A Pragmatic View on Resolving Conflicts in Goal-oriented Requirements Engineering for Socio-technical Systems

Ishaya Gambo[1,2][a] and Kuldar Taveter[1][b]
[1]Institute of Computer Science, University of Tartu, Estonia
[2]Department of Computer Science & Engineering, Obafemi Awolowo University, Ile-Ife, Nigeria

Keywords: Requirements Engineering, Stakeholders, Socio-technical Systems, Conflict Resolution, Agile Methodology.

Abstract: Requirements engineering has critical importance in the significant and successful number of software development projects involving multiple stakeholders to deliver high-quality software-intensive systems. The stakeholders' statements concerning the desired systems are expressed as goals to be achieved by the system in goal-oriented requirements engineering (GORE). In socio-technical systems (STS), the goals are achieved by cooperating with man-made agents within the software-to-be and human agents. However, as stakeholders often chase after mismatching goals subjectively, identifying and resolving conflicts in requirements becomes an inevitable part of GORE. This paper outlines the urgent need and processes required to investigate conflicts in the agile agent-oriented modeling (AAOM) methodology for engineering STS. We present a pragmatic view of our proposed strategy in a framework from a deductive and qualitative research perspective. The proposed strategy can attach stakeholders' corresponding roles to the hierarchical goal model's goals, which naturally brings out the stakeholder's needs and intentions. Additionally, it can relate the goal models to the most popular artifacts of agile software engineering. Thus, our pragmatic view builds upon well-established STS, especially in utilizing AAOM methodology.

1 INTRODUCTION

Conflicts in a collaborative goal-setting process are a genuine problem in many design systems. For example, requirements engineering (RE) and socio-technical system (STS) both rely on different stakeholders' collaborative participation. In this context, conflict is inevitable in such a setting, mainly because the different stakeholders are prone to disagreement regarding their goals for the system. This situation even gets worst when viewed from a psychological perspective requiring different people to deal with their individual goals hierarchies as a challenge. Clearly, these challenges are compounded even further when these goals are considered across multiple stakeholders with varying needs and backgrounds, which makes conflict an indispensable part of the process.

Goals have been introduced to RE to represent needs and intentions by different stakeholders, which are conceptually viewed as agents (Mirbel and Villata, 2012; Rehman et al., 2010). On the one hand, in goal-oriented requirements engineering (GORE), the different stakeholders' views on the desired system are presented as the goals to be achieved by the system. Consequently, requirements are treated as goals (Eridaputra et al., 2014). On the other hand, in STS, the goals are achieved by cooperating with artificial and human agents included in the software to be created. As stakeholders often pursue incompatible goals, identifying and resolving conflicts becomes an essential activity in the RE process (Van Lamsweerde et al., 1998; Bendjenna et al., 2012), especially for GORE.

In this paper's context, STS and "agent" are notions we have introduced for understanding and representing conflicts in requirements so that conflicts could be more easily identified and resolved. We define an STS as a system consisting of diverse, active components - both human and man-made - that collaborate in designing and sustaining the STS. We term such active

[a] https://orcid.org/0000-0002-1289-9266
[b] https://orcid.org/0000-0003-3074-7618

Gambo, I. and Taveter, K.
A Pragmatic View on Resolving Conflicts in Goal-oriented Requirements Engineering for Socio-technical Systems.
DOI: 10.5220/0010605703330341
In *Proceedings of the 16th International Conference on Software Technologies (ICSOFT 2021)*, pages 333-341
ISBN: 978-989-758-523-4

components as agents, which form a distributed system.

This paper is concerned with articulating some of our views on identifying and resolving conflicts in RE. The paper is a continuation of the research in Gambo (2016) and Gambo and Taveter (2021). The focus here is on better conflict management in GORE for STS instead of the traditional RE approach we have investigated in previous research. Our concern is fourfold in this paper. First, we seek to understand and establish how software engineers can address conflicts in stakeholders' expectations in an STS context. Secondly, we want to understand what software engineering (SE) activity aspects are appropriate for addressing the first issue. Thirdly, we seek to unveil the substantial evidence of work done and existing gaps in the literature addressing or attempting to address the first and second issues. Fourthly, we seek to know what suitable method(s) exist to help with a wide range of design problems addressing conflicting goals in diverse dimensions, paradigms, instances.

Therefore, this paper aims to address the main research question: How to identify and resolve conflicts in requirements that are expressed as goals for different stakeholders in GORE for STS? The main research question entails the following sub-research questions:

- RQ1: how to categorize and rank the goals for conflict resolution?
- RQ2: how to prioritize the goals?
- RQ3: how to resolve conflicts between the goals in the order of their priorities?
- RQ4: how to automate conflict resolution by a RE tool?

