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Stakeholder management in PED projects: challenges and management model

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ABSTRACT

The importance of stakeholder analysis and stakeholder management is magnified as project complexity increases. Complex projects can be characterized by uncertainties arising from emerging technologies and the involvement of various types of stakeholders and their interests. Positive Energy District (PED) projects are an example of such undertaking, coupling novel energy solutions with distinct stakeholders and their diverse positions, claims, and requirements pertaining to the project. In this study, our objective is to provide a stakeholder management framework for future PED projects. The qualitative case study follows the theory elaboration methodology and aims to formulate a conceptual stakeholder management framework for PED projects. Thus, our contribution focuses on expanding the domain of project stakeholder management by characterizing and validating it in a new, time-relevant project context.

Keywords

Positive Energy District;
Inter-organizational collaboration;
Project stakeholder management.

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1. Introduction

A structural shift from an energy system that is based on finite energy sources, such as fossil fuels, toward a system that uses more renewable energy sources is considered “energy transition.” Historically, energy systems have been relatively centralized, that is, energy has been centrally produced in large power plants, transmitted into cities, and then distributed among the various consumers. Today, along with energy transition, energy systems are decentralizing and decarbonizing, which have given rise to a strong interest in local communities generating and supplying energy [1, 2]. To achieve the European energy and climate targets and ensure the attainment of the long-term vision for energy transition, urban development must move from individual building solutions towards Positive Energy Districts (PEDs) or other similar concepts [3]. A PED is a platform that consists of “buildings that actively manage the energy flow

between them and the broader energy (electricity, heating, and cooling) and mobility systems by making optimal use of advanced materials, local renewables, storage, demand response, electric vehicle smart-charging and ICT” [4].

As such, novel technological solutions and the relationships between the buildings and the entities residing in the district are being integrated [5]. Locally, the technological execution of an innovative PED solution requires intensive expertise from energy system designers and energy solution providers. Notably, besides technological novelty, a PED project entails challenges arising from the complicatedness of the stakeholders involved. As a district development undertaking, a PED involves multiple municipality agencies concerned with the planning, development, and governance of city districts. The other involved parties are energy system designers, contractors, housing companies, business

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owners, customers, and local residents in the area that hitherto might not have had relations with each other.

As PEDs are planned and implemented as projects, and due to the previously highlighted technological and relational complexities, project management serves as a critical step toward achieving desirable outcomes. As complexity heightens, the significance of project stakeholder management concurrently increases [6]. Therefore, understanding the stakeholder environment and efficiently managing it would boost the chances of success [7]. With the intent to replicate to 100 cities by 2025 [8], the success of early districts is key to catering to replications and to avoiding the emergence of opposition. The aforementioned premises serve as the principal motivations for this research.

This study aims to explore stakeholder management in the context of PED projects and to develop new knowledge on how the project stakeholders of a PED project should be catered to. The goal is to contribute to the existing body of project stakeholder research and to seek practical implications for future PED projects and other similar endeavors. To address these research objectives, the following research questions were formulated.

RQ1: How should stakeholders be managed in complex project settings?

RQ2: What are the main challenges encountered in PED projects?

RQ3: What are the main steps for stakeholder management in PED projects?

This paper is organized as follows. We begin with a literature review that clarifies stakeholder management activities, and then we synthesize a generic framework for project stakeholder management, thus addressing the first research question. Next, we present our methodology for the empirical case research. We then provide descriptions for two parallel case projects in the same PED setting. Thereafter, key challenges are identified and described, thereby answering the second research question. Finally, based on both prior literature and the identified challenges, we present the main steps for stakeholder management in PED projects, and end with the discussion and conclusions.

2. Project stakeholder approach

Stakeholder management is one of the key areas of project management [9] whose central purpose is to enable and enhance management's capabilities in making

informed strategic and operative decisions that cater to stakeholders' interests and expectations [10, 11]. Notably, the key issue in this domain arises from the identification and recognition of different stakeholders. Therefore, understanding the convoluted stakeholder environments of complex projects is crucial to attain success [7].

The term "stakeholder" has been given several definitions in project management literature. One of the pre-eminent definitions is by Freeman [12], who stated that stakeholders include all organizations or individuals that can affect or be affected by the project. Narrower definitions highlight the nature of interest or claim that a stakeholder has on a project [13]. However, inclusions that are too narrow may result in some stakeholders being disregarded and their potential claims being overlooked [14]. Remarkably, in practice, the adoption of a wide array of definitions can result in near infinite stakeholders, resulting in additional challenges. In addition to stakeholder definitions, project management scholars have created various categorizations for stakeholders. One of the widely utilized classifications separates internal and external stakeholders. Internal stakeholders are formal members of the project group and, thus, are usually aligned with the project objectives [15]. By contrast, external stakeholders are not formal participants to the project, but they can affect or be affected by the project's achievements and, hence, have vested interest in the project [16].

2.1. Stakeholder prioritization

Not all stakeholders deserve the same effort or endowment. Limited project resources make managing all stakeholders equally a problematic and unfavorable task [17]. The project entity and the management should focus attention where it is essential and prioritize those who have ultimate influence over the project. The stakeholder salience framework [18] enables this prioritization by classifying and ranking various stakeholder types according to their power, legitimacy, and urgency. Power is a stakeholder's ability to bring about outcomes it desires [19]. Legitimacy is a stakeholder's capacity to make sound claims perceived as desirable and appropriate within the socially constructed system of norms, values, and beliefs [18]. Urgency is the dynamism of a stakeholder or the ability to call immediate actions for its claims [18]. Depending on the possession and combination of these attributes, a typology for stakeholders can be formed. Stakeholders possessing all three are

