Integrating Stakeholder and Social Network Analysis into Innovation Project Management

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Abstract. This paper addresses a way to analyze the dynamically evolving social context of innovation projects complementary to traditional project management methods and tools. This social context being decisive for any project's success or failure, it proposes a Social Network Analysis (SNA) based approach to identify, visualize, and systematically analyze project stakeholders, their personal roles and attitudes towards the project, as well as their mutual interrelationships. This approach has been implemented as an extension to the naviProM methodology and toolset published earlier by the authors. Based on the analysis of an innovation project case study in a complex corporate environment, the proposed approach is explained and validated.

Keywords: Innovation project management · Social Network Analysis (SNA) · Corporate entrepreneurship · Decision aid

1 Introduction

Projects are embedded in a social context of human beings that is centered in the project team. All these people have their own context in terms of attitudes, interests, culture, etc. They also have relationships among each other as well with others, direct or indirect, personal or professional ones. In general, this social context has an important influence on a project's success, since it is the foundation on which project decisions are made. Innovation projects are characterized, among other properties, by a dynamic evolution of this social context. Typically, an idea is born and nurtured within a small core team. For the realization of the idea the project team has to grow in size and connect with many other players. As a result, it finds itself embedded in a complex network of stakeholders influencing the further course of the project. Traditional project management methods and tools do not support the continuous specification, visualization and systematic analysis of such highly influential stakeholder networks. This leads to the fact that they are often neglected or even ignored and can be a reason why some projects fail. In this article, we propose a social network analysis (SNA) extension to the naviProM innovation project management methodology we introduced in earlier publications [1, 2]. The key characteristic of this methodology is that it systematically considers the uncertainty that is linked to a particular project work package or task as the driving parameter to decide how this work package or task shall

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be executed and managed. The social stakeholder dimension affects uncertainty by the stakeholder's capabilities, attitudes, influences, as well as mutual relationships. In order to point this out, this paper is organized as follows. Section 2 explains SNA principles and analyses related published work. Section 3 explains the particular project roles we decided to focus on, as well as the motivation behind. Section 4 reiterates on the case study presented in [2]. Section 5 complements this case study by a social context analysis at the end of two key project phases. Section 6 discusses the results achieved and their added value. Section 7 relates this work to the SPI Manifesto. Finally, Sect. 8 concludes and gives an outlook to related future activities.

2 SNA Principles and Related Work

A project team that is embedded in an organizational, and therefore social and political, context can be modelled as a network graph that has a complexity measure. Networks can be examined in terms of their structure and composition [3, 4]. The former provides a quantitative and/or graphical representation of the interconnections between the network nodes (i.e., the "network syntax"). The network composition describes the characteristics of the nodes and their links (edges) and quantifies the diversity of those attributes (i.e., the "network semantics"). [5] provides an outstanding overview of network metrics for structure and composition. For structural metrics, size, density and centralization are key on network level. For nodes and edges, different centrality measures convey measurable information related to the connectivity of particular nodes with the rest of the network or parts of it. As for quantifying composition, metrics such as the Index of Qualitative Variation (IQV) provide measures of e.g. network heterogeneity.

Representing stakeholders and their relationships within a project or process with such network graphs and using related metrics opens up the opportunity for the applying of the huge body of network graph analysis algorithms to analyzing of social networks. This particular type of graph analysis methods and applications has given rise to the scientific field of Social Network Analysis (SNA) [4]. SNA methods are based on an extensive yet flexible set of metrics that can be applied on multiple levels of analysis, both of purely social networks, and of projects, processes, products, and services (e.g. [6]). In a particular project context, such analyses have a key role in predicting and understanding interdependencies and influences both on and from the project to the task level [7].