These questions served as the motivation for writing this paper to further extend the research agenda in conflict management during RE and set the stage for future direction. We outlined how these sub-research questions are answered in the proposed approach and hypothesis Section of this paper. Worthy of mentioning, the research questions are currently under consideration. The paper seeks to open new lines to extend our research by presenting our conceptual views to straighten the research agenda.

The paper begins with a section that presents the background on GORE, STS, capacity and evidence gaps in both GORE and STS. After that, we present our proposed approach and hypothesis in Section 3. Finally, we conclude the paper and provide our next line of action as future works in Section 4.

2 BACKGROUND

In many design systems, addressing stakeholders' goals is inevitable for a perfect, acceptable, and satisfying system. The GORE seeks to address this, especially in a world that relies heavily on complex multi-stakeholder design problems.

Research on conflict management from GORE perspectives is unorganized, fragmented, and sparse. Much is unknown about identifying and resolving conflicts in a more engaging way involving the different stakeholders in a specific application domain. In the case of GORE, the business context is essential, especially knowing why things are done. We call that knowing the "why" behind the "how" from the cognitive aspects based on human-human interaction and human-to-tool interaction. Conflict resolution is an excellent example of requirements negotiation techniques (Easterbrook, 1994).

Altogether, the problem of conflict resolution in RE is aggravated further by the iterative nature of agile SE methodologies (Version One, 2015). In practice, the heart of agile methodology focused on creating a collaborative participation culture that accommodates changes and elaborates requirements repeatedly along with the iterations in an agile SE process (van Dijk, 2011). In this situation, conflicts in the stakeholders' goals pose a significant threat to the system's success.

According to De Lucia and Qusef (2010) and Paetsch et al. (2003), the main techniques used for resolving conflicts in requirements in agile SE include Joint Application Development (JAD), modeling, and prioritization negotiations with stakeholders. However, none of the listed approaches is efficient enough for dealing with many requirements expressed by different stakeholders. More broadly, we have observed that handling conflicts in requirements in the context of agile SE methodologies are still at an early stage (Vijayasarathy and Turk, 2008).

Remarkably, earlier research on handling conflicts in GORE has been reported in Easterbrook (1994), Horkoff and Yu (2016), and Kushiro et al. (2016). Despite much of the research in the literature on dealing with conflicts, there is still a lack of enough success stories in the use of existing techniques reported so far. For example, how to make people use these techniques is challenging, especially for the stakeholders. Also, the need to focus more on working with the domain experts in the resolution process is crucial. Against these prevailing challenges, handling conflicts in goals remains an active research area in GORE (Horkoff et al., 2017; Horkoff et al., 2016).

As observed in Pohl (2010), a variety of relationships hold between goals. Such relationships include goal decomposition relationships and goal dependencies (Anton, 1996; Al-Otaiby et al., 2005; Lee and Zhao, 2006). Various GORE methodologies represent goals in decomposition hierarchies (Antón et al., 1994; Sterling and Taveter, 2009; Van Lamsweerde, 2009; Van Lamsweerde, 2001; Pohl, 2010). Differently from other GORE methodologies, the AOM methodology (Sterling and Taveter, 2009; Miller et al., 2014) represents both functional and quality goals within one hierarchy of goals, where the quality goals are associated with (i) the functional goals that the quality goals are concerned with and (ii) the roles of stakeholders responsible for the attainment of the corresponding functional and quality goals. The AOM methodology is enhanced in Tenso and Taveter (2013) and Tenso et al. (2016) by elaborating the goals at the lowest level of a goal tree hierarchy - leaves of the goal tree - into user stories (Cohn, 2004; Paetsch et al., 2003; Vanhanen et al., 2009; Haugset and Stalhane, 2012), resulting in the Agile AOM (AAOM) methodology.

2.1 Our Notion on Socio-technical Systems

STSs are complex and collaborative in nature, involving a more significant portion of human involvement concerning their social status and perspective. In this regard, STS is made up of social relationships that are networked (Dalpiaz et al., 2013). The complexity in STS is due to the social actors that need to interact and the technical components required to fulfill their goals (Paja et al., 2013). Dealing with these goals becomes suitable within the premise of GORE for conflict resolution.

Figure 1 describes a generic view of the STSs, showing the various processes, the operational environment and relating them with GORE activities. As shown in Figure 1, the operational environment indicates what characterizes STS situations, which comprises conflicts, inconsistencies, negotiation, and work system, among several others.

