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Summary

In order to address complex problems, to serve clients more effectively or to gain legitimacy companies join or form groups in which they cooperate with other companies. In such collaborative groups companies want to reach their own goals as well as a collective goal. In the formation of collaborative groups challenges related to trusting others and the goal of the collaboration are expected to appear. A typical solution to such challenges is the installation of a governance mechanism. The presence of a governance mechanism structures and directs the collaborative group. The creation and installation of this governance mechanism is, however, subject to the same challenges affecting the collaborative group in general. In order to overcome these internal challenges the involvement of an external actor has been highlighted. The external actor will drive the process in which institutions are created. This external actor can be called an institutional entrepreneur.

Institutional entrepreneurship refers to the process of creating institutions by the institutional entrepreneur. This process is based on enabling conditions that characterize the starting position of the institutional entrepreneur. These conditions are the position and characteristics of the institutional entrepreneur, and the context in which the institutions are created. Previously, three steps have been identified in the process of institutional entrepreneurship. These steps are the use of discursive strategies, the mobilization of resources and the design and implementation of institutions. The process of institutional entrepreneurship is a dynamic system in which institutions are created and used in order to go further. In this process institutional entrepreneurs can come across challenges that might change or divert the process itself, or the process may be influenced by other actors. While knowledge about the evolution of the process of institutional entrepreneurship is highly valued, it has not been investigated yet. This study was designed to fill this gap in the existing body of literature. The following central question has been formulated to guide this research:

> *How does the process of institutional entrepreneurship evolve through the development of a governance mechanism in a collaborative group?*

It was not the focus of this study to investigate cooperative aspects of collaborative groups or the organizational aspects of a shared institution, but rather the evolutionary perspective of the process that creates the institutions and facilitates the collaborative group. In order to explore this subject a single case was studied using a case study approach, where an external actor leads the creation of institutions for a group of companies. The data was gathered and analyzed through a process of four steps. First documents were studied and unstructured interviews were conducted to create an overview of the case and prepare further steps. Thereafter semi-structured interviews were conducted and based on these interviews a working document was used to create patterns. These patterns were created by grouping statements and ideas from the data sources. The third step was composed of semi-structured

context interviews and the creation of case study reports. The final step was employing the methods used to come to the conclusions of this study, inference loops were used to capture patterns and to abstract strong claims from the available data. The findings of this study are presented by a model for the process of institutional entrepreneurship and its application to the studied case.

I present a new, and more elaborate, model for the process of institutional, where multiple consecutive cycles of the process institutional entrepreneurship are recognized. Every cycle is composed of the steps that have been introduced previously, the use of discursive strategies, resource mobilization and the design and implementation of new institutions. After each cycle the effects of discursive strategies, activated resources and new institutions have changed the collaborative group. These changes are identified through the aspects that characterize the collaborative group, namely the levels of trust, commitment and goal consensus. The cyclic model implies that without the changes in the aspects of collaborative groups the activities of the next cycle could not have been performed, which prevented the realization through a single cycle of institutional entrepreneurship.

In the studied case three cycles were observed. Using the cyclic model changes in the goals and activities of the institutional entrepreneur were identified and analyzed. The goals and activities are based on the development of the collaborative group and changed after each completed cycle. The new goals build on the institutions that have been created in the previous cycle(s), and are advancing towards the envisioned situation. In the first cycle favorable short term incentives were used to commit companies to the long term perspective. In the second and third cycle the activities of institutional entrepreneurship are increasingly addressing companies as a resource as well as partners in the development of the collaborative group. The envisioned institutions are directed towards establishment and commercialization, and the activities are actions to gain and maintain internal and external legitimacy, rather than cooperation. A very important point in the process of institutional entrepreneurship proved to be the creation of mutual dependency between the envisioned institutions and the companies in the collaborative group. Through the creation of mutual dependency the challenges related to collaboration are avoided, as the companies will be cooperating primarily with the collaborative group rather than with the other companies. With the dependency of the collaborative group on its participating companies the conditions are provided for higher levels of trust, goal consensus and commitment. In turn the created mutual dependency provides the collaborative group with internal legitimacy and a basis for external legitimacy, as well as the resources for further development.

The creation and application of the multi cycle model for the process of institutional entrepreneurship directly contributes to this field of research in three ways. Primarily, the existing model, which has only been coined recently (Leca et al., 2008), is further developed in this study. When the creation of new institutions is studied, one will find that multiple cycles of institutional entrepreneurship will

follow after each other, rather than that the institutions are created in one single run of the three steps. The created model gives other researchers a tool to structure their studies. Secondly, earlier studies have observed changes in the role of the institutional entrepreneur and have given explanations for their particular changes. Based on the presented model the focus of the institutional entrepreneur can be predicted on basis of the process, particularly based on the institutions that are created in the preceding cycle. Thirdly, the emergence of mutual dependency gives a deeper understanding of the use of discursive strategies, the mobilization of resources and the implementation of institutions. By contributing to these steps in the process is shown that mutual dependency is of high importance in the understanding of the entire process of institutional entrepreneurship.

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1 Introduction

1.1 Research goal

Cooperation between firms is not a new and certainly not a rare phenomenon, nor is research in this topic. Academic interest has been accelerating since the efforts of Teece (1986). Companies have many motivations for participating in a collaborative effort related to technological development, innovation processes and market opportunities (Hagedoorn, 1993). There are various forms of cooperative efforts, varying in the number of included companies and the form and extent of cooperation. Single dyadic alliances have received overwhelming amounts of attention. Defined groups of companies, tied together in collaborations, received less attention (Das & Teng, 2002). However, such a collaborative group can be a very interesting form of cooperation. For a variety of reasons groups of organizations join or form cooperations such as addressing complex problems, ensuring availability of resources, more effectively serving of clients and the need to gain legitimacy. In a more general sense, collaborative group participants are seeking to achieve some end that they could not have achieved independently or with a single other partner.

In creating and institutionalizing such a collaborative group the participating companies will probably face challenges. The companies are presented the dilemmas of trusting the participants not to take advantage of them, and the dilemmas of choosing for safe bets or higher risk options with higher possible returns. With such collective action dilemmas (Oliver, 2003) the participants of the collaborative group may not reach an optimal situation by themselves and therefore successful creation of the collaborative group is challenging. Considerations of companies and the collaborative group in general are related to three aspects, trust, goal consensus and commitment. In collaborative groups each of these aspects should be present on a sufficient level. Coordination of the collaborative group is required to ensure the level of these aspects and to prevent fuelling the dilemmas associated with collective actions. Therefore cooperative efforts such as a collaborative group are often formalized (Kilduff & Tsai, 2003).

Provan and Kenis (2007) argue that when companies are working in a group towards a common goal as well as their individual goals, a governance mechanism will be installed. These scholars propose three mechanisms: shared governance, a lead organization and the network administrative organization. The installation and maintenance of a governance mechanism is also a challenge, as the participating companies may not recognize the need for a governance mechanism or face dilemmas concerning trust. In some cases group formation is enforced and a governance mechanism is installed by mandate, which is the case in the public sector (Provan, Fish & Sydow, 2007). Recently scholars have started wondering how a governance mechanism will emerge when a mandate is absent (Provan & Kenis, 2007). With the group of companies that is unable to create a governance mechanism itself

and there is no mandate that forces one, another solution is required. Such a situation of an under-organized context provides an opportunity for institutional entrepreneurship (Phillips, Lawrence and Hardy, 2000). The institutional entrepreneur is an organized actor, with sufficient resources or the competences and capabilities to acquire them, who leads the creation of new institutions (DiMaggio, 1988). With such actions an institutional entrepreneur could be the solution in creating a governance mechanism for the collaborative group.

The institutional entrepreneur has received little interest from academic scholars in the field of collaborative efforts of groups. Yet particularly in the process of creating and institutionalizing a collective organization the solution of the institutional entrepreneur is emphasized (Robinson, Rip & Mangematin, 2007). In the development of institutions created by institutional entrepreneurs much depends on the activities of the institutional entrepreneur. The institutional entrepreneur is expected to act in such a way that the heterogeneous set of involved actors is addressed and satisfied, and the collaborative group is successfully created. The institutional entrepreneur needs to undertake activities and make arrangements that solve challenges that emerge in creating and maintaining the governance mechanism. In the present literature on institutional entrepreneurship the role of enablers and conditions for institutional entrepreneurship is emphasized, but little attention has been given to what role the institutional entrepreneur actually has and how the process of institutional entrepreneurship evolves. The role of the institutional entrepreneur consists of the particular activities of the institutional entrepreneur in relation to their sequence, extent and effects, which is the process of institutional entrepreneurship..

Intended in this study is to contribute to the set of solutions for creating and maintaining the governance mechanism for a collaborative group. The analysis of the creation of the governance mechanism will contribute to a deeper knowledgebase for collaborative groups. An investigation into the process of institutional entrepreneurship in the creation of a governance mechanism will therefore be characteristic for the development of the collaborative group. The study aims to give insights around the activities of the institutional entrepreneurs and how the process of the institutional entrepreneurship is evolving with the development of the collaborative group.

1.2 Research questions

Based on the research goal the central question is formulated, which will be answered in this study:

> *How does the process of institutional entrepreneurship evolve through the development of a governance mechanism in a collaborative group?*

1.3 Research setting

The High Tech Factory is a shared production facility to be redeveloped from existing cleanroom facilities of the MESA+ institute for nanotechnology of the University of Twente. It has the objective of realizing a (pilot) production infrastructure and organization for micro- and nanotechnology products, this will allow companies in this field to focus on growth instead of the required basic facilities. The High Tech Factory is initiated by an institutional entrepreneur in cooperation with 14 SMEs. These companies are mostly spin-off companies from the University of Twente and the MESA+ institute, operating in micro- and nanotechnology and local companies with expertise in realizing (pilot) production & packaging facilities.

The realization of the High Tech Factory is planned in four phases. Phase 1 encompasses introduction- and enabling activities, where companies are developing specific knowledge about production and the development of production machinery. Phase 2 is the creation and start-up of an equipment fund. This fund will finance the equipment that may be rented by the participating companies. Phase 3 is the redevelopment of the R&D facilities of MESA+ into the production environment of the High Tech Factory. In Phase 4 the High Tech Factory becomes fully functional as the intended shared production facility, combining the functions of offering (cleanroom) facilities and a banker role for the equipment fund. The institutional entrepreneur leading the development of the High Tech Factory has a different role in each of the four phases and will change side by side with the development of the High Tech Factory.