Besides network theory, role theory helps to better characterize nodes (stakeholders) based on their specific role, expectation, norm, or skill profile. In the context of innovation projects, research emphasizes the single role of the champion or entrepreneur promoting the project from idea to implementation [8] or the sponsor providing support based on commitment or resources. Roles are temporary as networks, which means that they may change and have different relevance for specific tasks during a project life cycle. This is even more important considering the individual relationships between these roles and project's tasks. IPs must be formally integrated into the permanent organization to which innovative solutions generally do not fit. Thus, well-established practices and processes must be adjusted or eliminated, leading to active

and passive organizational resistance. Furthermore, under conditions of high uncertainty, when there is no formal organizational acceptance or affiliation of an idea, dedicated resources are limited. Teams have to create value related to their vision in order to build a network of supporters that will lead them in the targeted direction (e.g. with their network, expertise, resources) [9]. It is even more important to not isolate the project and rather be aware of and understand the established structures, processes, or habits that constitute the overall system [9]. In this case, people do not fulfil their formal functions or roles, but act on the basis of personal conviction, interest and motivation. They have a positive attitude towards the project. Besides this attitude, the influence of stakeholders is relevant. The project's integration into established organizational structures makes the success dependent on dedicated and committed resources and therefore on individual stakeholders' attitudes and influences [10]. However, people with a negative attitude can have a negative influence on the project, e.g. through resistance, fear or conflict.

3 Innovation Project Roles and Stakeholder Relationships

With respect to naviProM [2], it is assumed that the stakeholder network influences all the elements, i.e., input, outcome, as well as the context. As specifically informal roles strongly influence the development of tasks [11], we focus on informal relations without explicitly differentiating hierarchy network relations. Based on scientific findings in role and network theory [11], we identified major roles with respect to the task perspective and IPs in the corporate context. Two central roles have an essential influence on task-related uncertainty, particularly with regard to the task's objective:

1. The user or customer, who potentially uses or buys the final solution, as well as the early adopter who embraces new solutions before other market players.
2. The sponsor or principle, who commissioned the task, and who provides resources that are not formally implemented as well as project support and protection in demonstrating task feasibility [12].

These roles determine the requirements and shape the objective of a task. To specify, capture, transfer and operationalize this objective in concrete actions, further roles are critical for tasks:

3. The core team that drives the project.
4. Functional experts who have complementary and required expertise to specify fulfil a task.
5. Coaches who may support the project core team on the methodical level.

In the corporate context, relationship management between the task and the existing organization is of high relevance. In particular, throughout their entire life cycle, projects need access to resources within this organization, human and non-human ones. To overcome the related challenges, another role is critical:

6. Gatekeepers can provide access to the required resources on the organizational level.

Figure 1 shows the different roles (1–6) represented as nodes in the naviProM-Net tool extension that we propose. A red dotted framed node makes it possible to differentiate between internal and external network actors.

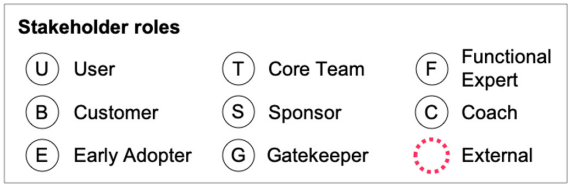

Fig. 1. Stakeholder roles [2]

As the influence and attitude of actors may vary, the model further captures positive, negative, and neutral attitude as well as low, medium, and high influence (Fig. 2). The relationship can be undirected, unidirectional, and bidirectional. The core team obviously has the highest and ideally positive impact on the task progress; however, the idea is to visualize the team as a whole in order to capture all the potential project influences coming from stakeholders.

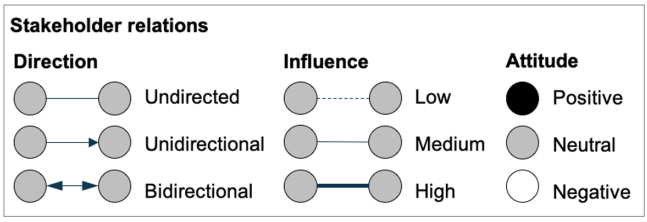

Fig. 2. Stakeholder attitude and influence [based on [2]]

Figure 3 shows a sample network providing an example of how the proposed visualizing elements can be used and interpreted. In this network, the team is directly linked to one gatekeeper ("G"-node), one sponsor ("S"-node), two internal as well as one external functional ("F"-node, red dotted line) experts. These direct relations are considered in the investigation of personnel or egocentric networks. However, core teams may not have all the required network contacts in their direct network. As depicted by the three external customers ("B"-black node, red-dotted line), actors can also be indirectly linked through a chain of relations which may hamper access to required resources. The gatekeeper is of particular interest, since he has the only access to the external market, i.e., the customer. This important relationship with the customer is represented by a fat double-sided arrow. The gatekeeper's negative attitude towards the project (indicated by the white-color in the node) could indicate potential obstacles (e.g. suppression of knowledge flow) and refers to special attention. In other words, whether the massively influencing stakeholder (here the stakeholder) is using its

influence to support, hamper or even stop the task is affected by its attitude towards the task. The functional experts as well as the sponsor have a neutral attitude toward the project (grey-colored nodes) and have low (dotted line) to medium influence (thin line) on the project.

