Continuous, Requirements-Driven Support for Organizations, Networks, and Communities

Matthias Jarke[1,2], Ralf Klamma[1], Gerhard Lakemeyer[1], and Dominik Schmitz[2]

[1] RWTH Aachen University, Informatik 5, Ahornstr. 55, 52056 Aachen, Germany
{jarke,klamma,lakemeyer}@cs.rwth-aachen.de
[2] Fraunhofer FIT, Schloss Birlinghoven, 53754 Sankt Augustin, Germany
dominik.schmitz@fit.fraunhofer.de

Abstract. Next to requirements engineering, business process reengineering and organizational impact analysis have been discussed in Yu's original thesis as application areas of i*. In our research, we elaborate and combine these three fields by aiming at continuous, requirements-driven support for organizations, networks, and communities. While i* is well suited to capture the static relationships and rationales in these cases, extensions have been introduced to cope with the dynamics of these forms of organization, such as delegation discussions, evolution, the growth (or shrinkage) of trust, etc. We integrate a dedicated speech act perspective and provide a mapping to ConGolog, a logic-based high-level process modelling environment, to enable simulations. Analysis means are extended furthermore to include dynamic social network analysis.

1 Introduction

Modern forms of organization such as networks or communities of practice as well as traditional hierarchical ones do not automatically evolve smoothly and well in a self-organized fashion. All types have varying pitfalls and shortcomings that need to be addressed explicitly.

In organizations, strict processes tend to hinder effective interactions over time. Business process reengineering was a first attempt to address this problem and also one of the early application areas of i*. Currently, approaches that treat interchangeable business rules explicitly are considered to be promising.

On the other hand, inter-organizational or strategic networks have emerged as a new paradigm to address the requirements of nowadays volatile markets, culminating in the idea of the virtual enterprise. Various partners are intended to dynamically come together to temporarily join forces to answer market needs. Instead of stable hierarchies dynamic, trust-based relationships are supposed to provide the foundation of these networks thereby enabling flexibility and stability at the same time. But trust needs to be built up and maintained.

And finally, communities of practice are a currently heavily investigated field, mainly driven by the so called "Web 2.0" emphasizing the interaction of users in wikis, blogs, etc. Again such communities where people with similar interests

exchange ideas are not free from problems. Disturbances such as trolls, i. e. persons that only interact in single-edge discussions they initiated themselves, need to be considered and coped with, especially if it is as easy and "cheap" to enter a community as in the web.

2 Objectives of the Research

All these forms of organization profit from a careful requirements-based investigation of conditions that influence their success or failure. But as research on equilibrium analysis has shown, it does not suffice to analyse only a steady-state, e. g. before the set-up. Continuous support that takes the dynamics and transitions into account is required to ensure a sustainable success.

Thus, the objective of our research is to provide a foundational framework for setting-up, managing, maintaining, and evolving organizations, networks, and communities involving human as well as technological actors. i* has proven to be suitable to capture the various relationships and rationales of the actors involved. Our multi-perspective modelling methodology [2] furthermore integrates a dedicated speech act perspective as well as a planning and simulation perspective. Additionally, we aim at a general integration of agent based approaches, including actor network theory and social network analysis to capture these complex problems by considering, resolving, and integrating multiple viewpoints. Building on earlier work, we use the knowledge representation language *Telos*, that also underlies, i* as the integration platform.

In addition to enabling formalized modelling and simulation of the object of investigation, we provide means to analyse situations and settings in order to gain insight into the dynamics, for example, regarding trust relationships. Dynamic social network analysis allows to investigate the effect of measures on the structure of the organization, network, or community as well as on other relationships, extending the currently available analysis support for i* and enabling a comparison with the intended outcome.

3 Scientific Contributions

Multi-Perspective Modelling Methodology to Capture Trust Together with sociologists we have developed a model of trust in networks that varies from existing approaches in that it considers three kinds of ingredients: trust, confidence (system trust), and distrust. Only a suitable balance enables the success of a network. A multi-perspective modelling methodology [2] has evolved around this model to provide support from a computer science perspective building on earlier work to capture cooperative processes in enterprises.

i Extensions Covering Dynamics to Enable Simulations* i* has been extended via a precondition/effect element and sequence links to operationalize the presentation in order to enable simulations. Furthermore, we provide a quantitative interpretation of softgoal contributions that enables the agents within our simulations to autonomously reason about various alternatives at run-time [3].

Mapping to ConGolog The above extensions aim at alleviating the automated mapping to the simulation environment especially in regard to clarifying ambiguities. ConGolog is a logic-based process simulation environment that builds on the situation calculus. The user of our SNet modelling and simulation tool starts by modelling the relationships of the organization, network, or community in a role based manner in i*. In the next step these generic roles are instantiated by agents that vary in regard to some details such as duration or contributions. After finally specifying the initial trust setting, simulations can be run that initiate the proactivities of agents which themselves result in delegations, i. e. complex interactions of the agents involved.