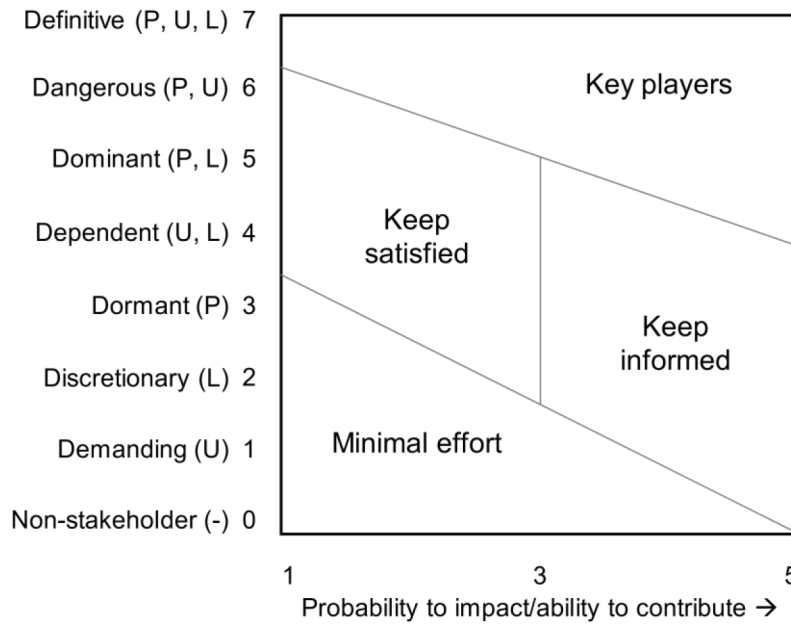


Figure 1: Stakeholder assessment matrix [21]

recognized as definitive stakeholders, whilst those with no or minimal number of attributes are considered least important for management and decision-making. Saliency can vary during a project’s duration [18], implying that the hierarchical structure and prioritization can develop as the project moves forward.

Olander [20] expanded stakeholder characterization by considering the impact level, probability to impact, and positioning toward the project, together with the saliency attributes, thereby fostering a more comprehensive stakeholder analysis. Aapaaja and Haapasalo [21] further conceptualized Olander’s approach into a stakeholder assessment matrix that categorizes stakeholders into different groups according to their saliency and probability to impact or ability to contribute. The proposed framework conceptualizes the influence of stakeholders and helps in allocating resources where they are most appropriate.

2.2. Integration and early involvement

Generally, construction projects suffer from poor performance that manifests as time and cost overruns that are partially caused by the inability of project participants to work together effectively [22, 23]. Integration aims to facilitate inter-organizational collaboration which, in a project environment, can be regarded as a process whereby different organizations are linked together to work collaboratively toward the common objectives of

the project [24]. Integration aids in aligning the objectives of various subprojects and supports the pursuit of common goals [25] rather than focusing on sub-optimization [26].

One of the key activities to empower inter-organizational integration is the early involvement of relevant actors. This refers to the inclusion of stakeholders in the project from the earliest moments to altogether formulate the project objectives and determine the means by which these objectives will be reached [27]. The opportunities to influence project success are at their highest during the early stages of the project [28]. Late revisions are usually more complicated to implement and the associated costs are much higher [29]. Furthermore, unique or complex projects often require the collaborations of multiple private and public organizations in the development of the project and end-product. Therefore, the early involvement of reasonable stakeholders enables uniting the competencies of the project organization and choosing better solutions for the customer to ultimately deliver more value [30].

Instituting integration and initiating early involvement may entail a multitude of challenges, including contractual complexity, lack of prior experience in collaborative project environments, and challenges to leadership in the form of deficient team-building efforts [31]. Project participants are often reluctant to invest in early project stages where uncertainties are at the highest level [32]. Resistance to cultural change prevails as the biggest

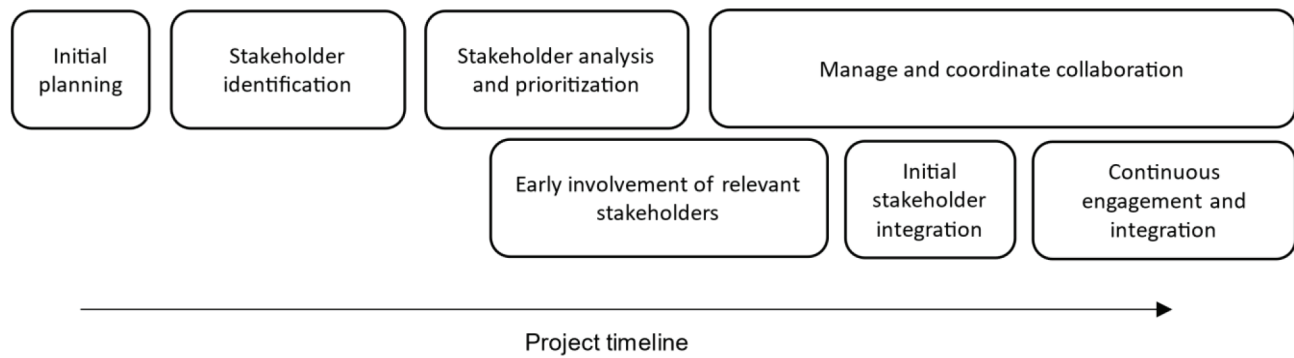


Figure 2: Generic stakeholder management model for complex project settings

barrier to implementing and adopting early involvement, and the major cause of this resistance arises from a lack of understanding the concept and its benefits [33].

2.3. Stakeholder engagement

Stakeholder engagement has become the key concept describing how organizations practice the stakeholder theory [34]. While many definitions and descriptions exist, perhaps the most widely used is the one by Greenwood [35], which describes stakeholder engagement as practices that the organization undertakes to involve stakeholders with organizational activities in a positive manner. Stakeholder engagement helps the stakeholder network achieve a higher-quality collaboration, thereby increasing the economic sustainability of the project [36]. As the complexity of the project environment increases, so does the effort required for the stakeholder engagement activity to achieve its intended performance targets [7]. Stakeholder engagement is an iterative process throughout the project's life cycle [37], and it should commence during the earliest stages possible [38].