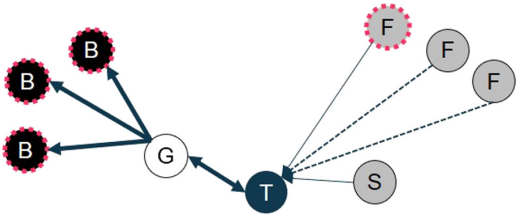

Fig. 3. Sample network

In order to apply the naviProM-Net appropriately, we propose capturing all directly and indirectly related actors to the core team in a first step. Second, the attitude towards the project must be assessed. Third, the influence and the direction of this has to be determined. The size (measured by the number of nodes; here: 8) and diversity (number of different nodes; here: 6) of networks vary and typically increase during a project [13]. Thus, all relevant actors and relations shall be captured and assessed during project setup and adjusted at the beginning of each project phase. This makes it possible to capture dynamics, to analyze the stakeholder influence in retrospective, and derive necessary strategies in order to e.g. close network gaps, win lacking sponsors or convince critics.

Based on its visualization elements, naviProM-Net makes it possible to systematically capture relevant project actors and their relationships to the project in order to detect critical or missing nodes or relationships. The key advantage of encoding these roles and their relationships in the form of a connected graph is to make available the huge set of graph analysis algorithms to understand stakeholder influences in order to apply this knowledge to task planning and analysis as well as strategy development. For example, a node's centrality is a measure of the corresponding stakeholder's capacity for reaching other stakeholders. Stakeholders with high centrality have the potential to fulfill the role of gatekeepers.

4 Case Study

In order to illustrate the practical application and added value of the naviProM-Net tool set extension, we further elaborate on the case study we presented in [2]. It is based on a corporate innovation project at a leading global Life Sciences company, where a new and innovative product-service system [14] shall be developed. This product-service system shall be facilitated by a mobile application whose design requirements were quite unknown from the beginning, since the target users' expectations had not been well analysed. A key success factor for this project is therefore to integrate pilot