The High Tech Factory is a very interesting case to study for three reasons. First, the study is interesting because it focuses on collaboration of spin-off companies in an exploitative setting. The High Tech Factory shows that collaborative efforts in high tech fields are not limited to explorative activities, but is also present in exploitative activities. Following Rothaermel and Deeds (2004), exploitation is what follows after exploration in the product development path. This transition from exploration to exploitation is an important step in new product development; this is where companies actually make money. Exploration and exploitation are different processes requiring different people, competences, activities and organizational structures (Burns & Stalker, 1961; March, 1991; Benner & Tushman, 2003). Companies are encouraged to cooperate with other firms or partners in order to realize these exploitative processes. The importance of the cooperation in the strategy of the firm is likely increase with the rise of importance of scale economies (Gomes-Casseres, 1997). Secondly, the High Tech Factory is interesting because it involves only relatively small companies in an emerging field that is not bio- or information technology. Most studies concerning small high tech companies focus on biotechnological companies. These companies operate different strategies compared to similarly sized companies in other high tech fields, as they tend to focus on being acquired by larger firms. Related is the fact that in the case of the High Tech Factory no large companies are involved.

Where studies on collaboration of small, high tech firms often involves the cooperation with a larger firm, the High Tech Factory concerns only a collaborative effort among SMEs. Thirdly, previous studies on the clustering of and co-location in high tech fields, such as nanotechnology, have focused on exploration, academic research and industrial R&D (Agrawal & Cockburn, 2003; Knoben & Oerlemans, 2006; Robinson et al., 2007). Current developments in micro- and nanotechnology indicate that exploitation, the production and manufacturing, is subject to clustering and co-location. The development of the High Tech Factory suggests that the creation of technological platforms in production and manufacturing is the next step, after research, for high tech fields.

At the moment of this study, during the spring and summer of 2009, Phase 1 of the development of the High Tech Factory is running. In this phase ten projects are executed, each with several participating companies. The companies within individual projects are complementary to each other in terms of input for the project. The creation of the High Tech Factory is led by a management layer on top of these projects. This research is set halfway in phase 1, which started November 1st, 2007 and is due May 1st, 2011. In 2010 phase 4 is scheduled for initiation and the results of phase 1 are of great importance for the successful launch of the High Tech Factory facilities.

The unique developmental trajectory of the High Tech Factory offers an opportunity for explorative research. This study intends to unfold the mystery of creating a shared and coordinated facility. Also will this study give insight in challenges and opportunities that can be expected in later phases of the High Tech Factory in terms of, for example, cooperation between companies, transfer of knowledge and external influences. Based on these findings recommendations will be formulated for the High Tech Factory concerning future decisions and developments.

1.4 Research strategy

The High Tech Factory is an opportunity for explorative research. In this study, which focuses on the High Tech Factory, different fields of research are connected that are suffering from an absence of an established theoretical basis. These fields are the development of shared production facilities in fields of emerging technologies and the mechanisms for creation of organizations by institutional entrepreneurs. Qualitative research has several relevant advantages for a research object such as the development of the High Tech Factory (Babbie, 2007). It is purposeful in examining social processes, the research can be adapted according to its own developments and the research is inexpensive in both time and resources.

The study will focus on a single case study using the case study approach. The case study is built on a phenomenon with multiple dimensions, the High Tech Factory. Case studies are characterized by giving a broad view of the situation with less external validity. To answer the research question several different aspects of the High Tech Factory need to be investigated. Namely, which parties are exactly

interacting, how these actors are involved in the development of the High Tech Factory and how the High Tech Factory is being developed. A chronological overview of important actions and occurrences in the creation of governance structures in the High Tech Factory is constructed. Based on this overview the development of the High Tech Factory is analyzed.

The expected outcomes of this study are to gain insight in the role and activities of the institutional entrepreneur and process of institutional entrepreneurship. From this we expect to learn how a governance mechanism can be built and guide the creation and development of the collaborative group.

1.5 Methods for data collection and analysis

Multiple sources of data are employed in this study. Interviews are used as the primary data source and have been taken at company, managerial and contextual level of the High Tech Factory. The extensive set of qualitative data was triangulated using other, secondary, sources of data such as documents, observations and archival records.

The case study under analysis is characterized by multilevelness, which is why data was collected on multiple levels of the case: the institutional entrepreneur, contextual actors and the participating companies. The focus is on interactions between the institutional entrepreneur and the participating companies, the collaborative efforts in the projects and the managerial activities of the institutional entrepreneur in the organization of the High Tech Factory. To ensure the comprehensiveness of the study it was decided to include all ten project leading companies. These participants are important because of their position and share in the High Tech Factory, and often they participate in multiple projects.

In order to be able to put the current developments and activities of both the institutional entrepreneur and the participating companies in perspective, the projects in have also been analyzed to create a context for the development of the High Tech Factory. The use of multiple sources per project will also provide a better picture of the project trajectories. For the developments of the High Tech Factory and its governance mechanism the management, the shareholder and funding institutions were interviewed.

Inference loops were used to capture patterns and abstract strong claims from the available data. The loop consists of the following consecutive steps: Developing an inference, an underlying pattern in the data; Making of a claim based on this pattern; Reviewing all supportive and unsupportive data; Formulating deductions; If these deductions prove to be correct, the claim has been corroborated.

1.6 Thesis structure

In chapter 2 the theoretical framework will be presented. This framework will organize theoretical constructs that are used to capture the processes in the development of the High Tech Factory in a model that can be analyzed. Chapter 3 elaborates on the methods used in this research by going deeper into qualitative and explorative research, the embedded case study and the processes of data collection and analysis. In chapter 4 several aspects of the complex phenomenon of the High Tech Factory are introduced; The environment of the High Tech Factory consisting of the University of Twente, the MESA+ institute and the spin-off companies, the history and plans of the High Tech Factory and an overview of the participating companies. This elaboration on the context of this study will help to comprehend the findings of this study. Chapter 5 presents the data from this research, a chronological narration framed by the theoretical concepts from chapter 3 and the data is then analyzed in chapter 6. Chapter 7 concludes this research by presenting: (1) Answers to the central question. (2) A discussion of the conclusions showing the added value of this study. (3) The limitations of this study and opportunities and directions for future research. (4) Recommendations for the further development of the High Tech Factory, and general managerial implications.

2 Theoretical Framework

2.1 Cooperation among companies

The most general form of cooperation is a strategic alliance. Strategic alliances are *"interfirm cooperative arrangements aimed at achieving the strategic objectives of the partners"* (Das and Teng, 1998: p. 491) in the form of *"voluntary arrangements between firms involving exchange, sharing, or co-development of products, technologies, or services"* (Gulati, 1998: p. 293). When a strategic alliance is formed by at least three partners, as is the case in the High Tech Factory, scholars speak of an alliance constellation or a multilateral alliance (Das & Teng, 2002; Doz & Hamel, 1998). Das and Teng (2002) discuss alliance constellations as a static project in which companies have a share, rather than a dynamic and evolving group of which companies are a part. This study concerns a group of companies that are interlinked with multiple ties on several organizational levels and, although it may be closely related, such a group is not adequately described by the term alliance constellation of Das and Teng (2002). The multilateralism Doz and Hamel (1998) discuss is not necessarily constricted to a single alliance with multiple firms, they also discuss multiple alliances with the same firms and different alliances in a network of coalitions. When multiple partners start alliances in larger groups scholars tend to focus on networks and clusters, not alliances.

The literature on networks is quite extensive; Scholars have distinguished many forms and foci, from social networks to organizational networks and beyond. The interest in networks continues to expand and includes many different disciplines. Networks are most often discussed from a social perspective. Brass, Galaskiewicz, Greve, & Tsai (2004: p. 795) define a network as *"a set of nodes and the set of ties representing some relationship, or lack of relationship, between the nodes."* From this point of view networks are groups of actors, where the actors can be persons, groups, companies or any other entity able to represent a node. A typical understanding of network is all the people you know, or have a relation with.

Some scholars, however, define networks narrowly (Provan, Fish and Sydow, 2007; Provan & Kenis, 2007). Provan and Kenis (2007: p. 231) discussed networks in a more concrete way: *"Networks are groups of three or more legally autonomous organizations, network participants, that work together to achieve not only their own goals but also a collective goal."* A network in this perspective contains a well defined set of participants which are connected to one another in a formal arrangement. For larger networks the organizational structure can grow increasingly complex as subnetworks may form, differences in centrality among participants can arise, and governance structures can take more forms and different roles (Provan & Kenis, 2007). These studies, which also include the work of Tracy and Clark (2003) on structure and location of cooperations, are particularly relevant in studying the multi-level character and open-ended collaboration intensions of the High Tech Factory. However, because

networks are generally considered to be much broader, a setting of a well defined group of organizations collaborating is best not described by the term network to avoid confusion. Other scholars that discussed similar settings spoke of clusters, rather than networks. These clusters are regional and linked to particular industries, but are generally less formal and less related to alliances.

In order to use perspectives from Das and Teng (2002) about alliance constellations and from Provan and Kenis (2007) about networks the High Tech Factory will be regarded as a collaborative group. In this discussion I will use the term 'collaborative group', rather than either network, cluster or constellation. First shall be discussed what the characteristics of collaborative groups are. Thereafter the challenges of cooperating in a group of companies are introduced, regarding challenges in coordination and resolution of conflicts. Governance mechanisms are solutions to these challenges. Three possible governance mechanisms for collaborative groups are discussed. To create and maintain the governance mechanism the involvement of the institutional entrepreneur is presented. The final piece of the theoretical framework is about the development over time of the role of the collaborative group, the institutional entrepreneur and the governance mechanism.

2.2 The collaborative group

2.2.1 Cooperation in groups

In collaborative groups companies want to reach their own goals as well as a collective goal. There are several important aspects of cooperation between companies, which influence the form, dynamics and outcomes of these cooperative efforts. These aspects can be organized on the level of individual participants and aspects which are related to the level of the collaborative group. In a collaborative group the following aspects are expected to be of importance. On the level of participants, trust, commitment and goal consensus, and on group level, the expected exchange horizon, the number of partners, selection of partners, intermediary support and the external environment.

On the level of individual participants one of the most frequently discussed aspects is trust. Trust is an aspect of a relationship between partners described as ''*the willingness to accept vulnerability based on positive expectations about another's intentions or behaviors*'' (McEvily, Perrone & Zaheer, 2003: p. 92). Gulati (1995) has shown that trust in dyadic, as well as in multilateral, relationships and cooperative efforts is an important factor. A large body of research has created insights in the general need for trust in organizations, including the different ways trust can be demonstrated such as characteristically and norm based (Provan & Kenis, 2007). Sherer (2003) found that confidence, measured by the beliefs, perceptions, and procedures that build trust, is also important to the success of manufacturing networks.

Commitment is the "*willingness of partners to exert effort on behalf of the relationship*" (Monczka, Petersen, Handfield and Ragatz, 1998: p. 557). Commitment has often appeared as the object of attention in strategic alliance literature. Monczka et al. (1998) point out that commitment to a relationship can be demonstrated in several ways. Most often commitment takes shape of committing resources to the relationship, which may, for example, be an organization's time, money or facilities. As another form of committing resources support of a firm's CEO is seen as an important success factor for networks (Sherer, 2003). Das and Teng (2002) emphasize the influence of generalized reciprocity; members need to demonstrate their goodwill and commitment by making contributions while expecting others to reciprocate at a future time.