2.4. Conceptual framework

Our project stakeholder management framework based on literature research consists of six key activities: stakeholder identification, analysis, prioritization, early involvement, integration, and engagement. Effective project stakeholder management aims to unify stakeholders as a project organization working collaboratively toward project objectives to mitigate the silo mindset and sub-optimization and to synergize individual competencies to be able to choose the best solutions for a project. Notably, it is critical to create a stakeholder management model for PED projects, balancing even the contradictory requirements of separate stakeholders for the benefit of the project. The early involvement of

stakeholders engenders collaboration, which, in turn, facilitates mutual trust and communication and enables better results, performance, and value creation for the project [39, 40, 41].

3. Research methodology

This research started with an aim to understand stakeholder management for forthcoming PED projects and subsequently expand the body of research on managing stakeholders in complex inter-organizational projects. A forthcoming PED project enabled a case study approach, and we collected empirical data from two interconnected case projects that were embedded in the same PED. Our study followed the theory elaboration methodology. In theory elaboration, prior conceptual ideas and models are used as a basis for developing new theoretical insights [42, 43]. The case study approach was chosen for its feasibility for the theory elaboration method [44] and its suitability for practical implications within the specific context. Furthermore, a case study is an appropriate approach as the nature of the project is new and unique, requiring a detailed qualitative analysis. For this study, we began by drawing the general conceptual framework for managing stakeholders in complex projects, and then elaborated it to the context of PED projects for a more detailed illustration.

Data for the case study were collected in 2020 using various methods to form a comprehensive understanding of the project's background, important events, impacting actors, common objectives, and challenges encountered. Ten semi-structured interviews were arranged with representatives of relevant project partners. In addition, our case PED project meetings were participated in, enabling participatory observation. Memorandums of past meetings were also examined. The project's EU level

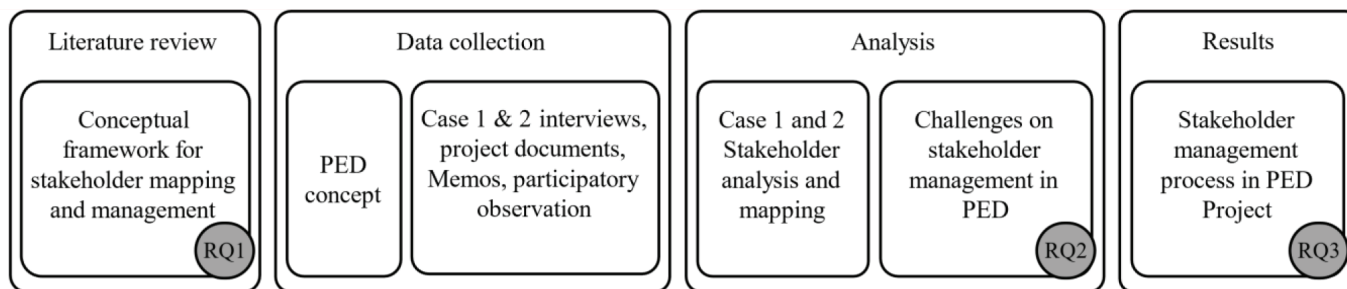


Figure 3: Research methodology and research process

Table 1: Main informants in the case project interviews

Type of Data Collection	Title	Organization
Interview	Geodesist	City
Interview	Urban planner	City
Interview	Project manager	City
Interview	Development manager	City
Interview	Researcher, urban design and planning	University
Interview	Principal scientist	Research center
Interview	Development manager	Energy company
Interview	Development engineer	Energy company
Interview	Construction manager	Housing company
Interview	Project engineer	Grocery company

deliverables, technical plans and drawings, related websites, newspaper articles and land use contracts between project partners were likewise studied.

The case analysis started with analyzing the case materials and forming an understanding of the cases’ events and main stakeholder positions. Based on the collected data, timelines for both cases were formed to recognize major occurrences and the actions leading to them. Afterward, detailed case descriptions covering the key actors and events of the cases were written. Stakeholder salience assessment was constructed to illustrate stakeholder positioning in the case projects. During the empirical analysis of the data, the focus of examinations was on deployed stakeholder management practices and stakeholder management related issues. The aim of the empirical analysis was to identify the differences, shortcomings, and additions compared with the presented theoretical framework.

4. Positive energy districts

By a definition, a PED consists of “buildings that actively manage the energy flow between them and the

broader energy (electricity, heating and cooling) and mobility systems by making optimal use of advanced materials, local renewables, storage, demand response, electric vehicle smart-charging and ICT” [4]. It can be described as an urban neighborhood working toward a surplus production of renewable energy with annual net zero energy import and net zero CO₂ emissions. PED projects seek to implement energy transition, optimize the amount of energy produced locally, and boost the use of renewable energy, waste recovery technologies, and innovative storage solutions to reduce greenhouse gas emissions. The impacts of a PED can also be recognized at social and economic levels with the creation of new business models and jobs, attraction of investors, and increase of the citizens’ involvement in energy issues through citizen engagement.