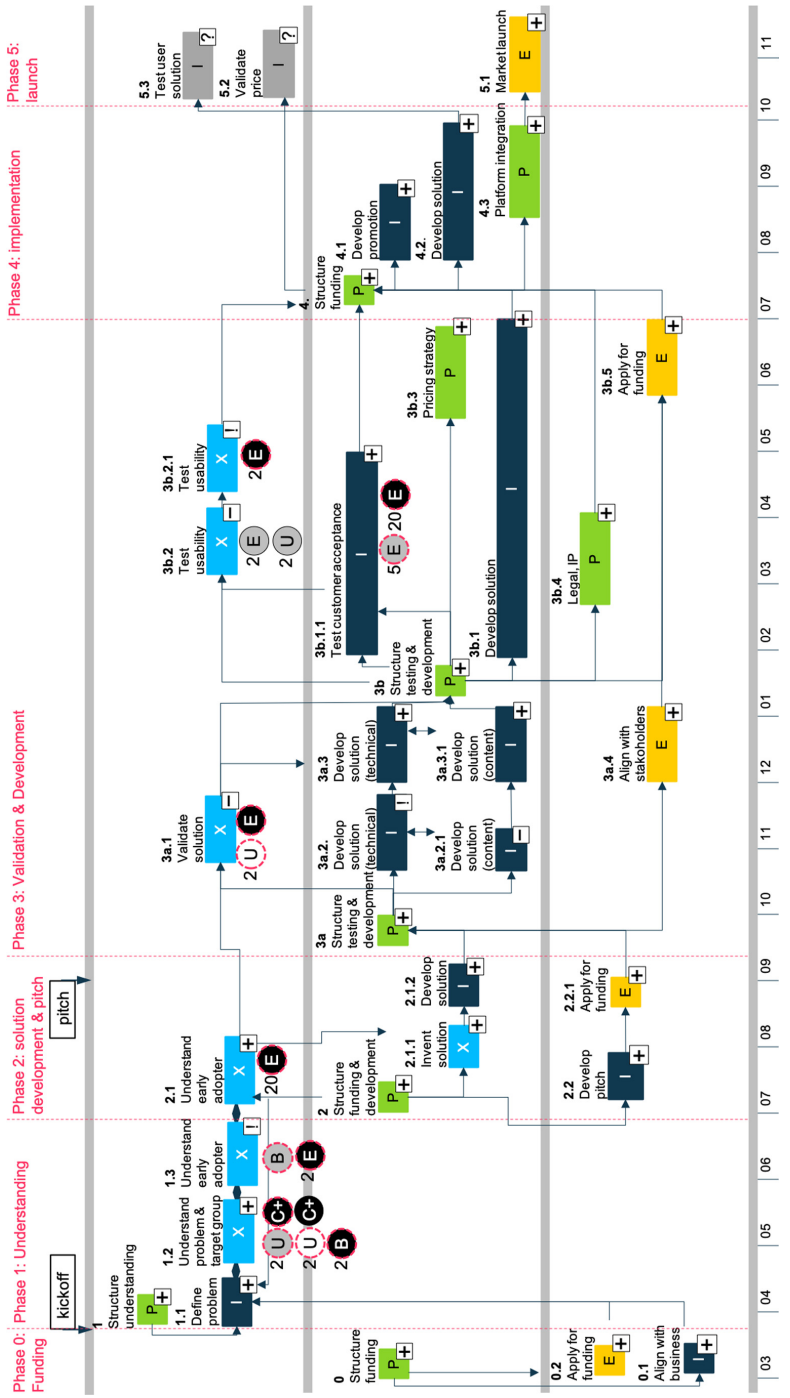

Fig. 4. naviProM-Flow representation of the case study project over five phases

customers as early adopters in the development process from the very beginning in order to assure well identifying their needs and expectations. During system and software design, it will be crucial to include regular preliminary validation steps at these early adopter's premises to include the target profile in the validation cycles and be able to adjust requirements and design decisions where necessary. The team did not execute the validation cycles well as can be seen in the naviProM-Flow (Fig. 4). The naviProM-Net (Fig. 5) helped the team to understand some of the reasons.

Figure 4 shows the course of the project across the four essential development phases, with the fifth phase (market launch) only started at the time when we finished accompanying the project. The language and tool we used to prospectively plan (during the accompaniment period) and retrospectively analyse the project based on individual tasks and their uncertainty levels is naviProM-Flow [2]. For brevity, we will not explain the entire project course here, but rather ask the interested reader to study [2]. We also provide a legend reminding the meaning of the graphical language elements we use in naviProM-Flow in Fig. 5.

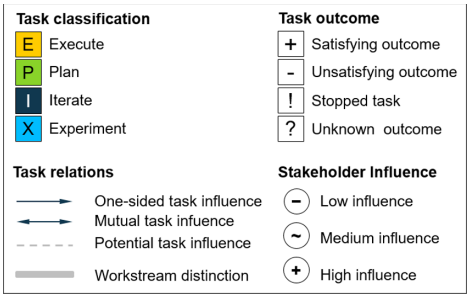

Fig. 5. naviProM-Flow project planning language elements

We clustered the project tasks into the three work streams Customer Development Work stream (CDW, top swim lane of Fig. 4), Solution Development Work stream (SDW, middle) and Business Development Work stream (BDW, bottom) in order to keep thematically related tasks together. In [2] we already pointed out that the project results available at the beginning of phase 5 suffer from unsatisfying results in phase 3. Therefore, we want to highlight how naviProM-Flow makes the major challenge of this IP visible before focusing on phases 1 and 3 in order to analyze the project's success path from the stakeholder network perspective. The long chain of experiments in the CDW, indicates that the team struggled to reduce the uncertainty related to customer needs from phase 1 to 3. Although a product-service-system project requires close interrelationship between CDW and SDW, real-life validation ensuring the service's usability in the market was not integrated. As mentioned in [2], the experiments did not generate the facts needed to validate the developed solution.