Cherns (1976) observed that it must perform four subsystems functions identified by Parson (1951) for any social system to survive. These functions include: "attainment of the goals of the organization; adaptation to the environment; integration of the activities of people in the organization, including the resolution of conflict whether task-based, organization-based or interpersonal based; and providing for the continued occupation of the essential roles through socialization" (Parson, 1951). Of importance in this sub-function is the aspect of conflict identification and resolution. For a software engineer, these subsystem functions are essential requirements for designing social systems. They could form the basis for goal management in terms of conflict resolution.

STSs are designed to meet the business goals (Sommeville, 2010) of human agents. In this context, the agents pursue both functional and non-functional goals, as shown in Figure 2. In Sterling and Taveter (2009), a functional goal is defined as a particular state of affairs intended by one or more active entities - agents - in the STS and a non-functional or quality goal as a quality requirement for achieving the

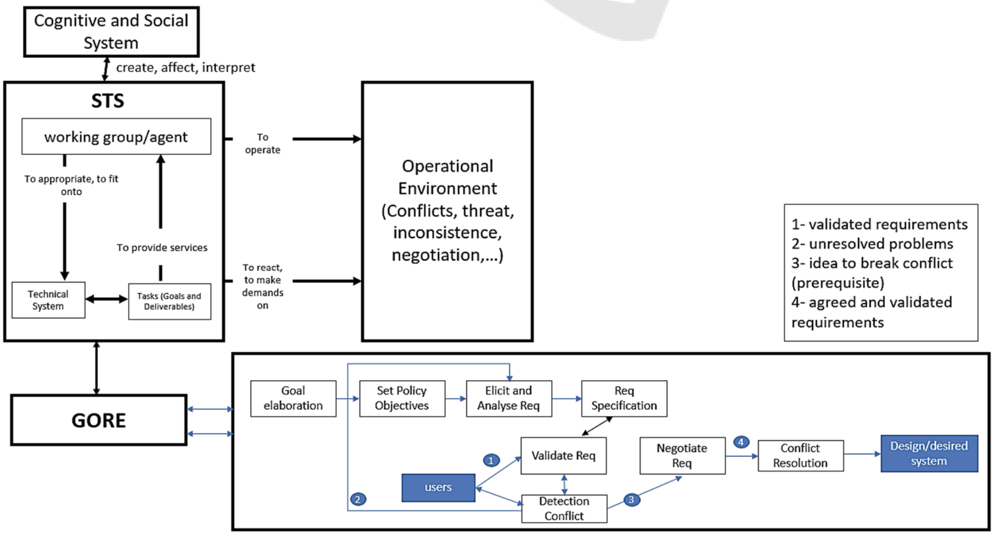

Figure 1: The STS environment and processes linking GORE.

functional goal. This is in line with the definition of goals in Van Lamsweerde (2009) and Van Lamsweerde (2001), according to which goals are either functional goals, prescribing the intended services to be provided by the system, or non-functional goals, also known as quality goals, which describe the quality of service, for example, accuracy, safety, security, usability, interoperability (Keller et al., 1990; Van Lamsweerde, 2009). However, an important difference between the treatment of goals put forward in Van Lamsweerde (2009) and Van Lamsweerde (2001) on the one hand and in Sterling and Taveter (2009) on the other hand is that while Van Lamsweerde (2009) and Van Lamsweerde (2001) ascribe goals to monolithic systems, Sterling and Taveter (2009) ascribes goals to distributed systems consisting of many interacting agents. The latter approach makes the treatment of conflicts a lot easier because conflicts essentially occur between autonomous agents.

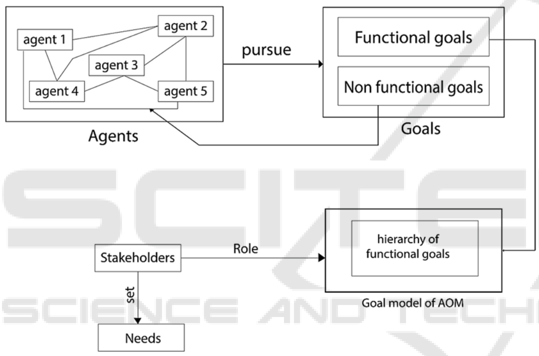

Figure 2: View of STS showing the agents and the goals they pursue.

Furthermore, STSs require a proper understanding of operation and execution dynamics (Dey and Lee, 2017). They are expected to change human behavior (De Lemos et al., 2013). Because of the preceding, (i) conflicting goals need to be addressed to harmonize intentions and expectations in future or subsequent developments; and (ii) an appropriate methodology is inevitable for engineering quality products acceptable by all involved stakeholders. In our opinion, such methodology should be able to identify and resolve conflicting goals and expectations of these stakeholders.