PED projects can be characterized as complex inter-organizational projects because they apply new technologies with relatively low maturity levels, combine various stakeholders with different backgrounds, and require the formation of new collaborative business models. PEDs require aligning multiple city departments’ and other stakeholders’ processes and objectives

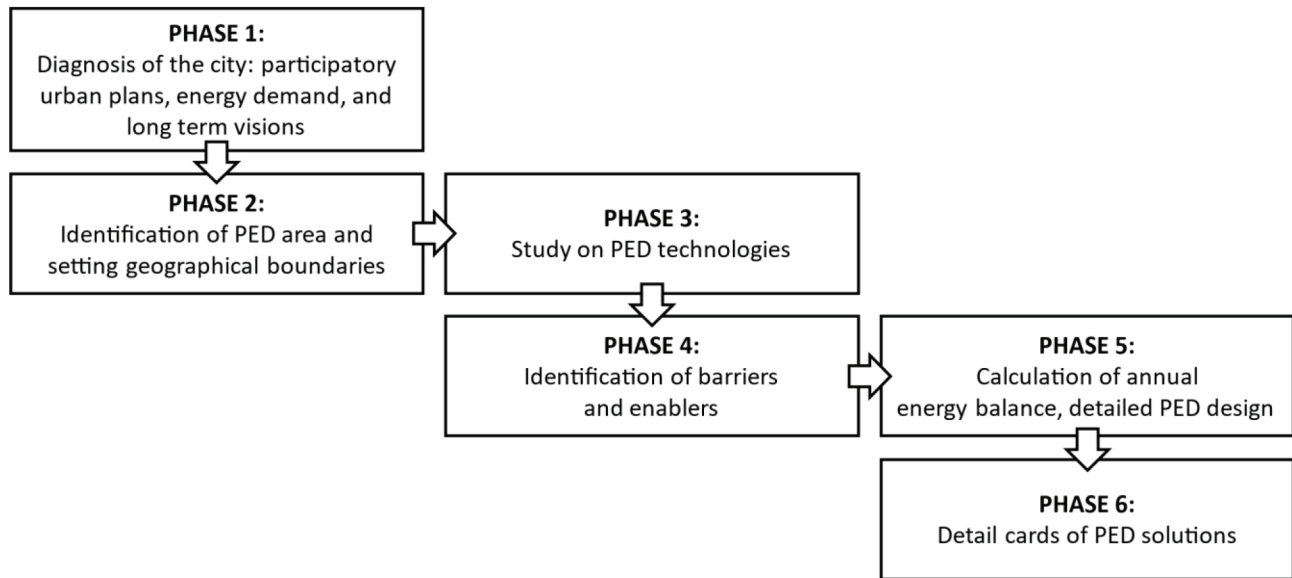


Figure 4: PED project phases in our case projects

by overcoming the traditional silo mindset in collaborative work. However, managing the interests and constraints of both internal and external stakeholders of a PED requires a high degree of coordination.

In our case projects, an initial plan for the optimal path of planning and implementing PEDs aiming to harmonize cities' spatial planning with energy planning (Figure 4) was created. At the beginning of a PED, a thorough diagnosis of the city must be made to clarify and assess the state of city plans, energy demand, and long-term visions. Potential areas should be researched and compared to identify the optimal district location and set geographical boundaries for the PED. The later phases rearrange the focus toward citizen participation and the needed technologies and energy solutions. Barriers and enablers for the PED project should be recognized and evaluated to identify any political, economic, social, technological, environmental, or legal constraints that require specific actions. The planning process is completed with a verifying calculation of the annual energy balance and the formation of detailed plans for the technical solutions.

4.1. Case descriptions

The case project is a PED project taking place in Oulu, Finland. It is a part of an EU Horizon 2020 Smart Cities and Communities Lighthouse innovation project entitled MAKING-CITY – Energy efficient pathway for the city transformation (2018–2023). Herein, the PED concept is

demonstrated, tested, and validated in two lighthouse cities. During the project, the aim is also to replicate the demonstrated PED solutions in six follower cities by utilizing the knowledge gathered in the pilot projects. For the Oulu PED, there are seven local partners and an EU project level coordinator planning and implementing the PED as a collaboration.

The PED in Oulu will be consisting of at least a grocery store and multiple apartment buildings in its vicinity. These buildings will be sharing an energy network infrastructure that works around an existing district heating network. The buildings are equipped with energy systems utilizing new technologies to generate renewable energy and heat to be transferred between the PED actors. The PED partners and their roles in the project are presented in Table 2. The two cases are sub-projects under the PED project of Oulu. The two are studied and described separately to gain more comprehensive insights into the PED and its challenges.

4.1.1. Case 1

The first case revolves around a collaboration between the City-owned Rental Housing Company and the City-owned Energy Company in the PED project. The Housing Company takes part in the PED project by building two new apartment buildings and retrofitting an existing one to fit the PED energy network. The energy solutions for these buildings are planned and implemented as a collaboration with the Energy Company.

Table 2: Partner organizations' roles in our case PED project

Partner Organization	Role in the PED Project
Fundación Cartif, Spanish Nonprofit Research Institution (Coordinator)	Coordinating at the EU project level, reporting, managing the entity
City of Oulu (Lighthouse City)	Decision making and enabling, urban and land use planning, coordinating at the local level, organizing meetings
University of Oulu (Technical Partner)	Recognizing the idea of a PED in Oulu, gathering the project group, conducting research, supporting partners
VTT Technical Research Centre of Finland, a Finnish Government-owned Nonprofit Technology Research Center (Technical Partner)	Innovative energy systems design, managing the technical planning, implementing a monitoring system
City-owned Energy Company (Energy Company)	Owner and operator of district heating network, planning, investing, and implementing the related energy systems, as well as measuring and maintaining them
Finnish Grocery and Restaurant Cooperative (Grocery Company)	Building a grocery store that produces heat for the PED network
City-owned Rental Housing Company (Housing Company)	Building two new apartment buildings and renovating one apartment building with innovative energy solutions, enabling monitoring of PED solutions
Private Construction Company (Construction Company)	Building (expectedly) two new apartment buildings with innovative energy solutions, main constructor of the grocery store

The stakeholder network of Case 1 is presented in the stakeholder assessment matrix in Figure 5.

The EU project application formation was conducted with the whole project consortium and can be described as the planning phase of the PED project. This phase consisted of meetings with the whole

project group, smaller gatherings with some of the actors, and emailing information back and forth. The Housing Company planned their own premises in the PED network, the energy solutions used in them and the required investments together with the Energy Company.