Goal consensus refers to the *"degree to which an organization's specific goals and services are agreed upon by the parties"* and such consensus by organizations that are tied in collaboration is a *"prerequisite to exchange"* (Van de Ven, 1976: p. 31). Goal consensus is generally perceived to allow participants in an alliance to perform better than when there is conflict concerning the goals (Provan & Kenis, 2007). Consensus on goals is thus a relational aspect of a cooperative effort between two or more persons, parties or organizations. Although it is a relational aspect goal consensus is not necessarily related to trust among partners. There can be consensus, or conflict, regarding the content and process of goals and their attainment while the partners are still trusting each other. Obviously goal consensus has implications for efforts in collaborative groups. Participants are more likely to be committed to the collaborative group and more likely to work together, when there is a general consensus on broad level goals, or goals on level of the cooperative effort with a selection of the partners. Similarity of purpose can result in a hampering process; especially when competitive pressures make the organizations reluctant to cooperate. As there are many sides to goal consensus and its implications, there can be great variety in the level of goal consensus among participants of collaborative groups. Connected to goal consensus is the expected exchange horizon, referring to the expected temporal duration of the collaborative effort (Das & Teng, 2002). In collaborative groups a longer exchange horizon may increase the need for generalized reciprocity, governance, and goal consensus.

The number of partners will have implications on the form, dynamics and outcomes of collaborative groups. The number of potential relationships will increase exponentially as the number of partners grows. Hwang and Burgers (1997) were able to show that the games played by multiple parties (as in collaborative groups) are fundamentally different from the games played by two parties (as in dyadic alliances), using a game-theoretic framework. They also showed that the complexity of the games being played increases exponentially with each added partner.

Intermediary support can include many different roles. Generally it includes the facilitation of interaction, gate keeping and arbitrative actions in the networked alliance (Suarez-villa, 1998). For

networks intermediary's involvement often improves other success factors, rather than being the source (Sherer, 2003). For collaborative groups an intermediary can offer services that stimulate the overall functioning of participants individually and/ or the collaborative group as a whole.

Partner selection has a considerable impact on the content, shape and outcomes of a collaborative group. Character, rather than expertise, should be investigated when choosing participants for manufacturing networks (Sherer, 2003). Attractive characteristics, which increase the likelihood of being selected, include reputation for successful cooperation and a firm's existing alliance network (Gulati, 1995b, 1998; Uzzi, 1997). Beckman, Haunschild and Philips (2004: p. 259) have made a proposition based on the framework of March (1991): *"firms use the choice of new partners as a form of exploration, and form additional relationships with existing partners as a form of exploitation."* Partner selection is expected to be critical for collaborative groups, as it is a fundamental driver of stability and change, and it determines the mix of skills and resources available (Beckman et al., 2004; Rai, Borah, & Ramaprasad, 1996; Sherer, 2003).

It is impossible to regard a group without reference to the environment in which is it situated and based on (Sherer, 2003). External environment encompasses many different and independent factors such as local industries, governmental programs, economic influences and proximately based network partners. For networks of SMEs, group membership criteria often emphasize geographically proximate core competencies (Human & Provan, 1997).

2.2.2 Challenges for collaboration in groups

The companies starting or operating in a collaborative group are presented the dilemma of trusting the other participating companies not to take advantage of them, and the dilemma choosing for safe bets or higher risk options with higher possible returns. In their discussion of multilateral alliances Doz and Hamel (1998) argue that the real differences between alliances with two or three partners and multilateral alliances is the greater difficulty of management and maintenance. These scholars state that "*what can be assumed with few partners needs to be managed explicitly and actively with many*" (Doz & Hamel, 1998: p. 224). Referred is to three major difficulties in maintaining alliances with multiple firms that have been identified: norms of reciprocity, conflict resolution, and coordination. Similarly, Provan and Kenis (2007) stated that for networks, with a goal-directed organization and a distinct identity, a governance mechanism is necessary to ensure that participants engage in collective and mutually supportive action, that conflict is addressed, and that group resources are acquired and utilized efficiently and effectively.

2.3 Governance

In their study of modes of governance for whole networks Provan and Kenis (2007) described three governance mechanisms that can be applied to collaborative groups; shared governance, lead organization governed and network administrative organization (NAO) governance mechanism.

A group where governance is shared among the participants is run with 'shared governance'. This type of governance is often seen as desirable by individual participants at the formation. Participants are often highly decentralized and actions are typically uncoordinated. Shared governance is strongly dependent on the commitment of partners. Although some activities may be allocated, symmetrical power distribution is expected through the collaborative group. The group acts collectively and there are no single entities representing the group as a whole (Provan & Kenis, 2007).

When one, in the group participating, organization takes the lead and plays to role of a hub, the collaborative group is governed through a 'lead organization'. Such a structure can be arranged when inefficiencies of shared governance are high and a single participating member is willing and capable to represent the group, as a result of choice or mandate. High centralization and brokerage are connected to this governance mechanism as administration and facilitation is focused. For the additional tasks and responsibilities lead organizations are funded by collaborative group members or external funds (Provan & Kenis, 2007). In case of forming collaborative groups the choice for governance through a lead organization is related to the concept of an anchor tenant (Agrawal & Cockburn, 2003), where large local firms play a central role in regional innovation systems.

In case there is a separate entity to govern the collaboration, Provan and Kenis (2007) speak of the 'network administrative organization' (NAO) governance mechanism. In this situation the collaborative group is centralized and there is a key role for the broker in coordination and sustaining the collaborative group. A NAO is not a member of the group as its exclusive purpose is the governance of the group. The size of a NAO can vary with its tasks from a single person to a formal organization, depending on the size and goals of the collaborative group. A NAO may include boards of participants to increase legitimacy and deal with complex collaborative group level problems and issues, while reducing the complexity of shared governance.

2.3.1 Governance effectiveness

The choice for a particular governance mechanism and the effectiveness of the chosen mechanism is influenced by aspects of the governance mechanisms and moderated by the characteristics of the collaborative group and its participants. The successful adoption of a particular form of governance will be based on a selection of structural and relational aspects and characteristics, namely: Trust, the number of participants, goal consensus and need for collaborative group level competencies (Provan &

Kenis, 2007). An overview of the three governance mechanisms and the related aspects is given in table 2.1.

Trust, which has been described as an aspect of collaborative groups earlier, is for governance especially relevant in terms of trust density and distribution. Trust density and distribution refer to the extent that members of the collaborative group trust each other and whether or not it is reciprocated among other members. In case of shared governance, the level of trust density should be high. In case of a brokered governance form trust can be moderate for NAO's or low for lead organization governance (Provan & Kenis, 2007).

The number of participants, or the size of the collaborative group, has a considerable impact on the chosen governance mechanism. Shared governance is best suited for a small numbers of participants; this will allow full and active face to face participation. When the number of participating firms is larger the shared governance mechanism becomes highly inefficient, especially when the members are geographically spread (Saber, 1998). Brokered governance through a member or a NAO no long requires direct involvement of other members for many decisions. Interaction among partners is no longer needed on the collaborative group level. A small number of participants can be undesirable as members may feel disregarded. There is no specific number which is correct for particular forms of governance. However as a rule of thumb: collaborative groups up to 6 – 8 members can be governed by shared governance and a NAO can govern the largest number and the most diverse collection of participants (Provan & Kenis, 2007).

The existence of collaborative group level goals is important for collaborative groups by definition. The need for goal consensus is related to the type of governance. In cases of shared governance a high level of goal consensus is necessary. For a lead organization governance mechanism the goal consensus can be moderately low, as the lead organization assumes the strategic and operational decisions. This is the best scenario when decisions need to be made on group level goals and network members are less able to resolve conflict or are only partially committed to the collaborative group goals. Governance by NAO's requires a moderately high level of goal consensus. At least a subset of the group members is required to be involved in decisions on collaborative group level strategy; these are typically committed to the collaborative group level goals. Although goal consensus can be very high among a few members of the NAO governed collaborative group, other members are likely to be less committed and involved, with only modest goal consensus. It is a task of the NAO leader to resolve possible conflicts, related to the collaborative group, among members and to enhance commitment to the collaborative group and its goals (Provan & Kenis, 2007). When there is low goal consensus there is no point in working together in a collaborative group.

Collaborative group members are participating to achieve some end that they could not have achieved independently. A relevant question is how the competencies that are required to achieve collaborative group-level goals can be attained. Two issues are central at this point: What is the nature of the performed tasks? And what external needs are required by the collaborative group? The NAO governance mechanism is particularly effective when the skills, which are required by the group, are related to collaborative group-level needs. Collaborative group members in general or lead organizations may not have these skills, such as writing proposals and reports, quality monitoring, or conflict resolution. External demands can also range from high to low, including tasks such as lobbying, seeking new members and acquiring funding. Again the NAO governance mechanism will be the mechanism of choice in case of extensive external demands; an external funder may need a single spokesman for the entire group, ruling shared governance out; and lead organizations are unlikely to match the set of skills which is required (Provan & Kenis, 2007).

Governance form	Trust	Number of participants	Goal consensus	Need for Group Level competences
Shared Governance	High density	Few	High	Low
Lead organization	Low density, high centralization	Moderate	Moderately low	Moderate
Network Administrative Organization	Moderate density	Moderate - many	Moderately high	High

Table 2.1. In this table the three types of group governance in relation to the aspects and structural characteristics of groups, adapted from Provan and Kenis (2007).

2.3.2 Tensions influencing effectiveness

Provan and Kenis (2007) identified three core tensions which have impact on the effectiveness governance mechanisms: Governance efficiency versus member inclusiveness, internal versus external legitimacy, and flexibility versus stability.

The primary tension regarding efficiency, the ratio of outputs over inputs, is the need for administrative efficiency opposed to the involvement of members in the governance. More involvement will lead to a larger investment of time and effort and a lower efficiency. A NAO governed collaborative group is likely to strike a better balance in the tension than either of the two other governance forms. A dedicated staff can take care of the governance tasks efficiently and structured. A representation of members can be installed for invoice in strategic issues. However, the NAO governance mechanism can be seen as bureaucratic (Provan & Kenis, 2007).

A collaborative group has to maintain its legitimacy among its members, internal legitimacy, and to the outside world, external legitimacy. Internally, the governance mechanism should stimulate interaction among partners and build trust among them. Externally, the governance mechanism will be the face of the collaborative group, and participants may feel undermined or may not see the benefit of

external activity. The problem is that none of the three governance mechanisms is ideally suited to fully address each side of the legitimacy tension. The shared-governance mechanism is best suited to address internal legitimacy needs. The lead organization mechanism is suited to address the external legitimacy needs. The NAO mechanism can strike a balance between the two other mechanisms. However, it may be quite difficult to adequately address both legitimacy needs, especially at the same time (Provan & Kenis, 2007).