2.2 Capacity and Evidence Gap in GORE for Conflict Resolution

Several factors motivate RE researchers and practitioners to go after the correct, consistent, and unambiguous requirements specifications from stakeholders for implementing and delivering quality systems in a development project. In particular, the desire to deliver quality and cost-effective products is frequently expressed, driven by deeper motivations to ensure product acceptance and satisfaction. In most cases, the motivation borders more on tackling the complex issues in managing requirements and arrive at a mutual consensus in stakeholders' goals and expectations.

Therefore, we argue the need for a clever technique from both researchers and practitioners that fits GORE's scope for STS to harmonize the psychological, social, and behavioral perspectives during goal elicitation and elaboration. Requirements engineers need to be interested in stakeholders' psychological, social, and behavioral perspectives and understand their knowledge level in capturing their goals. We need to think about the goals to be achieved in the context of the problem domain. When these are addressed, it will be possible to build a system that systematically handles conflicts.

As of 2014, conflict resolution was among the topics reported to have not been addressed systematically (Daneva et al., 2014) because of the RE and SE research community's little attention. In our opinion, we envision the need for conflict management in goal-oriented requirements elicited for STS in several domains by relating stakeholders' requirements to each other within a hierarchy of goals (Miller et al., 2014). These goals are essential for managing conflicts among multiple (several) viewpoints in RE (Nuseibeh et al., 1994; Robbins, 1989; Van Lamsweerde, 1998). According to Gambo and Taveter (2021), the more the number of goals we have in a goal hierarchy, the more requirements to analyze and reconcile.

3 PROPOSED APPROACH AND HYPOTHESIS

The main research method we intend to use in addressing the research agenda in this paper is the deductive approach in case study research in SE (Runeson et al., 2012). This approach starts with an existing theory, sets out a hypothesis for the research, and finally makes observations that eventually either confirm or reject the hypothesis. In this paper, the theory is the proposed strategy for conflict identification and resolution within the AAOM methodology for STS.

Figure 3 reflects the conceptual framework describing the proposed strategy. Figure 4 overviews the research objectives, the approach for achieving each of the objectives, and the related research question(s) each approach attempts to answer.

3.1 *RQ1:* How to Categorize and Rank the Goals for Conflict Resolution?

To answer *RQ1*, the stakeholders' requirements will be elicited. For requirements elicitation from stakeholders, the interviewing techniques suggested in Runeson et al. (2012) will be applied. The elicited requirements will be represented in the form of a goal model of AOM (Yue, 1987), a hierarchy of functional goals assigned to the quality goals, and stakeholder roles. As has been put forward in Tenso et al. (2016), Tenso et al. (2017), and Tenso and Taveter (2013), the functional goals at the level of leaves of the goal tree are elaborated into user stories.

As shown in Figure 3, the requirements elicited will be used to establish the hierarchy of functional goals for the goal model of AOM. An alternative to interviews and questionnaires could be more innovative scenario planning approaches (Hughes et al., 2017).

As Figure 4 reflects, the requirements filtering technique in Butt et al. (2011) will be adapted to

