & Watson, R. T. (2002). Analyzing the Past to Prepare for the Future: Writing a Literature Review. *MIS Quarterly*, *26*(2), xiii–xxiii.

WKWI. (2008, June 20). WI-Orientierungslisten. *WIRTSCHAFTSINFORMATIK*. doi:10.1365/s11576-008-0040-2