Combined Analysis Approach Although ConGolog has a formal foundation, it still only allows for simulations and is thus complementary to other existing approaches that build on model-checking (Formal Tropos) or Datalog axioms (Secure Tropos) [10]. From our perspective, Formal Tropos and Secure Tropos can be of help to analyse initial, intermediate, or final situations, i. e. snapshots from the dynamic simulations. For example, the user can be supported in evaluating the outcome of simulations and in adapting a setting to investigate a finding in more detail. The other way round, our simulation approach overcomes the instantiation limitations of a model-checking based approach. Also, the ability to consider the dynamic process of how a "system-to-be" can earn the trust of it users could be helpful to smoothly put the new or adapted system at work.

High-Level, Social Analysis Support Next to the above mentioned analysis means via Formal and Secure Tropos, social network analysis opens up a broad field of further analysis means that concern, for example, investigations on clustering, centrality etc. including extensions that consider their dynamic evolution over time. A graphical representation is often at the heart of these approaches and a corresponding toolkit has been developed that eases the application of these approaches [1]. Furthermore, we model our expectations in regard to emerging structures with i* and enable a matching with the outcome of social network analyses via a suitable pattern language [8, 9, 7].

4 Conclusions

We have applied our research approach in several projects. In a health care organization [6], trust relationships regarding the transfer of stroke patients between an acute ward and a rehabilitation ward have been analysed. Already a static investigation revealed considerable trust problems. Entrepreneurship networks [5] also involve trust relationships, but the dynamics are getting more important here. Due to the many complex features that need to be available such as network rules, agent evolution, monitoring, etc., it has not yet been possible to run a complete real world case study but simplified examples hint already on the potential of the approach. And finally, regarding communities disturbance patterns such as trolls on mailing lists have been investigated. They were easily captured in i* and the modelling was used to analyse large repositories of mailing lists.

Altogether the extension towards capturing dynamics seems a valuable step, that opens up new kinds of analysis. The means to cope with the large amount of data that results from this are already at hand (social network analysis) and currently integrated in our system (see next section).

5 Ongoing and Future Work

Current research concerns understanding and elaborating the intertwining of the various agent related theories, i*, actor network theory, and social network analysis and the potential of such an integrated methodology. Especially, the integration of the developed simulation facilities with the analysis means from dynamic social network analysis is currently targeted. Other areas include enhancing the modelling and simulation features by providing implementations for agent evolution, explicit consideration of network rules, and enabling monitoring to enable more realistic simulations [4]. Finally, we aim at applying our tool to a real world evaluation example.

Acknowledgment. This work was partially supported by the excellence initiative of the German government (UMIC cluster) and the Deutsche Forschungsgemeinschaft (SFB 427 and GK 643).

References

1. Y. Cao, R. Klamma, M. Spaniol, and Y. Leng. A toolkit to support dynamic social network visualization. In *VISUAL*, LNCS 4781, pages 512–523. Springer, 2007.
2. G. Gans, M. Jarke, S. Kethers, and G. Lakemeyer. Continuous requirements management for organization networks: A (dis)trust-based approach. *Requirements Engineering Journal*, 8(1):4–22, 2003.
3. G. Gans, M. Jarke, G. Lakemeyer, and D. Schmitz. Deliberation in a metadata-based modeling and simulation environment for inter-organizational networks. *Information Systems*, 30(7):587–607, 2005.
4. G. Gans, D. Schmitz, T. Arzdorf, M. Jarke, and G. Lakemeyer. SNet reloaded: Roles, monitoring, and agent evolution. In *AOIS*, LNCS 3508. Springer, 2004.
5. M. Jarke, R. Klamma, and J. Marock. *Zu den Wirkungen des regionalen Kontexts auf Unternehmensgründungen*, chapter Gründerausbildung und Gründernetze im Umfeld technischer Hochschulen: ein wirtschaftsinformatischer Versuch, pages 115–154. EUL-Verlag, 2003.
6. S. Kethers, G. Gans, D. Schmitz, and D. Sier. Modelling trust relationships in a healthcare network: Experiences with the TCD framework. In *ECIS*, 2005.
7. R. Klamma, M. Spaniol, Y. Cao, and M. Jarke. Pattern-based cross media social network analysis for technology enhanced learning in europe. In *EC-TEL*, LNCS 4227, pages 242–256. Springer, 2006.
8. R. Klamma, M. Spaniol, and D. Denev. Paladin: A pattern based approach to knowledge discovery in digital social networks. In *I-KNOW*, pages 457–464. Springer, 2006.
9. R. Klamma and S. Steinfels. Innovationsmanagement und Web 2.0. In *Analyse sozialer Netzwerke und Social Software - Grundlagen und Anwendungsbeispiele*, pages 273–302. GITO-Verlag, 2007.
10. D. Schmitz, G. Lakemeyer, and M. Jarke. Comparing three formal analysis approaches of the Tropos family. In *AOIS*, LNAI 4898. Springer, to appear.