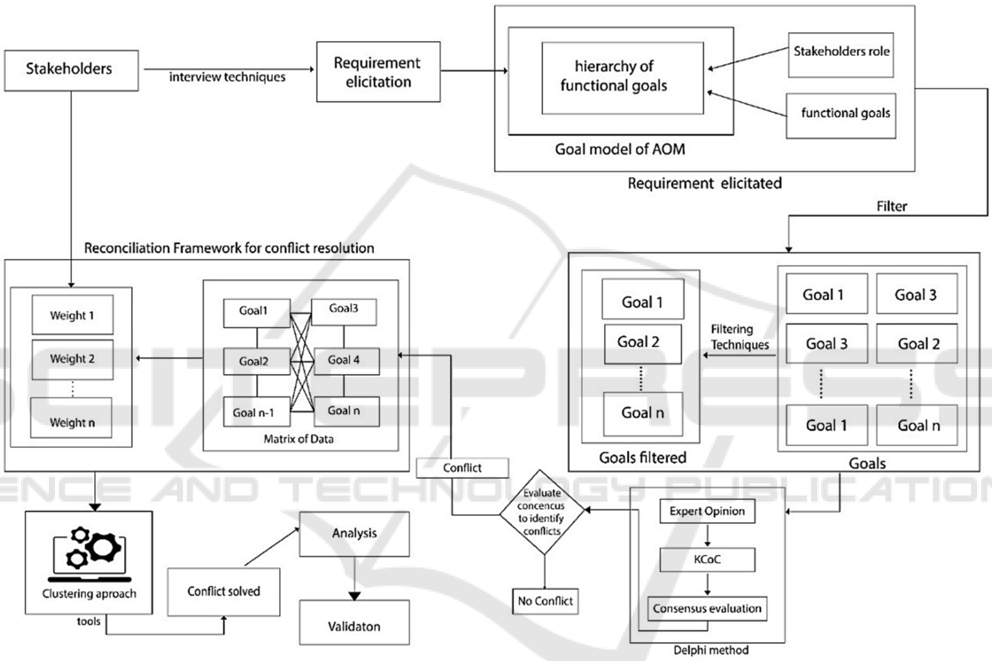

Figure 3: Conceptual framework.

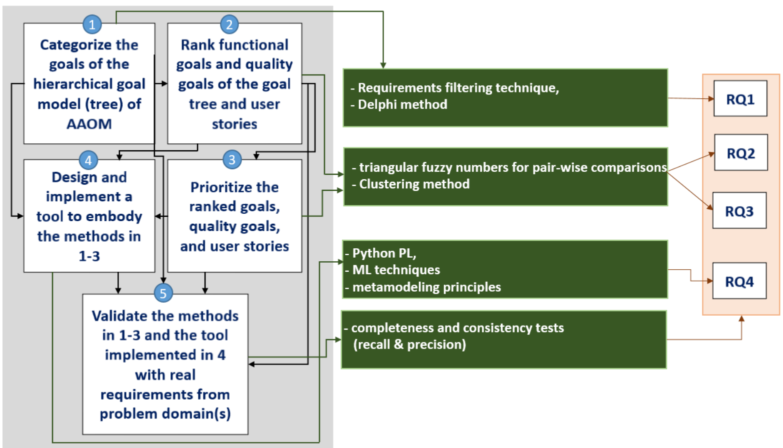

Figure 4: Proposed strategy.

eliminate redundant goals from the goal tree and categorize the goals. The relevant hypothesis (i) is that the technique (Butt et al., 2011) is adequate for categorizing the goals. After that, the goals categorized will be ranked based on the Delphi method's ranking techniques (Gambo, 2016; Keeney et al., 2011). The Delphi method, in this case, is based on the opinions of experts. The relevant hypothesis (ii) is that the Delphi method can be adapted for ranking goals and the associated user stories.

3.2 *RQ2:* How to Prioritize the Goals?

We will introduce the triangular fuzzy numbers for pair-wise comparisons of goals based on a defined ranking scale. The aim will be to establish a matrix of data suitable for prioritizing goals using a clustering approach. The priority will be based on the rankings, which the stakeholders provide.

3.3 *RQ3:* How to Resolve Conflicts between the Goals in the Order of Their Priorities?

A suitable clustering algorithm will be adapted to establish a strategy for conflict resolution partition. Worthy of mention, the goal trees will be partition into various clusters and assign relative weights to each cluster by the stakeholders. The relevant hypothesis (iii) is that the adaptation of the algorithm (Gambo and Taveter, 2021) for partitioning the goals of the goal tree is feasible. With the clustering approach, the most desirable clusters and goals will be determined.

3.4 *RQ4:* How to Automate Conflict Resolution by a RE Tool?

The adapted requirements filtering technique proposed in Butt et al. (2011), the adapted Delphi method (Gambo, 2016; Keeney et al., 2011), and the adapted clustering algorithm (Gambo and Taveter, 2021) will be embedded in the modeling tool. The tool will be based on the further development of the AOM4STS tool (Sapožnikov, 2015)[1] for GORE by AOM (Yue, 1987).

The metamodeling principles outlined in Roost et al. (2013) will be applied to ensure that the conflict resolution tool would cater to diverse problem domains. Consequently, the hypotheses (i-iii) stated above will be confirmed or rejected by the empirical observations based on real-life case studies in designing and developing STS. The rejected hypothesis will be mitigated by searching for and attempting a new appropriate method.

Finally, requirements from real-life case studies will be elicited, analyzed, and reconciled to validate our methods and tools. When doing so, completeness and consistency tests will be adapted using recall and precision as parameters to assess the optimality of the proposed solutions for identifying and resolving conflicts for requirements in GORE for STS.