5 Integration of Stakeholder Network Analysis

The naviProM-Nets of phases 1 and 3 visualize the missing connection between the CDW and SDW in a different way. In phase 1 the naviProM-Net (left part of Fig. 6) shows a strong focus on future users and costumers. It was the neutral to negative attitude of one of the target groups noted during the activities 1.2 and 1.3 (see Fig. 4) that lead to the definition of who is an early adopter, customer, or user in this figure. The social network of this project phase also shows three smaller clusters of sponsors and gatekeepers. Their strong relationship with the core team and attitude towards the project (either positive or neutral attitude) signals the political support in the early phase of the innovation project.

In phase 3 (see right-hand side of Fig. 6), the social network grew. Additional functional experts who had the necessary skills to build the application, were added to the network. This gave rise to the formation of the new cluster content development and expanded the existing network clusters technical app development, market access, marketing strategy and business alignment. Note that some functional experts are external to the organization as some activities were outsourced. The team also expanded its external network and included additional customers, early adopters and users. The relationship between the team and the sponsors, gatekeepers did not change.

The core team made a clear internal responsibility split (represented by giving each core team member its own "T"-node.) Each team member managed a single network cluster. There was only one cross link between the clusters. One core team member together with a functional expert from the marketing access cluster were responsible for carrying out experiments with customers and users. These experiments proved to be time intensive. The limited capacity of these key players was one of the explanations why experiments were not executed as designed and had an unsatisfying outcome. Because of the missing cross links, it was up to the core team to share information.

6 Evaluation and Discussion

NaviProM helps to understand why the project was more successful in phases 1 and 2 [2] as in phases 3 and 4. The main reason was that the required experiments of phase 3, designed to validate the product-service-system solution under real life conditions were not executed as recommended by naviProM. They failed due to several reasons such as lack of capacity and improper experiment.

The social context analysis using naviProM-Net helped the team to detect and analyze decisive stakeholder networks and gaps, as well their evolution over the project course. They identified that from project phase 3, their network changed significantly, bringing along a network that clearly enlarged the core team. This is a very positive aspect in itself (given the development challenges ahead in all the three work streams). However, naviProM-Net also uncovered that this enlarged network effectively consisted of several individual network clusters that were only linked via individuals in the core team. Other links between those individual networks were missing, which alerts on a lack of communication, collaboration and integration, knowledge diffusion, as well as on a certain vulnerability and fragility of the entire network.

Even without the determination of graph-related metrics such as node centrality, connectivity, etc. the social network visualization at different stages of the project helped understand the sources of the project's key strengths and weaknesses. Most of these root causes are not visible at all in a traditional project management charts such as Gantt and PERT. Applied regularly and prospectively throughout a project, the social network analysis therefore allows identifying sources of potential problems early, and consequently adjust the project management strategy. Here, the biggest challenge is the objective collection of data required to correctly classify stakeholders and their inter-relationships. While the evaluation of formal interaction is technically easy, however, subject to data protection rights, informal interaction is difficult to capture and quantify.

7 Relevance to the SPI Manifesto

People are represented by the very first letter in the SPI Manifesto's "ABC" [15]. People are at the center of every process, every organization, as well as every change process. Innovation projects are intrinsically about change, about a dynamically growing and moving network of stakeholders each having their particular direct or indirect influence on the project. From this perspective, this work gives an important contribution to current project planning and management practice in terms of fostering the pro-active integration of the human and social context perspective into project planning and strategy development. If applied from the outset, and regularly throughout the entire project duration, the influences on the project coming from people can be much more easily and systematically included in any project decision.

8 Summary, Conclusion and Outlook

We have proposed and applied an SNA-based method and tool in order to support project managers and teams to systematically include the consideration of social context in any project related decision at any time. As an extension to the naviProM methodology and tool set, naviProM-Net allows capturing key stakeholders, the roles they fulfill, their attitudes and influences in the project, as well as their interrelationships as connected network graphs. This enables the application of graph-related algorithms for the systematic evaluation of social network metrics revealing important information such as a stakeholder's centrality, network distances, etc. Applied regularly throughout a project, naviProM-Net allows the modeling and visualization of the dynamic evolution of a project's social context, which is particularly helpful and relevant in innovation projects where project managers have to develop strategies for growing the project and its spread within an organization and/or on the market.