Flexibility can be manifested in strategic direction, member involvement and size. It can make a group strongly adaptive to its surroundings. Stability is critical for collaborative groups in gaining internal as well as external legitimacy. Concerning the members of a collaborative group, a lack of commitment is the flipside of flexibility. The strategy of the collaborative group should be sustainable for the group members (Gomes-Casseres, 1994). Similarly, Provan and Milward (1995) found that stability was a major factor for explaining effectiveness, even when resources were inadequate. Shared governance requires members to be flexible and committed. As the collaborative group is under strong influence of those members, short term goals and targets will be best to focus on. NAO and lead organization governed collaborative groups can have a stronger focus on stability and long term goals.

2.3.3 Creating a governance mechanism

The used governance mechanism needs to be created and maintained. In the process of creating a governance mechanism the companies are presented the same dilemmas of trust, goal consensus and commitment they are facing in general. Provan and Kenis (2007: p. 248) remarked "*if there is no mandate, how do network governance forms get started in the first place?*"

For the creation of a governance mechanism the same aspects apply as any other part of the collaborative group. Trust among the collaborative group needs to be build over time, which can be a time consuming process. In large groups actors rarely have the same ideas concerning its management. Companies are expected to express low commitment to a group that doesn't exist and as such providing no guarantee of added value to the company. Considering these aspects and the dilemma's that precede them, the companies that may participate in a collaborative group are not expected to create a governance mechanism by themselves, such as shared governance or the lead organization governance mechanism. In such a situation a third party can stand up and provide an external solution. When there is no external mandate or collective action that creates a governance mechanism to structure the collaborative group a third party can take the actions that lead to the creation of a governance mechanism.

Such an external party, that drives a process of creation where direct participants lack action, can be called an institutional entrepreneur. An institutional entrepreneur is an organized actor, with sufficient resources or the competences and capabilities to acquire them, who leads the creation of new

institutions (DiMaggio, 1988). According to DiMaggio (1988: p. 14) institutional entrepreneurs arise when they see "*an opportunity to realize interests that they value highly.*" In this context institutions are defined as "*rules, norms, and beliefs that describe reality for the organization, explaining what is and is not, what can be acted upon and what cannot*" (Hoffman, 1999: p. 351). In creating new institutions an institutional entrepreneur can build a governance mechanism for collaborative groups.

2.4 Institutional entrepreneurship

Institutional entrepreneurship refers to *"activities of actors, who have an interest in particular institutional arrangements and who leverage resources to create new institutions or to transform existing ones"* (Maguire, Hardy & Lawrence, 2004: p. 657). Institutional entrepreneurship is performed by actors. The actions of these actors are centralized around the creation, diffusion, and stabilization of institutions (Leca, Battilana & Boxenbaum, 2008). Institutional entrepreneurs are embedded agents; they are dependent on existing and expected technologies, industry structures and institutions (Garud, Hardy & Maguire, 2007). For actors to qualify as institutional entrepreneurs they must (1) break with existing rules and practices associated with the dominant institutional logic(s) and (2) institutionalize the alternative rules, practices or logics they are championing (Garud & Karnøe, 2001). The origin of institutional entrepreneurs depends on maturity of the field they are operating in (Maguire et al., 2004). Institutional entrepreneurs tend to be dominant actors if their field of operation is mature, whereas in emerging, or immature, fields institutional entrepreneurs are traditionally not dominant. In such emerging organizational fields, institutional entrepreneurs tend to be actors whose positions provide them with both legitimacy and the ability to bridge stakeholders, enabling them to access dispersed sets of resources (Maguire et al., 2004).

2.4.1 Enabling conditions

For institutional entrepreneurship to be present three enabling conditions have been identified; opportunities in the organizational field, the social position of the actor and the characteristics of the institutional entrepreneur. The organizational field should offer an opportunity for institutional entrepreneurship. Uncertainty in the institutional order may provide opportunity for strategic action (Fligstein, 1997). This is particularly the case with precipitating jolts or crises in the organizational field, or the presence of acute, field-level problems that might precipitate crises (Leca, et al., 2008). Institutional entrepreneurs can create these events (Rao, 1998) or can react to events instigated by other members of the field (MacGuire, Hardy and Lawrence, 2004). Additionally, Phillips, Lawrence and Hardy (2000) suggest that unstructured or under-organized contexts provide opportunities for institutional entrepreneurship. Secondly, the social position of the institutional entrepreneur impacts the actor's perception of the field (Dorado, 2005) and the social position also impacts the access to recourses (Lawrence, 1999). The social position of the institutional entrepreneurs is defined as "*their*

position in the structure of social networks" Dorado (2005: p. 397). Thirdly, the actor's characteristics are important in role of institutional entrepreneurs. Institutional entrepreneurs must be possess a high level of social skills and be able to draw on existing cultural and linguistic materials (Fligstein, 1997; Garud et al., 2007) Institutional entrepreneurs are also required to have (access to) particular resources (Maguire et al., 2004).

2.4.2 Process of institutional entrepreneurship

Based on earlier studies the process of institutional entrepreneurship was unfolded by the distinction of three different steps, the use of discursive strategies, the mobilization of resources and the design and implementation of institutions (Leca et al., 2008).

The first step in the process of institutional entrepreneurship is the use of discursive strategies. In their review Leca et al. (2008: p. 12) define discursive strategies based Rao et al. (2000: p. 44) as actions to *"frame the grievances and interests of aggrieved constituencies, diagnose causes, assign blames, provide solutions, and enable collective attribution processes to operate."* In this step institutional entrepreneurs theorize their envisioned project in such a way that it will resonate with the interests and values, and problems of potential allies (Leca et al., 2008). To do this the initial problems must be framed, specified, and then the promoted project must be justified (Suddaby & Greenwood, 2005). A high level of empathy with potential allies is needed to frame the problems skillfully. Therefore institutional entrepreneurs must be able to identify with the states and relate to the interests of others (Fligstein, 1997). When it is not one coalition but fragmented groups that populate the field, the institutional entrepreneur needs to find a common ground among the interests of those different actors (Fligstein, 1997). When there are complex dependencies among the members of the field, institutional entrepreneurs need to both legitimize the field to the major stakeholders on whom the field's members are likely to depend, and build an identity specific to the field members (Déjean et al., 2004; DiMaggio, 1991). Leca, et al. (2008: p. 11) describe the process as *"a complex political and cultural process, where institutional entrepreneurs must mobilize diverse social skills depending on the kind of institutional project they intend to impose"*

When the problem is framed and the proposed solution legitimized, the second step can be taken, resource mobilization. The success of institutional entrepreneurs is linked to their ability to mobilize resources, defined as "*their access to, and skills in leveraging scarce and critical resources, which are needed for political action*" (Leca et al., 2008: p. 14). Two types of resources are required in the process of institutional entrepreneurship, tangible and intangible resources. Building a coalition with other players can be based on tangible resources (Garud et al., 2002), and these resources can be used to pressure important stakeholders to favor a project (Demil & Bensédrine, 2005). Intangible resources

are required in the forms of social capital, legitimacy and formal authority, in order to continue activities and to promote acknowledgment of other actors (Fligstein, 1997; Phillips et al., 2004).

The third step is the design and implementation of new institutions by institutional entrepreneurs. To define the design and implementation of institutions the statement of Leca et al. (2008: p. 17) is used, they state that "*institutional entrepreneurs can stabilize interactions to ensure that institutions, once diffused, will be maintained. To this end, institutional entrepreneurs develop institutional arrangements. … Institutional entrepreneurs shape the carriers of institutionalization, which include regulative and normative elements."* Institutional entrepreneurs achieve the design and implementation of institutions by linking existing routines, norms and values to their projects. This step employs the previously acquired legitimacy, support and resources (Leca et al., 2008). In emerging fields, in which boundaries need to be set and a common identity is yet to emerge, normative carriers are prominently employed by institutional entrepreneurs for structuring and professionalization of a field. These normative carriers include, the definition of a professional identity (Hughes, 2003), membership strategies (Lawrence, 1999), professionalization (DiMaggio, 1991), and the establishment of standards (Garud et al., 2002).

2.4.3 Challenges for institutional entrepreneurs

Institutional entrepreneurs can come across several challenges. Most importantly, institutional entrepreneurs operate in an organizational field which can be changed over time or be misinterpreted by the institutional entrepreneur. There are two dynamic characteristics that greatly determine the possible influence of the institutional entrepreneur, multiplicity and the degree of institutionalization, and these characteristics are changed by the actions of institutional entrepreneurs (Dorado, 2005). The multiplicity of the organizational field is the number and overlap of institutional referents available in the organizational field. Dorado (2005) states that tightly closed fields provide little exposure to multiple institutional referents and are therefore less likely to facilitate action of an institutional entrepreneur. Open organizational fields allow the display of tensions and thus favor the development of new institutions. The degree of institutionalization is the second characteristic. In emerging fields successful processes of institutional entrepreneurship will give a rise in the degree of institutionalization. As such, future institutional entrepreneurship is less likely to be facilitated. Institutional entrepreneurs thus face the challenge of taking away their opportunity for further actions. Another challenge that institutional entrepreneurs face is the dilemma between the imposition of self-restraints on the one hand and monetary benefits from technology commercialization on the other (Jain & George, 2007).

2.5 Development and evolution of governance

Institutional entrepreneur can be employed ensure creation of a governance mechanism. The creation of a governance mechanism enables the creation and development of the collaborative group. If the collaborative group develops it is likely that the governance mechanisms will be subject to change, which in turn will impact the (activities and role of the) institutional entrepreneur. Such forms of interdependence and co-development are examples of evolutionary processes.

2.5.1 Evolution

After the call for research into the dynamics of cooperative efforts some scholars have started exploring collaborative processes and alliance developments, adopting combinations of life-cycle, teleological, evolutionary, and dialectical theories of change (De Rond & Bouchikhi, 2004). Studies in single-lens theories on selection and adaption have a long history (Lewin & Volberda, 1999; Lewin & Koza, 2001). Relatively recent is the notion co-evolution, the joint outcomes of managerial intentionality, environment, and institutional effects (Lewin & Volberda, 1999). Particular in collaborative groups the effects of co-evolution are of interest, as strategic actions taken by firms or on institutional level can have a significant impact on their subsequent evolution of firms, industry and the environment (Levinthal & Myatt, 1994; Rodrigues & Child, 2003). De Rond & Bouchikhi (2004: p. 56) emphasize the *"co-evolutionary interchange of design and emergence, cooperation and competition, trust and vigilance, expansion and contraction, and control and autonomy."*

Co-evolution builds on the assumption that in all interacting populations of organizations change can occur and can be driven by direct interactions and feedback from the rest of a system. Therefore change can be the joint outcome of managerial intentionality and environmental effects, rather than an outcome of either managerial adaption or environmental selection (Lewin & Volberda, 1999). Collaborations, embedded in firms' strategic portfolios, co-evolve with the firm's strategy, the environment and the intentionality of the collaborations. These systems are called cooperative co-evolutionary systems (Koza & Lewin, 1998). For such co-evolution to occur the population must consist of heterogeneous firms that are able to interact and mutually influence each other (Volberda & Lewin, 2003).