4 CONCLUSION AND FUTURE DIRECTIONS

Suffice to say; this paper seeks to advance conflict identification and resolution strategy for GORE for STS within the AAOM methodology. This paper's novelty lies in the proposed strategy for identifying and resolving conflicts in GORE for STS. The strategy works with hierarchical goal models, where to the functional goals are assigned the corresponding quality goals and stakeholder roles and where the goals at the lowest level of a goal tree hierarchy - leaves of the goal tree - are elaborated into user stories.

Our pragmatic view intends to provide a clear direction and insight into which further research can be executed in a case study and given the problem domain to resolve conflicts in GORE for STS. We think incorporating user stories and case study data will help understand the underlying differences between goal prioritization, competing interests, and the social or organizational context. The goal will be to ascertain if these insights can further our understanding of broader STS principles' applicability. Eventually, the research should have useful implications for a range of domains.

We are optimistic that our proposed strategy will take advantage of (i) attachment of the corresponding roles to goals of the hierarchical goal model, which naturally brings out needs and intentions by the corresponding stakeholders, and (ii) relating the goal models to the most popular artifacts of agile SE - user stories - which will naturally enable conflict management in the context of agile SE.

We consider the full implementation and validation of our proposed strategy with a real case study and real requirements originating in real organizations for future work. For example, the healthcare domain as a case study stands out to provide a rich context within which our proposed

[1] http://www.tud.ttu.ee/im/Msury.Mahunnah/AOM4STS/

strategy can be examined. However, we are optimistic that a contrasting case would strengthen the design (our approach) either in terms of cultural context or industry sector.

When implemented, the proposed strategy will help reduce the cost of agile SE projects and save time at the early stage of development for achieving a high-quality software product. We are optimistic that the strategy and tool, when implemented, will facilitate the design of large-scale STS. Notably, it will provide software developers with the means to manage many goals and user stories as requirements and identify and resolve conflicts among the requirements.

ACKNOWLEDGEMENTS

The research reported in this paper has been supported by the Mobilitas Pluss Postdoctoral Researcher Grant MOBJD343 awarded to the first author.

REFERENCES

Al-Otaiby, T. N., AlSherif, M. and Bond, W. P., 2005. Toward Software Requirements Modularization using Hierarchical Clustering Techniques. In *Proceedings of the 43rd Annual Southeast Regional Conference–Volume 2 (Kennesaw, Georgia, March 18–20),* 223–228.

Anton, A. I., 1996. Goal-based Requirements Analysis. In *Proceedings of the 2nd IEEE International Conference on Requirements Engineering (ICRE' 96), Colorado, USA,* 136-144.

Antón, A. I., McCracken, W. M., and Potts, C., 1994. Goal decomposition and scenario analysis in business process reengineering. In *Proceedings of the* 6th *International Conference on Advanced Information Systems Engineering, Netherlands, June 6 - 10, 1994,* pp. 94-104. Springer Berlin Heidelberg.

Butt, W. H., Amjad, S. and Azam, F., 2011. Requirement conflicts resolution: using requirement filtering and analysis. In *Proceedings of the International Conference on Computational Science and Its Applications,* pp. 383-397. Springer Berlin Heidelberg.

Cherns, A., 1976. The Principles of socio-technical design. Human relations, 29(8), 783-792.

Cohn, M., 2004. *User Stories Applied: For Agile Software Development.* The Addison-Wesley Signature Series. Addison-Wesley.

Dalpiaz, F., Giorgini, P. and Mylopoulos, J., 2013. Adaptive socio-technical systems: a requirements-based approach. *Requirements engineering*, *18*(1), 1-24.

Daneva, M., Damian, D., Marchetto, A., and Pastor, O., 2014. Empirical research methodologies and studies in Requirements Engineering: How far did we come?. *Journal of systems and software*, *95*, 1-9.

De Lemos, R., Garlan, D., Ghezzi, C., Giese, H., Andersson, J., Litoiu, M., Schmerl, B., Weyns, D., Baresi, L., Bencomo, N. and Brun, Y., 2017. Software engineering for self-adaptive systems: Research challenges in the provision of assurances. In *Software Engineering for Self-Adaptive Systems III. Assurances* (pp. 3-30). Springer, Cham.

De Lemos, R., Giese, H., Müller, H.A., Shaw, M., Andersson, J., Litoiu, M., Schmerl, B., Tamura, G., Villegas, N.M., Vogel, T. and Weyns, D., 2013. Software engineering for self-adaptive systems: A second research roadmap. In *Software Engineering for Self-Adaptive Systems II* (pp. 1-32). Springer, Berlin, Heidelberg.