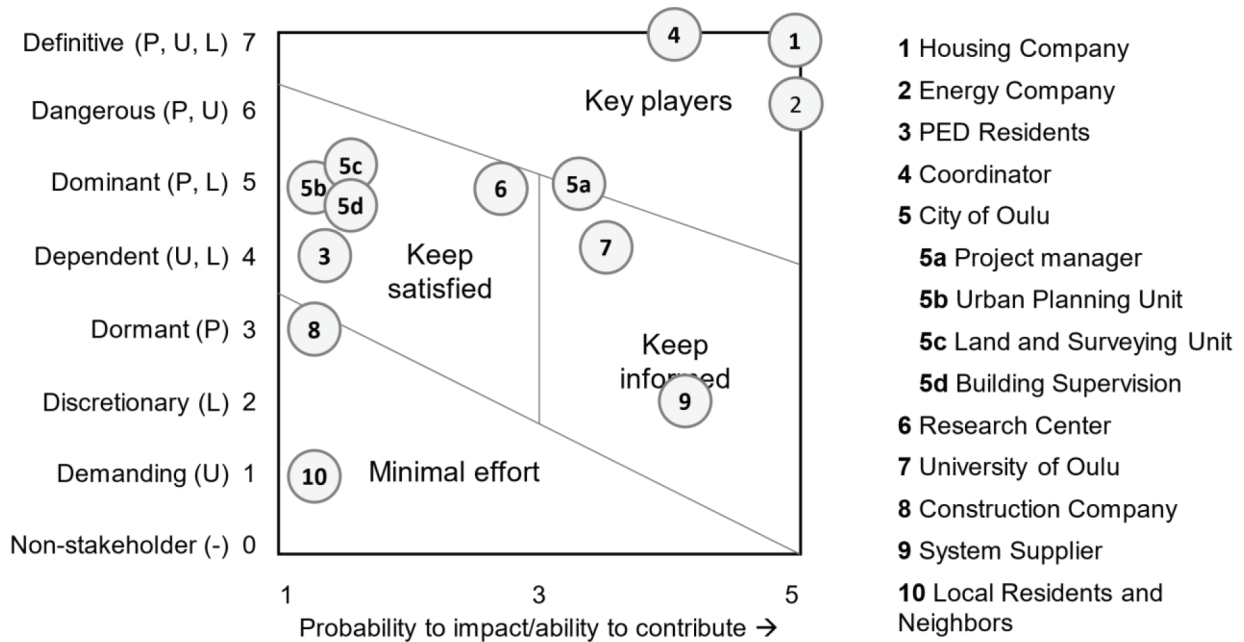


Figure 5: Case 1 stakeholder network

When the application was accepted and the project officially started, the Energy Company began to rethink the centralized energy production system they had originally planned and agreed upon with the project partners. The plans would have required a low temperature heat distribution network infrastructure besides the district heating network already existing in the area. For various financial and technical reasons, constructing an overlapping infrastructure solely for the PED project's purposes no longer seemed like the most feasible decision.

The Energy Company began changing the plans to include the existing district heating network by replacing one centralized heat pump with four smaller ones that would operate in different buildings of the PED. This fundamental change caused close to a year-long delay in the project, as the systems for each PED building had to be rethought and the investment financials recalculated. After the new solutions were planned, a competent System Supplier was chosen to deliver energy solutions.

As of this writing, the project is at construction and implementation phase. As the City of Oulu wanted to ensure a diverse housing stock in the area, the land use agreements implementing the regeneration plan for the wider urban neighborhood included a schedule that allowed for the private Construction Company to begin non-subsidized construction and selling before the City-Owned Housing Company. This delay posed an inconvenience for the Energy Company, as their preferred option would have been a swifter schedule.

The final collaborative business model concerning the energy solutions and heat transfer between the Housing Company and the Energy Company is still in progress. The basis of the energy system is in the district heating network owned by the Energy Company, but the new equipment will be operating in the Housing Company's buildings, making them the platform of energy production. Both companies have invested in the shared systems, and both utilize each other's energy and surplus heat in their own energy processes. This arrangement makes the pricing and compensation policies complicated.

4.1.2. Case 2

The second case is an analogical case description with the prior one. Its events take place in the same PED project in Oulu but are focused on the planning and building of a grocery store that works as a central energy

producer in the PED network. The participants of this case are presented in Figure 6.

Once the PED project group began the technical planning of the PED entity, the Grocery Company started to plan its store's energy solutions in detail together with the Energy Company. The store was planned to have versatile energy-efficient solutions, such as a carbon dioxide-based refrigeration system, energy-efficient LED lighting, condensing heat recovery, and solar panels. The produced energy would cover the store's energy demand and the surplus would be transferred to other PED buildings through a low-temperature heat distribution network that would be constructed during the project.

Although the grocery store was built a lot earlier than the rest of the PED buildings, the upcoming energy network had to be taken into consideration during the construction of the store. The store with its energy systems was constructed with the Construction Company as the main contractor. Multiple subcontractors hired by the Grocery Store and the Energy Company worked with the store's HVAC, electricity, refrigeration appliances, and energy systems.

Shortly after the official launch of the EU project, the Energy Company realized that the original plan with the low-temperature heat distribution network was not executable. The whole project group had to move from the agreed plan to a decentralized system that worked along the existing district heating network. As the grocery store had been constructed according to the original plans, the modification ended up being an inconvenience for the Grocery Company. Some of the energy systems had to be replaced with different ones, which resulted in technical difficulties for the transfer of the produced energy from the store into the district heating network. The low-temperature heat distribution network would have been the preferred choice with more benefits and efficiency for the Grocery Company.

At the time of our research data collection, the Grocery Company and the Energy Company do not have a contract on their shared business model yet. Instead, they rely on mutual trust and a verbal agreement. The basis of the business model is that the Grocery Company produces energy for the district heating network owned by the Energy Company and should receive some compensation. The fundamentals of the pricing politics are still under discussion and both actors want to keep track of and learn more about the energy amounts and efficiencies before final agreements are drawn up.