Systems of co-evolution have, according to Lewin & Volberda (1999), a set of essential properties and related implications for management and research. These properties are multi-levelness, multidirectional causalities, nonlinearity, positive feedback and path dependence. These properties can be expected to be present in the development of collaborative groups.

- The involvement of several organizational and/ or societal levels is related to multi-levelness. The aspect of multi-levelness implies that co-evolutionary effects take place at multiple levels within, and between firms, and their collaborative projects (Lewin & Volberda, 1999).
- In co-evolutionary systems a distinction can be made between direct and diffuse co-evolution. Direct co-evolution is when one actor or population evolving in response to another. Diffuse co-evolution is the present when one or more actors are evolving in response to several others in a broader system. The presence of both mechanisms is referred to as multidirectional causalities (Baum & Singh, 1994).
- Counterintuitive changes in a variable as a result of a change in another variable, is referred to as nonlinearity. Sets of actors not only evolve from the direct interactions between pairs of organizations, but also by indirect feedback through the system, which can result in conflicting effects (Lewin & Volberda, 1999).
- Positive feedback is present when actors systematically influence the system they operate in and are in turn influenced by this system within the scope of initial influence.
- Path dependence reflects choices and changes at earlier points in time on the evolution process (Lewin & Volberda, 1999; McKelvey, 1997).

2.5.2 Development of collaborative groups

As collaborative groups have to be created and developed there is an evolutionary aspect to their existence. Johnsen, Morrissey and Calloway (1996) found that structurally similar groups will develop in relatively the same way over time. Human and Provan (2000) studied small-firm manufacturing networks and found that they go through predictable stages in their development, which can also be applied to collaborative groups. These stages are; the pre-network organizational fields; formation; early growth; legitimacy deficiencies; and sustainment or demise.

In the first stage, before the collaborative group is formed, the corporations are already organized in a pre-group organizational field, the environment of related organizations within which firms operate. In this phase the legitimacy of cooperation as a competitive strategy can be recognized, the tendency companies already have for forming cooperative bonds among each other. The legitimacy of the industry locally may already be present or show a sudden increase. Key stakeholders, internally or externally, will appear. In the second stage, during the formation of the collaborative group, initial legitimacy building will focus primarily on the collaborative group as a form and entity. Different strategic orientations need to emerge for legitimacy building, both inside out and outside in. After formation, collaborative groups will go through a phase of early growth, the third stage. In the collaborative groups will important legitimacy building steps be taken, internally and externally. In this phase growing pains and legitimacy setbacks can appear. The sky is not the limit in the number of participants; expansion should be done with caution (Gomes-Casseres, 1994). Collaborative groups

will subsequently go through a phase where legitimacy deficiencies are emerging, stage four. Overemphasis of internal or external strategic orientation will create a weakness in the collaborative group. In the fifth and final stage, following the legitimacy deficiencies, a collaborative group will either be sustained or demise. Collaborative groups need both internal and external strategic orientations for continued or renewed legitimacy building. Failing this, continued legitimacy deficiencies result in demise of formal network. Retrieving legitimacy will result in network stability (Baum et al., 2003).

2.5.3 Evolution of governance

It is important to consider that all the aspects of collaborative groups, as described earlier, are time dependent. The individual aspects, trust, commitment and goal consensus, are directly related to the participants of the group and their interaction. As these aspects are strongly related to each other, dynamic interactions can be expected. Other aspects, especially on group level, are a result of the policy the collaborative group is conducting. The selection and number of partners, intermediary support and expected exchange horizon, influence the processes and perception of the collaborative group and its participants. The environment in which the group is operating is time dependent. The dynamics of these aspects and their combination are the drivers behind the evolution of the collaborative group's governance.

With the development of the collaborative group the management is likely required to change as well. Evolution from one governance mechanism to another is predictable, depending on what is in place (Provan & Kenis, 2007). This is particularly relevant when a shared governance or lead organization governed system is in place and likely evolution is towards more brokered and external governance. Evolution from an NAO to another mechanism is unlikely because it is the most formalized form and the most conductive for long-term sustainability. Apart from the evolution to another governance mechanism, certain aspects within a governance mechanism can also be subject to the effects of evolution. With a growing number of participants further formalization can take effect. With the passing of time, participating companies may adjust their strategies, individually or collectively, to which the governance mechanism needs to adapt.

In the process of developing the governance mechanism of the collaborative group the role of the institutional entrepreneur will change. The institutional entrepreneur will shift its focus between the three steps of the process: using discursive strategies, mobilizing resources, and designing and implementing new institutions. With the development of the collaborative group, the development of the governance mechanism will be directly influenced. Not only the daily activities of the institutional entrepreneur will change over time, institutions are constantly designed and redesigned. These

dynamics are changed due to the interactions of the different actors involved in the process (Leca et al., 2008).

2.6 Conclusion

In this chapter a theoretical framework has been presented which can be used to structure research on cooperation among companies in groups and embed the research in the existing body of knowledge. Furthermore, this chapter highlighted to need for this particular research.

Collaborative groups are a very interesting form of cooperation and which is touched by scholars from several directions. From earlier studies relevant aspects have been identified for collaborative groups. On the level of participants, trust, commitment and goal consensus, and on group level, the expected exchange horizon, the number of partners, selection of partners, intermediary support and the external environment. Companies will face challenges in starting or joining a collaborative group, and these challenges can be related to norms of reciprocity, conflict resolution, and coordination.

Solutions to the problems created by these challenges are governance mechanisms for the collaboration in groups. Three forms of governance mechanisms have been discussed, a lead organization, shared governance and the network administrative organization (NAO). Each of these governance mechanisms has characteristic conditions regarding governance efficiency versus member inclusiveness, internal versus external legitimacy, and flexibility versus stability. What is missing in the current body of literature is how these governance mechanisms are formed in the absence of a mandate.

In this framework the involvement of an institutional entrepreneur is proposed to fill this gap. An institutional entrepreneur emerges on basis of enabling conditions. Previously academics have identified distinctive steps in the process of institutional entrepreneurship, the use of discursive strategies, mobilizing resources and design and implementation of new institutions. How these activities can be employed to create a governance mechanism for a collaborative group and how the process of institutional entrepreneurship evolves over time is left unstudied. An evolutionary system is expected where the process of institutional entrepreneurship evolves through the interaction of the institutional entrepreneur, participating companies and other actors.

3 Methodology

In this chapter the research methodology will be described. The chapter will start with an argument on why qualitative research is used. Then the use of a case study approach is elaborated and explained. The third part on this chapter is a description of the research design, consisting of a case introduction, the choices related to the case and data collection. The last part is a detailed overview of the data collection and analysis processes.

3.1 Qualitative research

In order to explore the evolutionary processes in the realization trajectory of the High Tech Factory a qualitative field research approach was chosen. As mentioned in the introduction the proposed setting of the High Tech Factory is a great opportunity for explorative research. This is implied by the absence of an established theoretical basis for the creation of governance mechanisms by institutional entrepreneurs in collaborative groups, as well as the development of shared production facilities in fields of emerging technologies. In the light of this research qualitative research has several relevant advantages (Babbie, 2007): It is purposeful in examining and studying social processes. The research is flexible in the sense that it is possible to change over time. The research is relatively inexpensive in both time and resources. Concerning validity, an initial trade-off needed to be made between internal and external validity. Considering the higher need for the formation of a good and well developed theory on basis of a unique object of study, in comparison to the need for generalizability, a design favoring internal validity was chosen. Generalization is performed by analytical generalization, rather than empirical generalization.

3.2 Case study approach

To answer the research question of this study a case study was chosen. Yin (2003: p. 13) defines a case study as *"an empirical enquiry that investigates a contemporary phenomenon within its real-life context, especially when the boundaries between the phenomenon and context are not clearly evident."* For choosing a research design Yin (2003) gives three conditions to consider: The type of research question, the extent to which researchers have control over the investigated events and whether the studies phenomena are contemporary or historical in nature. Case study research is particularly useful to answer 'how' and 'why' questions, about a series of events that the researchers have no control over and are related to contemporary phenomena. For analyzing the case study the case study approach has been chosen.

This study is focused on a unique phenomenon, with no solid body of existing theory explorative research is the most appropriate. There are three reasons stated by Babbie (2007) why scholars perform explorative research: First, scholars often show a healthy curiosity for the unknown and

perform studies to create understanding. Second, feasibility of propositions can be tested this way. And third, methods for further study can be developed. For such explorative research case studies are particularly appropriate.

For new and complex systems that give rise to challenging academic questions a case study design is thus considered the most appropriate. As Van de Ven (2007: p. 76) states *"The more you can ground a research problem to reality from a user's perspective the more you learn to appreciate the multiple dimensions and manifestations of a problem and its solution space. Grounding a problem in reality entails an exploratory study into the nature, context, and what is known about the problem domain."*

3.3 Research design

3.3.1 Single case, three time perspectives

The use of a single case allows the researcher to adapt the research methods to one particular situation. In a situation where multiple cases are studied the methods may be overly generalized with missing important information as a result. With a single case all efforts are directed at reaching a thorough understanding of the case, where a diverse focus may become a threat to the comprehensiveness of the study. The choice for qualitative research relates to the need for the formation of a good and well developed theory on basis of a unique object of study. In comparison to the need for generalizability, internal validity is favored in the research design. The choice for a single case study is adjacent to this consideration.

In this study the development of the High Tech Factory is single unique case that is being studied. The High Tech Factory is a phenomenon involving multiple organizational levels. The study focuses on the High Tech Factory, which is challenging considering there are several closely related subjects that can be classified as High Tech Factory. It is part of the study to find out what *the* High Tech Factory is. There is High Tech Factory Phase 1 (Phase 1), which is a cooperative effort of 10 projects by a conglomeration of 14 companies and several academic research groups operating under the umbrella of a shared spokesman. High Tech Factory BV, the renamed MESA+ Technology Foundry BV (MTF BV), which currently rents a part of the MESA+ cleanroom and some offices. The High Tech Factory as it is to be created is a much larger facility including shared facilities and an equipment fund.