De Lucia, A., and Qusef, A., 2010. Requirements engineering in agile software development. In *Journal of Emerging Technologies in Web Intelligence,* 2(3), 212-220.

Dey, S. and Lee, S. W., 2017. REASSURE: Requirements elicitation for adaptive socio-technical systems using repertory grid. *Information and Software Technology*, *87*, 160-179.

Easterbrook, S., 1994. Resolving requirements conflicts with computer-supported negotiation. *Requirements engineering: social and technical issues,* 1(2), 41-65.

Eridaputra, H., Hendradjaya, B. and Sunindyo, W. D., 2014. Modeling the requirements for big data application using goal-oriented approach. In *Proceedings of the IEEE International Conference on Data and Software Engineering, November 26th - 27th, 2014, Aula Timur ITB, Bandung (Indonesia)*, 1-6.

Gambo, I and Taveter, K., 2021. Identifying and Resolving Conflicts in Requirements by Stakeholders: A Clustering Approach. In *Proceedings of the 16th International Conference on Evaluation of Novel Approaches to Software Engineering (ENASE 2021), April 26 – 27,* 158-169.

Gambo, I. P., 2016. Development of a Model for Conflict Resolution in the Requirements Engineering Process of Software Systems. *Ph.D. thesis, Department of Computer Science and Engineering, Obafemi Awolowo University, Ile-Ife, Nigeria*, 1-298.

Haugset, B. and Stalhane, T., 2012. Automated acceptance testing as an agile requirements engineering practice. In *Proceedings of the IEEE 2012 45th Hawaii International Conference on System Sciences, HICSS '12*, *Washington, DC, USA,* 5289–5298.

Hevner, A. R., March, S. T., Park, J., and Ram, S., 2004. Design science in information systems research. *MIS quarterly*, 75-105.

Horkoff, J., and Yu, E., 2016. Interactive goal model analysis for early requirements engineering. *Requirements Engineering*, *21*(1), 29-61.

Horkoff, J., Aydemir, F. B., Cardoso, E., Li, T., Maté, A., Paja, E., and Giorgini, P., 2017. Goal-oriented requirements engineering: an extended systematic mapping study. In *Requirements Engineering Journal*, *Springer London,* 1-28.

Horkoff, J., Aydemir, F. B., Cardoso, E., Li, T., Maté, A., Paja, E., and Giorgini, P., 2016. Goal-oriented requirements engineering: a systematic literature map. In *Proceedings of the 24th IEEE International Conference on Requirements Engineering (RE), 12-16 Sept. 2016, Beijing, China,* 106-115. IEEE.

Hughes, H.P., Clegg, C.W., Bolton, L.E. and Machon, L.C., 2017. Systems scenarios: a tool for facilitating the socio-technical design of work systems. *Ergonomics*, *60*(10), 1319-1335.

Keeney, S., McKenna, H. and Hasson, F., 2011. *The Delphi Technique in Nursing and Health Research*, Wiley-Blackwell, Chichester, UK.

Keller, S. E., Kahn, L. G., and Panara, R. B., 1990. Specifying software quality requirements with metrics. *System and Software Requirements Engineering*, 145-163.

Kushiro, N., Shimizu, T., and Ehira, T., 2016. Requirements Elicitation with Extended Goal Graph. *Procedia Computer Science*, 96, 1691-1700.

Lee, Y., and Zhao, W., 2006. A feature oriented approach to managing domain requirements dependencies in software product lines. In *Proceedings of First International Multi-Symposiums on Computer and Computational Sciences, 2006. IMSCCS'06,* June 20-24, 2006, Hangzhou, Zhejiang, China, 2(1), 378-386.

Miller, T., Lu, B., Sterling, L., Beydoun, G. and Taveter, K., 2014. Requirements elicitation and specification using the agent paradigm: the case study of an aircraft turnaround simulator. *IEEE Transactions on Software Engineering 40, no. 10* (2014), 1007-1024.

Mirbel, I., and Villata, S., 2012. Enhancing goal-based requirements consistency: An argumentation-based approach. In *13th International Workshop on Computational Logic in Multi-Agent Systems (CLIMA XIII), August 27-28, 2012, Montpellier, France,* 110-127.

Nuseibeh, B., Kramer, J. and Finkelstein, A., 1994. A framework for expressing the relationships between multiple views in requirements specification. *IEEE Transactions on software engineering*, *20*(10), 760-773.

Paetsch, F., Eberlein, A., and Maurer, F., 2003. Requirements engineering and agile software development. In *Proceedings of the Twelfth International Workshop on Enabling Technologies: Infrastructure for Collaborative Enterprises, WETICE '03, Washington, DC, USA,* 308-313. IEEE Computer Society.