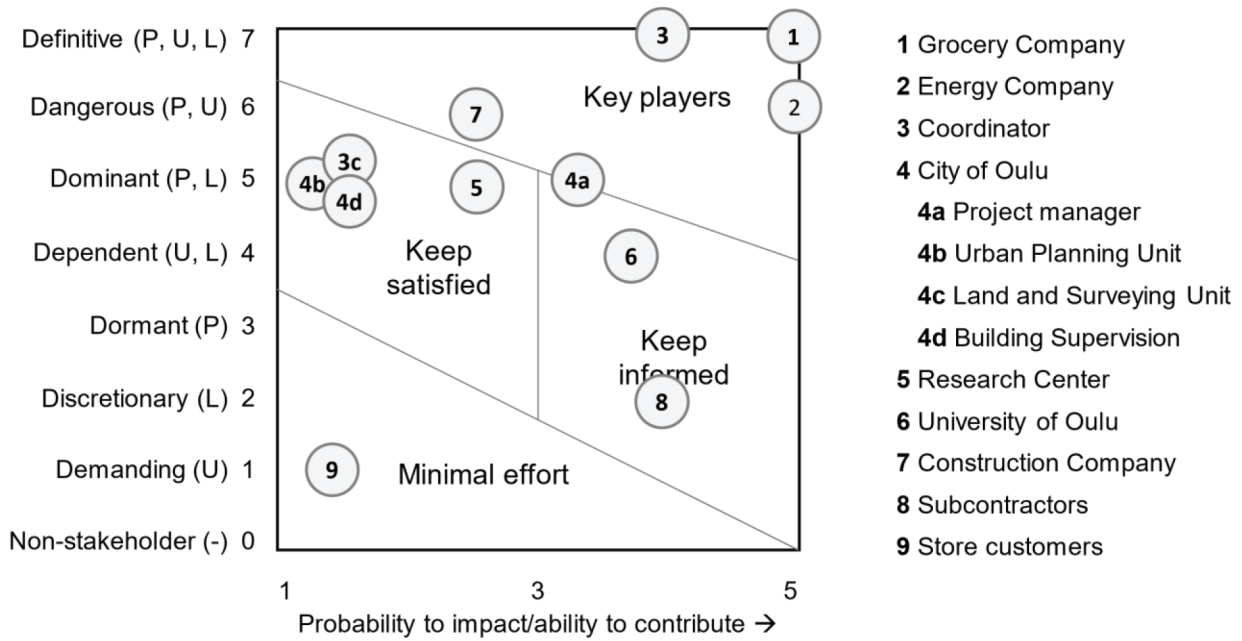


Figure 6: Case 2 stakeholder network

4.2. Challenges in stakeholder mapping and management

The identification of influential stakeholders in the project is critical for success. While no distinct stakeholder management process or a designated manager for stakeholder activities was in place, the project group and representatives managed in conjunction to identify and integrate all relevant internal stakeholders of the project. External stakeholders were identified and approached by hosting multiple participatory urban planning events and by asking public opinions before the EU and PED project preparation as the city was planning for the regeneration of the district. Nonetheless, the energy-planning aspect was not included in the participatory urban planning, and many of the interviewed participants felt that the informing and incorporation of external stakeholders was not sufficient and should have been given more effort. Lacking the official stakeholder management, there was no clear perception which stakeholders and claims should be prioritized. Often enough, the interviewees felt that those with the loudest voice got their will through.

The ambiguity was further heightened by the fact that management was divided into two levels. At the EU project level, the project was managed by the Coordinator, while at the local level by the Project Manager. At times, the participants perceived the EU project level management to be problematic due to the bureaucracy involved.

Due to the separation of management, decisions were more difficult to change, inducing inflexibility to the project. At the local level, the project utilized a shared leadership approach, rather than a traditional strict management one. This arrangement received varied feedback. Some felt that in a project of this type, it was the only feasible method, while others noted its engendered unclarity and would have welcomed a more coordinated and sturdier managerial grip. Nevertheless, due to earlier collaborations between a few of the local project participants, common trust was still present within the project organization, enabling smooth cooperation and decision making. Still, it was noticeable that the shared leadership style with no strict or clear responsibilities facilitated a rather uncontrolled management of various project participants' requirements at some points of the project.

One of the preeminent challenges the project faced was when a distinct revision had to be made to change the plans from a centralized energy system to a decentralized one. The change was initiated by the Energy Company and stated as necessary. This instilled uncertainty and inconvenience among the project partners. However, the project group managed the adjustment well, and many a partner recognized such unpredictability as inevitability in a long-lasting novel project.

The uncertainty within the open EU project call was also acknowledged. Not all parties were willing to invest

more effort to a project of which funding was not certain yet. Simultaneously, others required and demanded a higher degree of commitment from the rest. The participants felt that a deeper commitment could have made the EU project application phase easier. It was also noted that the challenges in the application phase could have been reduced with clearer roles and responsibilities among the project participants.

The project lacked a shared working location, which could have made the project environment and progress clearer for many. Instead, shared virtual workspaces were created for the project. As per the interviewees, virtual workspaces are not intended to replace a shared workspace and unfortunately lacked further utilization for collaborative purposes beyond project documentation sharing. The lack of a shared environment conjoined with diverse stakeholder groups may have given rise to disparate perceptions about the project. For some, the project had the position of being a pioneering research project. For others, it was perceived most as a daily construction business. The variety of the perceptions and goals, while aligned at the broader level, induced a burden for the project stakeholders. Clearer roles and more distinctly articulated project objectives could have granted remedy.

The main challenges encountered in our case projects can be summarized as lack of definite stakeholder

analysis and prioritization, a feeble integration toward an inter-organizational project entity, sluggish decision making, technological redevelopment, unwillingness for early commitment, and incoherent coordination of responsibilities.