The High Tech Factory Phase 1, which is running at the time of this study, is a subsidy project consisting of 10 projects. Each of these projects has a project leader ('trekker') and at least one project partner (the number of participants per project ranges between 2 and 5). Several of the participating companies are participating in more than one project. The projects are governed by a managerial layer. This layer includes the spokesman for the project, day to day project management and a board of all project leaders, the Project Coordination Committee (PCC). Prior to Phase 1there have been activities

related to the formation and start-up process of Phase 1 and the plans for the High Tech Factory in general. All these activities were performed prior to the start of Phase 1 in April 2008. Phases 2 and 3 have been scheduled and these phases concern the creation of an equipment fund and the redevelopment of the MESA+ cleanroom. Phase 4, the operation of the production facilities is planned for 2011. These phases make up the future of the High Tech Factory and its preparation.

On the level of the High Tech Factory a single case was studied and on the level of the companies the study is a multi case study. In the overall study this resulted in a single case. Because this case focuses on the Technical-Commercial director of MESA+ as institutional entrepreneur this particular case is very relevant in this field of research where *"studies of individuals acting as institutional entrepreneurs are needed"* (Leca et al., 2008: p. 24).

3.3.2 Choices

Within the case of the High Tech Factory choices were necessary regarding what would be studied, considering the size of the case. In case study research, studying multi-level phenomena, the choices are narrowed down to the sub-unit level. The choice of the studied units should be purposeful and targeted on the multiple levels of interest. The different levels on which choices are made are: the entity level of the High Tech Factory, a combined level of the companies and projects and the environment of the High Tech Factory. The projects and companies are combined because they are represented by the same individuals. As this research design focuses on acquiring a comprehensive and in depth understanding of the High Tech Factory all three levels are included. This choice represents an answer to the call of Leca et al. (2008). *"Because institutional entrepreneurship is a complex process involving different types of actors (e.g., individuals, groups of individuals, and organizations), more multi-level studies are needed to account for the field and organization as well as individual level of analysis."* (Leca et al., 2008: p. 21) For each of the levels a different focus is applied. The different levels are unique in their structure, operation and manifestation and to ensure the collection of a comprehensive set of data the approach for each level was adapted to characteristics of that particular level.

In Phase 1 the managerial team of the High Tech Factory is represented by the formal director and the project manager. To ensure completeness and to allow triangulation, both the formal director and the project manager are part of the study.

High Tech Factory Phase 1 encompasses 10 projects with 14 participating companies. The companies with the role of project leader form a group of 10 companies. These companies are involved since the start of the High Tech Factory and are often participating in other projects as well. In order to be able to cover all projects, to cover some projects from multiple perspectives and to cover the start of the High Tech Factory from several perspectives, the 10 project leading companies were studied.

For the contextual perspective two actors have been chosen to be part of this study, as these are is known to be having a considerable influence on the High Tech Factory. The University of Twente was selected as the only shareholder in the High Tech Factory. The other actor is the combination of the two funding institutions for Phase 1 of the High Tech Factory, SenterNovem and the Province of Overijssel.

3.3.3 Data collection methods

The development of the High Tech Factory and its interaction with participating companies is a developing process. This process has been started in the past, is running in present time, and will continue in the future developments. In such a situation a researcher look at the present, recent history and the expected future developments. Given the limitations on time available for the study a retrospective-prospective design, in combination with contemporary data sources, was chosen rather than a continuing longitudinal study. Retrospective data collection refers to looking back at past events and prospective data collection refers to the expectations of involved actors. Retrospective (and prospective) data collection have several relevant advantages, it is focused on the object of study as it helps the researcher preventing collecting an overload or an unusable set of data (Faems, 2006). The disadvantages connected to retrospective and particularly prospective data collection are related to a researcher's bias and the moment of study. Researchers can miss important data, when they aren't looking in the right place or making the wrong assumptions. The proposed (Yin, 2003) and also applied solution to this challenge was to use multiple data sources and conduct triangulation, converging lines of inquiry. The other disadvantage for retrospective data collection, which appears when the project under study isn't finished yet, is diminished by conducting prospective data collection as well. To minimize negative effects on the research findings the researcher only uses expectations from the object of study and doesn't speculate on basis of his own expectations.

To shape this retrospective and prospective data collection, multiple sources of data were used. Yin (2003) points out there are six sources of evidence and thus possible data sources in case study research: Documentation, archival records, interviews, direct observations, participant observations and physical artifacts. Based on the availability of the sources in the studied object the following sources were used: interviews, documents, archival records, direct observations. Next I will discuss the application of these data sources and their arrangement in two categories.

Interviews are used as the primary data source for this study, conforming to the general consideration of regarding interviews to be an essential source of information (Yin, 2003). Interviews provide a clear, to the point and rich method of data collection. There are, however, some drawbacks and challenges. Poorly formulated questions can lead to a bias in the study as the interviewee can provide the researcher with 'desired' answers. Also, when the researcher has a similar background as the

interviewee the researcher should be aware of losing objectivity and making premature or ungrounded assumptions. To avoid these pitfalls each topic was addressed in the interview at least twice. Researchers conducting interviews should also keep in minder to ask the right follow up questions, and prevent lacking to ask them. Suggestive questions should never be asked and weren't included. Additionally, all interviews were conducted face to face and at the natural environment of the interviewee, to comfort the interviewees.

Two types of interviews were used, unstructured and semi-structured. The unstructured interviews were conducted to gather information to give form to the study in terms of objectives and methods. The semi-structured interviews were used as the main source of data for this study. For semi-structured form has been chosen because some questions need to be answered, but not all 'questions' to be asked are known on beforehand, as the process, the object of study, is part of the interview outcome. Using semi-structured interviews room was left for additional information, in order to acquire as most useful information as possible related to the realization process of the High Tech Factory in itself and the role of the institutional entrepreneur. During the interviews the sequence of questions was not fixed, it depended on the specific development of the interview. The interviewees were only guided in their stories, depending on their elaborations multiple questions could be answered at the same time. Interview guiding documents with questions to be answered were prepared prior to the interview, to make sure all desired topics would be covered. Interviews were taken at company, managerial and contextual level of the High Tech Factory. For the projects the project leading companies of all projects were chosen, because they possess the most complete view of the project. In most cases the interviewee was the director of the company and was involved in other projects as well. Two interviews were conducted on managerial level, with the director and project manager. For a contextual perspective of the study the shareholder and both funding institutes were interviewed. In these context interviews more specific questions were asked, although the concept of semi-structured interviews was still applied. An overview of all interviews is presented in table 3.1.

Level	Interviewee / participants			Duration (*recorded)	Words (Pages)
Environment:	UT SenterNovem / Province Overijssel			34 min 26 min	1.686 (4) 641 (2)
Management:	HTF Director (unstructured) HTF Director (semi-structured) HTF Project manager			- 90 min * 28 min *	- 10.679 (19) 2.627 (6)
Projects:	LioniX Director (unstructured) Micronit Director (semi-structured feedback interview)			25 min 30 min	- -
Project	**Project Leader (interviewed)**	**Project partners (interviewed)**	**Project partners (not interviewed)**	**Duration Interview project leaders (*recorded)**	**Words (Pages)**
Project 1	Micronit	Medimate, Medspray, IMS, UT: MESA+		55 min *	6.495 (14)
Project 2	Medimate	Micronit	EnablingM3	63 min *	7.016 (13)
Project 3	Ostendum		UT: BPE	34 min	1.065 (3)
Project 4	Medspray	Nanomi, Micronit, IMS	UTIV	93 min *	10.967 (19)
Project 5	Nanomi	Medspray	Encapson	75 min	3.760 (9)
Project 6	UT, MESA+		LioniX, Phoenix	34 min *	3.679 (9)
Project 7	SmartTip (2x)		UT: TST	63 min * 5 min	6.925 (14) -
Project 8	SolMateS		TSST	52 min *	5.217 (13)
Project 9	Demcon		Bronkhorst, UT: TST, UT: WA	53 min *	7.301 (14)
Project 10	IMS		LioniX	48 min *	5.716 (14)

Table 3.1. An overview of all the conducted interviews.

Secondary data sources which were used were documents, archival records and observation. These data sources were used primarily in preparation of the interview guiding documents and the making of the case descriptions. The following pieces were used:

Documents	Archival records	Observation
• Project proposal Phase 1 • Project proposal Phase 2&3 • MST pilot production study plan • MST pilot production study report • Interim report: General part, 1-1-09 • Interim report: Project specific part, 1-1-09 • Contract of High Tech Factory Phase 1	• High Tech Factory kick-off meeting April 2008 • PCC meeting minutes November 2008 • Minutes of company start-up meetings	• PCC meeting, April 2009 • Ceremony of subsidy approval of Phase 2&3, July 2009

Table 3.2. The three types of secondary data sources, documents, archival records and observations.

3.3.4 Data analysis method

In chapter 2 the theoretical framework was presented that would be used for the analysis of this research. In this framework the institutional entrepreneur is presented as a possibility to create a governance mechanism that structures the cooperative effort in a collaborative group. To be able to analyze the process of institutional entrepreneurship first the emergence of the institutional entrepreneur was analyzed and thereafter the process itself and its effects.

The emergence of the institutional entrepreneur has been analyzed by the characterization of the e enabling conditions of institutional entrepreneurship: the organizational field, social position and the characteristics of the institutional entrepreneur. The organizational field is composed of the companies that are expected to participate in the collaborative group and other important actors. The challenges that the companies have been experiencing are addressed as well as the involvement of contextual actors. The social position of the institutional entrepreneur has been analyzed in relation to the actors occupying the organizational field. The characteristics of the institutional entrepreneur, which include skills and resources, were evaluated in relation to the plans and intentions.

The process of institutional entrepreneurship was defined by three consecutive steps: the use of discursive strategies, mobilization of resources and the design and implementation of new institutions. The use of discursive strategies concerns the commitment of allies and encompasses three types of activities that will be searched for, framing, specification and justification. The framing focuses on gaining empathy with the companies and other actors, and finding common ground. The specification concerns the creation of plans and sustaining the existing common grounds. Justification is related to creating awareness and legitimacy, primarily with important actors on which companies. The mobilization of resources characterizes the important resources and how they are activated. This includes the resources that the institutional entrepreneur has access to and the leverage of other resources. In the resource mobilization step has been analyzed what tangible and intangible resources play important roles and how they are created, mobilized and employed. Tangible resources can in case of the High Tech Factory be financial incentives or physical facilities. Intangible resources are related to social capital, legitimacy or formal authority. After the mobilization of resources the design and implementation of institutions was analyzed. These new institutions can, for example, consist of norms, regulative constructions or the formalization of routines. In the analysis has been described what new institutions are created, how existing routines norms and values are linked and how these institutions are sustained.

The development of the collaborative group has been analyzed though the effects of the process of institutional entrepreneurship. These effects are characterized by changes in the group-aspects and the development of the governance mechanism. Trust, commitment and goal consensus are the aspects which received the most attention as they are closely related to the challenges of the collaborative group. These aspects have been identified through the statements of companies regarding their actions and presumptions on cooperation with other companies and the High Tech Factory. With the creation of new institutions the governance mechanism will be extended and the collaborative group will be further developed.