Paja, E., Dalpiaz, F. and Giorgini, P., 2013. Managing security requirements conflicts in socio-technical systems. In *International Conference on Conceptual Modeling* (pp. 270-283). Springer, Berlin, Heidelberg.

Parson, T., 1951. The social system. London: Routledge and Kegan Paul.

Pohl, K., 2010. *Requirements engineering: fundamentals, principles, and techniques*. Springer Publishing Company, Incorporated.

Rehman, N. U., Bibi, S., Asghar, S., and Fong, S., 2010. Comparative Study of Goal-Oriented Requirements Engineering. In *Proceedings of IEEE 4th International Conference on New Trends in Information Science and Service Science (NISS), May 11th - 13th, 2010, Gyeongju, Korea (South),* 248-253.

Robbins, S. P., 1989. Organizational Behaviour: Concepts, Controversies, and Applications, (fourth edition) Prentice Hall, NJ.

Roost, M., Taveter, K., Rava, K., Tepandi, J., Piho, G., Kuusik, R. and Õunapuu, E., 2013. Towards Self-development of Evolutionary Information Systems: An Action Research of Business Architecture Development by Students in Socially Networked Groups. *Advanced Information Systems Engineering Workshops - CAiSE 2013 International Workshops, Valencia, Spain, June 17-21, 2013. Proceedings: CAiSE 2013 International Workshops, Valencia, Spain, June 17-21, 2013.* Ed. Xavier Franch, Pnina Soffer. Heidelberg: Springer, 1-15. (Lecture Notes in Business Information Processing; 148).

Runeson, P., Host, M., Rainer, A., and Regnell, B., 2012. *Case study research in software engineering: Guidelines and examples.* John Wiley & Sons, New Jersey.

Sapožnikov, A., 2015. Design and implementation of a Graphical User Interface for a Tool of Agent-Oriented Modelling (Agentorienteeritud modelleerimise töövahendi graafilise kasutajaliidese kavandamine ja realisatsioon). MSc thesis (*in Estonian, with an annotation in English*), Tallinn University of Technology, Estonia.

Sommeville, I., 2010. *Software Engineering*. London, England: Pearson Education.

Sterling, L., and Taveter, K. (2009). *The art of agent-oriented modelling*. MIT Press.

Tenso, T. and Taveter, K., 2013. Requirements engineering with agent-oriented models. ENASE 2013 - Proceedings of the 8th International Conference on Evaluation of Novel Approaches to Software Engineering: *8th International Conference on Evaluation of Novel Approaches to Software Engineering, ENASE 2013; Angers; France; 4 July 2013 through 6 July 2013*. SciTePress, 254-259.

Tenso, T., Norta, A. and Vorontsova, I., 2016. Evaluating A Novel Agile Requirements Engineering Method: A Case Study. *ENASE 2016 - Proceedings of the 11th International Conference on Evaluation of Novel Approaches to Software Engineering: ENASE 2016 (Evaluation of Novel Approaches to Software Engineering), Rome, 27-28 April, 2016.* SciTePress, 156-163.

van Dijk, R. W., 2011. Determining the suitability of agile methods for a software project. In *Proceedings of the 15th Twente Student Conference on IT*, 1-8.

Van Lamsweerde, A., 2001. Goal-oriented requirements engineering: A guided tour. In *Proceedings of the Fifth IEEE International Symposium on Requirements Engineering, Toronto, Ontario, Canada, 27-31 Aug. 2001,* 249-262.

Van Lamsweerde, A., 2009. *Requirements engineering: from system goals to UML models to software specifications*. Wiley Publishing.

Van Lamsweerde, A., Darimont, R. and Letier, E., 1998. Managing Conflicts in Goal-driven Requirements Engineering. *IEEE Transactions on Software Engineering*, 24(11), 908-926.

Vanhanen, J., Mantyla, M., and Itkonen, J., 2009. Lightweight elicitation and analysis of software product quality goals: A multiple industrial case study. In *Third International Workshop on Software Product Management (IWSPM),* 42 –52.

Version One, I., 2015. 9th annual state of agile survey. Last accessed on January 26, 2018, at http://info.versionone.com/state-of-agile-development-survey-ninth.html

Vijayasarathy, L. E. O. R., and Turk, D., 2008. Agile software development: A survey of early adopters. *Journal of Information Technology Management,* 19(2), 1-8.

Yue, K., 1987. What does it mean to say that a specification is complete? In *Proceedings of the International Workshop on Software Specification and Design (IWSSD-4), Monterey, USA.*