4.3. PED stakeholder management model

Integrated energy and spatial planning, optimized land use agreements, and detailed plans

The empirical study identified detailed urban plans and land use agreements as key preconditions for the PED project. Detailed plans outline the course of urban development in the neighborhood in the form of determining buildings' and constructs' functions, sizes, locations, and other characteristics, such as plans for transportation, public and commercial services, and retaining appropriate recreation areas. Land use agreements determine how the owners or tenants of the properties will execute the detailed plans for the area. Thus, these plans lay the foundation and baseline for the PED project. These plans also determine the actors of the PED and act as initiators and enablers for PED projects.

In both cases, the detailed plans and land use agreements were prepared before acknowledging the prospects of PED projects in the area. Thus, the implementation of the PED in the area was not a succession to a systematic planning. Rather, it was fitted to

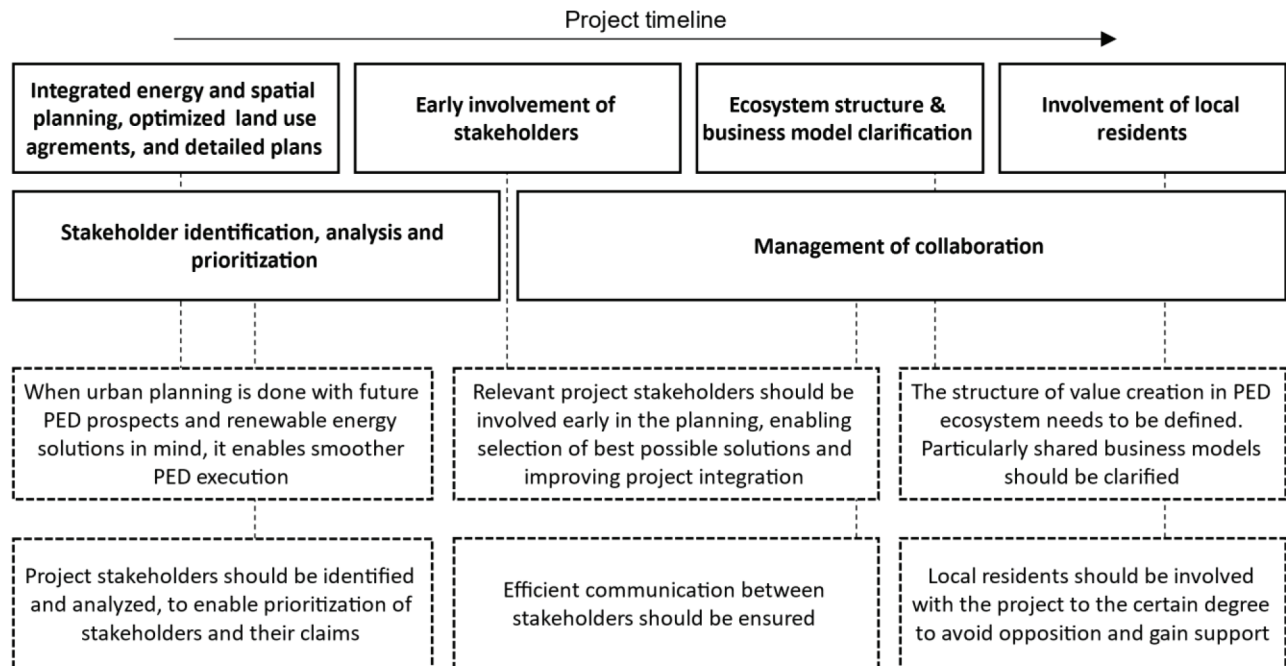


Figure 7: Stakeholder management model of a PED

pre-existing requirements and agreements. The findings suggest that such a case can cause multiple challenges for the project implementation. In an optimal scenario for future cases, integrated energy and spatial planning approach should account for future PED prospects and incorporate infrastructure readiness for novel renewable energy solutions.

Stakeholder analysis and prioritization

A PED project involves multiple stakeholders that have a central part in accomplishing project tasks and play a crucial role in the overall project success. Due to the variety of stakeholders coming from different industries with various backgrounds and connecting the goals of private businesses, plans of public institutions, and desires of future residents, the role of stakeholder management is emphasized. It is worth mentioning that stakeholder management processes are needed to improve the project management's understanding of the involved stakeholders and their needs. Stakeholder analysis should be conducted to unveil information about the expectations and requirements that the different stakeholders have about the project to help management come up with informed decisions and to support the project partners. The key stakeholder analysis activities that should be included are identification, classification, and prioritization of PED stakeholders. The first objective should be to identify all constituents who enable the project, affect the project's success, or who should be further analyzed. Once these stakeholder groups are identified, their importance to the project should be analyzed and their capability to influence the project should be evaluated.

Early involvement of relevant stakeholders

Stakeholders should be involved early on in the PED discussions and planning. They should also be integrated in the detailed energy systems design and investment planning conducted in the early stages of a PED project. This would ensure a more accurate and efficient planning, decrease costly revisions in later stages and enhance the collaboration and integration among the project participants. The three key focus areas are 1) enabling commitment, trust, and collaboration 2) clarification of common project objectives, and 3) finalization of technical solutions, investments, and schedules.

Management of collaboration and communication

A PED combines multiple stakeholders working together toward a mutual goal, with each simultaneously maintaining its own objectives in the project. Managing

this expansive combination of demands, interests, and claims requires a high level of coordination from the project management side. A project manager with clearly delineated responsibilities is essential to coordinate the collaborations of project partners and to ensure progress toward the attainment of the common goals. The project manager leads the direction of collaboration and collaborative decision making. To foster an efficient and collaborative project environment, open communication should be practiced. Regular meetings with clear agendas are a practical way to keep all partner organizations informed. Mutual trust is one of the cornerstones of collaboration, and it requires sophisticated effort, especially if the partnering entities have no prior relationships.