3.4 Data collection & analysis process

The process of data collection and analysis can be arranged in four steps. In the first step the study object, the High Tech Factory, was explored and studied, after this the project was formulated. The second step consists of the conducted interviews, the transcripts and their analyses. The third step focused on the analyses in the form of case study reports, stakeholder analyses and feedback interviews. The fourth and final step is the formation and discussion of claims arising from the data.

3.4.1 Step 1

The first step of the data collection and analysis process was introductory to and a preparation for the rest of the study. Prior to the start of this study an unstructured interview was conducted with Miriam Luizink, formal director of the High Tech Factory, to form a picture of the situation and direct further activities. Also all available documentation was studied, in which a strong focus was given to the most elaborate documents; the Phase 1 project proposal and the Phase 1 interim report. Hereafter an unstructured interview with Hans van den Vlekkert was conducted to get a participant point of view during the research design process. In order to prepare for the second step in the data collection and analysis process the interviews were prepared. This preparation was performed by creating interview guiding documents. These documents are compositions of information and questions about the interviewed project and related process, the company. The interview guiding documents were arranged in 5 sections: Participation in and the start of the High Tech Factory; Formation and design of the project; The project and related processes; The cooperation within High Tech Factory Phase 1; The future of the High Tech Factory and its relation with the company.

3.4.2 Step 2

Step two in the process of data collection and analysis methods encompassed the interviews with project leaders, the interviews with the management of the High Tech Factory, making the transcripts of all interviews and abstracting the critical incidents and patterns in core issues.

The interviews with the project leaders were semi-structured. A narrative strategy for events in project was used and a descriptive approach for other aspects (cooperation, reasons for entering High Tech Factory, future perspectives). The procedure regarding confidentiality was explained before the start of the interview. After the interview a transcript would written. This transcript would remain confidential to let the interviewee speak freely. After receiving the transcript the interviewee would have the chance, until two weeks after receiving the transcript, to review it and make additional comments, change statements when they contradictory to others or if they are unclear. They would also receive the case description for their company to review and suggest changes, before publication. Four interviewees returned comments, suggestions and/ or approval based on the transcript of their

interview. After the procedure was explained all the interviewees, expect one, were asked if they would allow recording the interview. A single interviewee refused taping at all times and would also refuse on this occasion; the decision for refusal was unrelated to this particular research. The second interview that wasn't taped suffered from circumstances that didn't provide the opportunity for taping the interview. None of the other interviewees had objections and these interviews were all taped. The prepared questions in the interview guiding documents were not numbered, thus preventing the researcher from strictly following the questions based on their order. During the interview checkmarks were placed next to questions that were answered in the process. In total all 10 projects have been focus of an interview. The interviews had an average length of approximately one hour, with upper and lower limit of, respectively, 93 and 34 minutes. The project managers have been interviewed to get the most complete view of the project, most of the time also director of the company and involved in other projects.

For the management of the High Tech Factory two interviews were conducted, with the director and project manager. The same procedure as the projects regarding transcripts, confidentiality and taping of the interview was used for the project manager. The director was not asked for comments or approval due to the pressing schedule of the director and the possibility of informal discussion on a day-to-day basis. Both interviewees allowed taping of the interview. The interviews with the project manager and director had a length of 28 and 90 minutes respectively.

For both the projects and the managers transcripts were made of the interviews. The interviews were transcribed literally in order to stay as close as possible to the interview. All transcripts have been accessible only to the researcher and the interviewee in question. Even though all interviewees for the projects are managers or managing directors the full transcripts were sent, rather than summaries and concluding remarks, based on the explorative nature of this study. Interviewees were asked to mention when statements that couldn't be included in the research for confidentiality reasons. This occurred several times and was taken into account in the making of the transcripts. Even though transcribing interviews is a time consuming and intensive job, all interviews have been literally transcribed on the same day or the day after the interview.

Based on the available documentation and the interview transcripts a timeline was constructed. For each event in the process a qualitative datum was entered into incident, resulting in a list of incidents relevant to the company and the project(s). Such events could be changes in the company, meetings with partners, mayor breakthroughs in the projects, challenges that impacted the progress or changes in the plans. With the constructed timelines comparable pictures of the projects were made. Based on the comparison of these timelines and on the perspective of the interviewees patterns were identified. A working document was developed in which these patterns were grouped on basis of their content. For each aspect involved in the development of the High Tech Factory patterns were developed and

grouped, such as the motivation of companies to join the High Tech Factory and their expectations for the future. In this document a pattern consisted of a statement on basis of the interviews together with supporting statements from other interviews or deductions from the timelines. This working document was used to reflect on used theory and to guide the rest of the study.

3.4.3 Step 3

The next step concludes the data collection process with the conducting of the context interviews. On the analysis side the case study reports are made, a stakeholder analysis is performed and the patterns are further investigated.

For context of the study two interviews were held, with the shareholder and with an interview both funding institutes. This background information was used to place the findings from other interviews in context. More specific questions were asked, although the concept of semi-structured interviews was still applied. Interviews had a length of approximately 30 minutes. The interviews were transcribed based on notes, in order to reduce the time burden for the researcher. To ease the making of notes during the interview, the prepared questions in the interview guiding documents were numbered. The transcripts were still written with the objective of staying as close to the interview as possible.

The case study reports are representing the main sources of data. In these reports, which are focused on the interviewed companies, the following parts are given: How and why the company participates in Phase 1, the process of the projects, a reflection on Phase 1 and the company's perspective on the High Tech Factory in the future and its role for the company. The case study reports are appendices to the results chapter of this report (Chapter 5).

A stakeholder analysis is performed based on the work of Mitchell et al. (1997). The analysis is used in the background analysis to identify and characterize individual actors in the development of the High Tech Factory, to place outcomes of the analysis into a more accurate perspective and to explain outcomes of this analysis by the difference between actors and the changes of actors and relationships.

3.4.4 Step 4

The final step in the data collection and analysis process consisted of the methods used to come to the conclusions of this study. Inference loops were used to capture patterns and abstract strong claims from the available data .The loop consists of the following consecutive steps. Developing an inference, an underlying pattern in the data, which was done based on the statements in the working document of step 3. Based on these inferences claims were made concerning the development of the High Tech Factory, the process of institutional entrepreneurship and the roles and activities of the companies.

Then the data was reviewed, trying to find supportive and countering data, these were weighted against each other. Based on the supportive and unsupportive data follow-up claims were made and evaluated. If these deductions prove to be correct, the claim has been corroborated.

4 Context

In this chapter the setting of the study is elaborated on. The High Tech Factory is a multilevel phenomenon operating in a complex environment. The trends in the high tech field of micro- and nanotechnology, in which the High Tech Factory is set, show why this field is particularly suitable for the creation of a shared production facility. The environment of the High Tech Factory is presented which consists of the University of Twente, the MESA+ institute and the creation spin-off companies. The plans for the creation of the High Tech Factory through the four defined phases will then be introduced, followed by an overview of the participating companies.

4.1 Micro- and nanotechnology

The spin-off companies from MESA+ are operating in the high tech field of micro- and nanotechnology. High tech fields are generally characterized by high levels of uncertainty and a global nature, for both small and large high tech companies (Moensted, 2007; Berry, 1998). Challenges for high tech companies are often associated with these characteristics. Particularly the uncertainty related to high tech fields is considered to be the cause of the barriers on the growth of small high tech companies (Moensted, 2007).

During the last decade the interest in the area of science and technology labeled nanotechnology has been exploding. Even at an early stage high expectations characterize investments in nanotechnology development (Saxl, 2005). These nanotechnologies are beginning to find their way to the markets. Products used to be created based on their use and the sector, but more and more is the creation of products technology driven. Rather than based on areas of application, product families are formed along certain technological directions, such as the different directions in the field of nanotechnology. Such a technological direction is called a technological platform: *"a set of instruments which enable scientific and technological production: it allows exploration and exploitation of a variety of options, for strategic research, technology development, and sometimes also product development"* (Robinson et al., 2007: p. 872). Technological platforms in the field of micro- and nanotechnology are increasingly being set-up, used and expanded. These activities induce the creation of techno-industrial networks, which are structured by the technology platforms. When these networks are created 'technological agglomeration' is observed; "*the geographic co-location of different scientific and technological fields*"(Robinson et al., 2007: 871).

Companies in the field of micro- and nanotechnology are subject to these trends in technological agglomeration for their research and industrial R&D (Agrawal & Cockburn, 2003; Knoben & Oerlemans, 2006; Robinson et al., 2007). With the growth to maturity of the field of micro- and nanotechnology the companies in this field are transferring their technologies towards products. These

companies, typically small and technology driven, struggle with the transition to exploitation. This transition from exploration to exploitation is an important step in new product development; this is where companies actually make money. Exploration and exploitation are different processes requiring different people, competences, activities and organizational structures (Burns & Stalker, 1961; March, 1991; Benner & Tushman, 2003). Networking and cooperation are considered an active way of organizing for high tech innovation for small firms (Moensted, 2007).

4.2 University of Twente and MESA+

The University of Twente is the entrepreneurial university. The university actively promotes entrepreneurship, through various programs, among its students and staff. The University of Twente is successful in the generation of spin-offs and has the highest spin-off ratio in the Netherlands: over 700 companies have originated from the university in the last 20 years (Kennispark, 2009).

The University of Twente has a strong position, nationally and internationally, in the field of micro- and nanotechnology. This position is based on the MESA+ Institute for Nanotechnology, one of the largest nanotechnology research institutes in the world. MESA+ delivers competitive and successful high quality research and uses a unique structure, which unites scientific disciplines, and builds fruitful international cooperation to excel in science and education. The institute has an intensive cooperation with various research groups within the University. 500 people are employed and the institute holds 1250 m2 of cleanroom space and state of the art research equipment. MESA+ has an integral turnover of 45 million euro per year of which 60% is acquired in competition from external sources. The MESA+ institute is managed through a hierarchical structure with two formal directors, Miriam Luizink is Technical-Commercial Director and Dave Blank is Scientific Director.

One of the factors for success has been the attention for commercialization by MESA+ and the University of Twente in general. MESA+ has been the breeding place for more than 40 high-tech start-ups to date with an exceptionally high survival rate (>90%). From the 30 startups that are created yearly by the university, approximately 3 or 4 are based on nanotechnology. At MESA+ there is a strong interaction with companies, due to co-location for example, and MESA+ has created a perfect habitat for start-ups in the micro- and nano-industry to establish and to mature. The use of its extensive facilities and cleanroom space under friendly condition and start-ups and MESA+ work intensively together to promote transfer of knowledge.