We have also shown the integration of naviProM-Net into other naviProM project management tool elements, which is an important contribution to making project management more holistic in terms of systematically including uncertainty as well as the social dimension in every project management consideration and decision. Initial applications of naviProM-Net in four diverse innovation projects in a leading Life

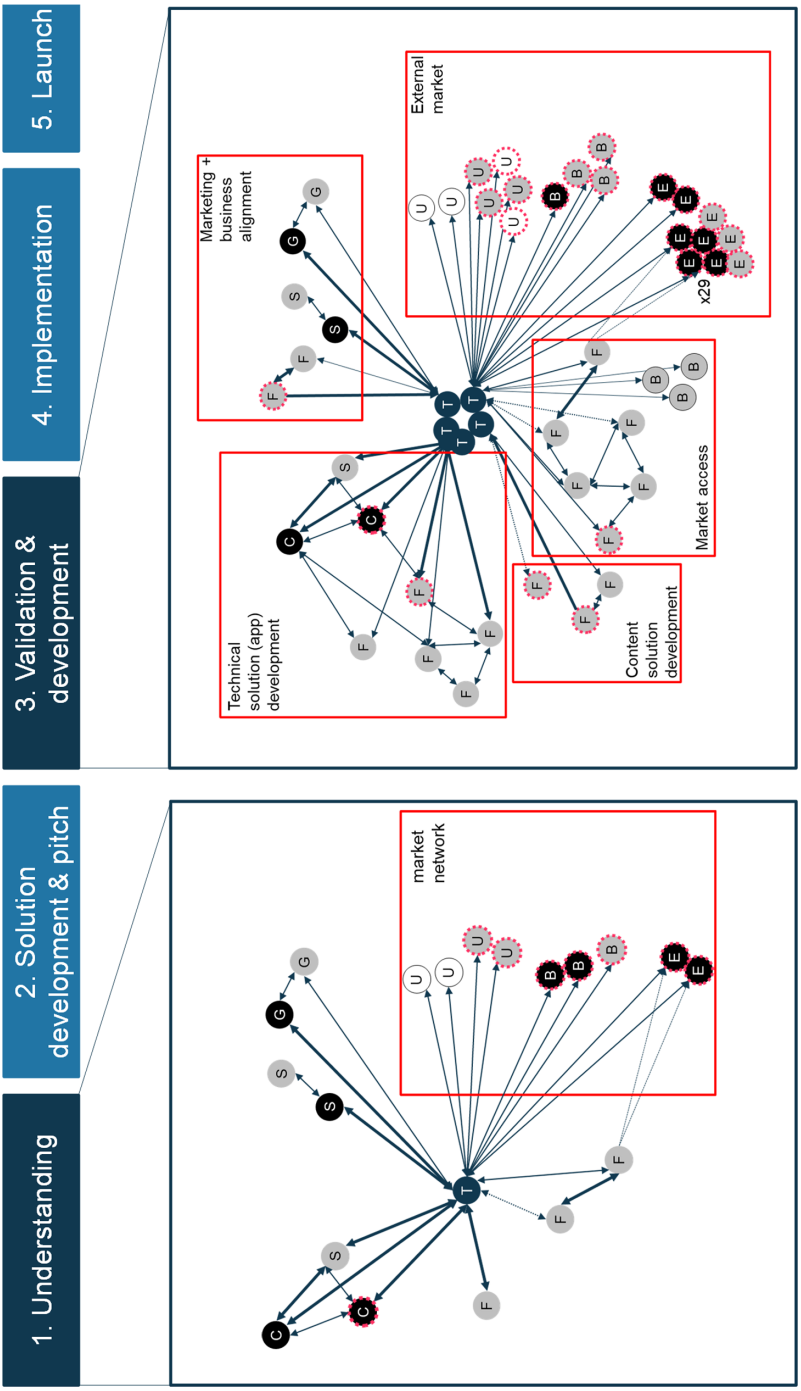

Fig. 6. naviProM-Flow representation of the case study project over five phases

Sciences company has proven very successful. Our future objectives are a broader application in various industries, as well as more detailed evaluation of the managerial impact of our method and tool set.

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