Clarification of ecosystem structure and business models

An additional complicating element to a PED project is devising and agreeing on ecosystem structures and business models regarding energy production. The groups of businesses and entities forming the completed district form a new cooperated energy ecosystem, linking the participants together. This new PED ecosystem can be regarded as a new entity established by adjusting the pre-existing business models of the partners. If the structure and detailed agreements of the ecosystem are left open ended or only agreed upon at the moment of completion, unnecessary uncertainty may emerge during the project. Such include energy flow between the entities, investments for the equipment, compensations paid for the energy produced, and the maintenance requirements and responsibilities for the systems. Therefore, it is critical to plan the principles in such a way that they are beneficial for both the individual organizations and the whole ecosystem. Making an unequivocal business model and structure for an entity is problematic, as multiple actors exchange energy back and forth. Further challenges exist in different legislations, whereby taxation and energy transmission costs may be applied repeatedly. In order to implement new, optimized and energy-efficient business models that endorse sustainable development, legislations concerning energy production and transmission may require updating.

Involvement of local residents

An increasingly important part of stakeholder management is the acknowledgement and engagement of external stakeholders. In the PED context, these external stakeholders are mainly local neighboring residents and future

residential customers. In the case of the Oulu PED, being based in the district heating network that is developed as part of a public infrastructure and joined by housing cooperatives, the citizens are not vital for PED project implementation but they certainly are for reaching an energy surplus during the PED use. If these stakeholder groups are not properly involved and embedded in the project, they may end up opposing it. Their involvement aims to convey information and understanding about the project and its purpose to these stakeholder groups. A more comprehensive approach should involve participatory planning regarding external stakeholders' preferences for living conditions and energy solutions. When the end-users of the PED project are heard, project outcomes are more likely to be satisfactory for them. Explaining and informing the purpose of a PED may also increase the interest and demand for services and housing for those sharing the values of sustainability and decrease any potential confusion that the project may cause.

5. Conclusions

A PED is characterized by its convoluted stakeholder environment. The sheer number of project stakeholders in the district development project can become substantial and the variety of involved actors may be considerable. Together with the demand for energy-related technical requirements, this calls for a degree of collaboration that goes beyond traditional project delivery. Furthermore, employment of new technologies entails new types of parties being involved into project environment. With these major characteristics present, we emphasize the crucial role of stakeholder analysis and management for the success of a PED project.

The vast array of stakeholders and their interests need to be carefully understood and balanced to create a viable working environment and to form an integrated project team to undertake these nontraditional district development projects. Integration and early involvement improve the chances of project success through mutual trust building and synergetic problem solving, as similarly noted by prior literature assessing complex projects [e.g., 25, 27]. Distinct to a PED, a few key actions are identified and described. Unique to the PED project context are the aspects of integrated energy and spatial planning, optimized land use agreements, and detailed urban plans. In addition, the initial step of the project phases carries significance, as the land use agreements and detailed urban plans may work as enablers or

limiters of the success of a PED. Ecosystem structure plays another significant and rather unique part in a PED project. Conjoining the new energy ecosystem into existing business models requires sophisticated planning and agreements. Finally, the involvement of local residents in the upcoming PED area is crucial for PEDs to reach their energy targets. Based on these findings, we propose a new stakeholder management framework (Figure 7) targeted for PED projects.

5.1. Scientific implications

The findings of this research are in agreement with many principles of stakeholder literature. Our findings align with the stakeholder approach [12] for project success. The findings also support the advantage gained by early involvement [27] and stakeholder prioritization [18, 20, 21] in the context of PED projects. Studying a PED project serves the project stakeholder management research, as it represents a complex inter-organizational project that is characterized by the simultaneous engagement of various stakeholders with vastly different backgrounds, and objectives, and the involvement of new technologies, concepts, and business models.

Furthermore, this paper contributes to the time-relevant and growing body of research addressing the transition toward next generation district energy systems (see e.g., [45, 46, 47]). Local energy transitions play a significant part in achieving set sustainability and carbon neutralism objectives [45], and PEDs are one of the meaningful pathways for implementing these transitions. Our approach strongly supports Butu and Strachan [45] in wide stakeholder engagement in early project planning and is aligned with Krog et al. [47] in highlighting the importance of end-user involvement and engagement in enabling successful technological transition for district energy systems.

5.2. Managerial implications

To achieve a desirable project performance for PED formation and implementation, management needs to incorporate a stakeholder mindset. The findings offer reasoning and evidence on the importance of stakeholder understanding and management in upcoming PED projects. Understanding the distinctive characteristics and stakeholder dynamics of a PED environment enables management to focus appropriate resources and efforts to the most crucial areas.

Besides PEDs, the findings offer utilization in other forms of inter-organizational energy related projects in

urban environments. The emphasized issues remain the same regardless of the specific environment: the influence of urban planning and land use agreements, the role of management, stakeholder behavior, communication across stakeholder groups, and the challenges initiated by new shared business models.

5.3. Limitations and further research areas

Being an innovation project, the PED concept and project was studied under specific circumstances. The case project took place within the MAKING-CITY project. Thus, some of the partnering organizations were able to obtain EU funding for their investments. As this may not be the case in upcoming PEDs, stakeholder saliency findings, for example, may not be directly applicable in future PED projects. Additionally, most of the project actors knew each other well from earlier collaborations. This enabled particularly easy decision making and collaboration in the endeavor, which may distort the implications for upcoming projects. In future PEDs, forming rather complex ecosystem structures may prove to be a more challenging feat if a sufficient degree of mutual trust between the participants has not been reached. The city's role in PEDs may also vary from project to project depending on the location. Therefore, the results may not be directly suitable for all PEDs; rather, they may serve as guidelines as to what factors affect the stakeholder network of PEDs.

Being an innovation project and part of a larger development scheme, the presence of research interests may distort parts of the findings. Validating studies could be initiated in future PED projects to confirm the findings in a more independent, market-driven environment.

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