The facilities of MESA+ for companies are managed by the MESA+ Technology Foundry (MTF), privately owned by the University of Twente. The MTF offers companies the change to locate themselves at MESA+, where offices and cleanroom facilities are available. With the growth of the spin-off companies the developments become focused on a more on production focused facility. In the near future a considerable opportunity is offered to house a new production facility. The University of

Twente is investing in a new NanoLab, where MESA+ will move to. As a large share of the equipment of the current facility will move to the new NanoLab, the current facilities become available. An additional drive to undertake a considerable step forward, were the encouragements from the government.

For the University of Twente is the High Tech Factory very important in the strategic positioning, Kennispark is profiling the entire region and the High Tech Factory is a very important link in this organization. The University of Twente is the shareholder of the organization, it is a company. Outside the shareholder meetings two times a year the board of the university contributes to the High Tech Factory in other ways. The board of directors of the university is lobbying and pulling strings in their network to increase the chances on getting the subsidies. The contents of the High Tech Factory are explained and getting the expectations too high is prevented. Additionally, the University of Twente is shareholder in many of the spin-off companies the High Tech Factory is intended for. On basis of being shareholder the university encourages these companies to participate in the development of the High Tech Factory and if they participate in Phase 1 the university tries to commit them to later phases as well.

4.3 Plans for the High Tech Factory

4.3.1 HTF Phase 1

Phase 1 of the development of the High Tech Factory is titled ‘the development of testing, packaging and assembly capabilities’ and encompasses the development of the specific equipment participating companies are requiring for their production processes. The development of the technology in Phase 1 is spread over 10 independent projects which together bring in coherence and broadness. In these 10 projects companies and university groups are participating. An overview of the companies participating is given in table 4.1. The following university groups are involved in Phase 1 of the High Tech Factory: Biophysical Engineering (BPE), Inorganic Materials Science (IMS), Transducer Science & Technology (TST), and Mechanical Automation (WA). The 10 projects and the companies that are leading them are presented in an overview in table 4.2.

Company	Field & Technology	Activities	Size (FTE)	Participant in project
Bronkhorst	Sensors	OEM	~250	9
Demcon	Mechatronics	R&D, prototyping	~80	9
EnablingM3	High Tech scaling up	Services	~1	2
Encapson	Life sciences	B2B supplier	~5	5
IMS	Production and assembly	Equipment design and building	~75	1,4,10
LioniX	Optics and microfluidics	Development and production for OEMs	?	10
Medimate	Life sciences, Lab-on-a-chip	OEM	6-8	1,2
Medspray	Life sciences, spray nozzles	OEM	~10	1,4,5
Micronit	Lab-on-a-chip	Foundry	~30	1,2,4
Nanomi	Life sciences et al.	B2B supplier	6	4,5
Ostendum	Life sciences, Lab-on-a-chip	OEM	~3	3,4
Phoenix	Software	Tool development	?	6
SmartTip	Electronics	B2B supplier	~5	7
SolMateS	Life sciences, electronics	Services and B2B supplier	4.5	8
TSST	Thin films	B2B supplier	?	8

Table 4.1. An overview of all companies participating in Phase 1 of the High Tech Factory.

Project	Content	Company
1	Towards a Lab-on-a-Chip production platform	Micronit
2	Automated production line for disposable Lab-on-a-Chip	Medimate
3	Young Interference chip for detection of micro-organisms	Ostendum
4	Spray nozzle assemblage	Medspray
5	Process installation for functional micro- and nanospheres.	Nanomi
6	Spray coating process	UT, MESA+
7	Development of an Universal Probe Tester	SmartTip
8	MediSol: Solutions for Medical coatings	SolMateS
9	Fabrication Micro-Coriolis flow sensor	Demcon
10	Fiber-Chip coupling assemblage	IMS

Table 4.2. An overview of the companies leading the 10 projects of Phase 1.

4.3.2 HTF Phase 2 & 3

Phase 2 is the realization of an equipment fund. With this fund the High Tech Factory intends to end the vicious circle where banks don't want to invest as the production is too low and companies aren't able to invest in new equipment. High Tech Factory Equipment Fund is a lease facility, where companies can submit a proposal for leasing their production equipment. Such an application consists of three steps. First an investment manager prepares the assessment of the proposal, which includes the business plan and whether it's complimentary to the NanoLab. Secondly an investment committee, consisting of entrepreneurs, investors and scientists, assesses the proposal and advises the High Tech Factory Fund on the decision of acceptance. Then the equipment is bought and owned by the fund, companies will be paying approximately 70% back in monthly installments. The returned money will go into a revolving fund and using the same model it will be used again to help new spin-off companies and their investments in locating their production in the High Tech Factory. Assumed is that, as the ownership is with the High Tech Factory, an agreement on sharing the equipment can be reached easier. Although using the fund is not a condition for being located in the High Tech Factory, a company should be renting space in the High Tech Factory in order to be using the equipment fund.

Phase 3 is the redevelopment of the physical production environment. In the proposal an estimate is given that with an investment of 6.6 M€ the facilities will be able to function for 15 years. When the building will not be redeveloped as the production facilities of the High Tech Factory it will be pulled down, as it is unusable as anything but a cleanroom or laboratory facilities.

Apart from the companies participating in Phase 1 the following companies have given their support and commitment: C2V, DeltaMask, Maser Engineering, Optisense, Blue4Green, MyLife Technologies and UNeedle.

4.3.3 HTF Phase 4

When the production facilities are to be realized in 2010 the final phase of the High Tech Factory is initiated, Phase 4.

4.4 Conclusions

Based on the characteristics of high tech fields the spin-off companies in the field of micro- and nanotechnology are ideally suited to participate in a shared production facility. The University of Twente is actively involved in the creation and support of spin-off companies. Additionally, the prospects of nanotechnology are strongly promoted by the University of Twente, which is holding to the image of centre in nanotechnology. The University of Twente has, based on these two arguments, a strong motivation to support the creation of the High Tech Factory. The MESA+ institute has a central role in the positioning of the University of Twente in this field. The central role for MESA+ places Miriam Luizink in the centre between the spin-off companies and the University of Twente. The distinct stages in the development of the High Tech Factory suggest that the activities of the institutional entrepreneur will be organized in distinct stages as well.

5 Data

In this chapter the development of the High Tech Factory is depicted. For background purposes detailed descriptions of the visions of the individual companies and of the development of the 10 projects in Phase 1 can be found in the appendices.

5.1 Prior activities

The desire for larger scale production of spin-off companies using the MESA+ cleanroom has been developing since 2002. The MESA+ Technology Foundry (MTF) was created, through which the institute has been renting space and cleanroom time to several. The Technical-Commercial director is formally responsible for relations between companies and MESA+. As the image of MESA+ is partially linked to its spin-off companies, an active position is taken by MESA+ in maintaining contact. The MESA+ institute is important for the image and results of the University of Twente, providing its directors with formal and informal authority. Because most companies in micro- and nanotechnology have relations with the University of Twente in this field and/ or are spin-offs, they are connections in the network of MESA+ and its directors. Based on the position the director of the MESA+ institute has a very prominent position at the University of Twente and is located at the centre of the network of local companies in micro- and nanotechnology.

In 2004 a feasibility study was set up to investigate whether the MTF should be further developed towards a more traditional foundry, the Pilot Production Micro/Nanotechnology (PP MN) study. In this study the following companies participated: Medspray, Micronit, Medimate, SmartTip, and Nanomi. The study concluded that there is too much national and international competition to justify a traditional Micro-/ Nano foundry. Towards the end of the PP MN study Miriam Luizink had come to the position of Technical-Commercial Director of MESA+. The activities in setting up the plans for the High Tech Factory would lead to the other conclusion of the PP MN study, saying that there is a business case for a production facility.

5.2 Creation of plans

The material facilities of the MESA+ cleanroom are at the basis of the plans for the High Tech Factory. The process of making these plans has been driven, coordinated and led by Miriam Luizink. Relevant actors have been involved at a very early stage in the creation of the plans.

The University of Twente has been investing in a new NanoLab, where MESA+ will move to. Space will become available as a large share of the equipment of the current facility will move to the new NanoLab. The creation of the plans for the High Tech Factory was started with a discussion on the future of the MESA+ cleanroom, with the developments of the new NanoLab in mind.

[On how the idea of a shared facility was formed] When we talk about shared facilities, it all started with a cleanroom, the current MESA+ cleanroom. ***(Miriam Luizink)***

"We are talking about the new NanoLab and Carré, MESA+ and Hogekamp will be emptied. Previously we have been talking about what to do with these buildings. We could take them down, but there were other options. I know a few companies very well. Then we started with making plans for a subsidy project." ***(Kees van Ast, University of Twente)***

As director of MESA+ Miriam Luizink was directly involved in the discussion on the future of the MESA+ cleanroom. In cooperation with representatives of the University of Twente was investigated what would be required to realize a shared production facility. Subsequently decisions on the plans were made.

"From my point of view, there weren't further developments until I had arrived. On basis of ideas of and meetings with others I decided that more back-end production steps could be realized." ***(Miriam Luizink)***

From the start, the board of the University of Twente was actively involved and it considered the development of the High Tech Factory to be very important, for reasons of strategic positioning, contribution to the nanotechnology image of the University of Twente and to learn from the process.

"It is very important for the positioning of the UT. We have the Kennispark and the High Tech Factory is a very important link in the chain. The UT tries to position itself in the industry, for its own, but also for its spin-offs. … There is also a general Nanotechnology image which we are building around the UT, these are not daydreams. … The High Tech Factory is also a pilot to see how you do such a thing, shared production, with companies together. We are going to learn much from this project." ***(Kees van Ast, University of Twente)***

An additional drive to undertake a considerable step forward, were the encouragements from the government through which Twente was encouraged to organize a larger plan.

"In The Hague they have been saying it for years to Twente, 'come with something big'. Those small project proposals that keep coming from Twente are nice, but we are missing an overall vision, a larger project." ***(Interviewee Miriam Luizink, High Tech Factory)***

Three requirements were formulated; the building needed to be redeveloped, the companies needed to be ready to move in with their production processes and they should be able to buy the relevant equipment. These three aspects, the building, the processes and the equipment, became the topics of the phases 1, 2 and 3 in the development of the High Tech Factory. The realization of the High Tech Factory is considered to be a single plan, but too large to execute in one go, therefore it was split up in three phases.

5.3 Social network

The companies developing technologies in micro- and nanotechnology in Twente form an intimate social network together with the University of Twente, which has been build over the last two decades. There are complex dependencies among these companies, MESA+ and the University of Twente. Many companies in micro- and nanotechnology are spin-off companies of the University of Twente, which is shareholder in several of them, and the companies continue to collaborate with research groups as part of their technological development. Through this network there are, and have been, all sorts of dyadic and multilateral ties, formal and relational, with no clear or overall structure between the various developing companies. The companies have frequently cooperated with others in the development or application of their technology. In the past, ideas of collective actions have been opted of which the PP MN study is the most prominent, in these actions similar ideas have been shared among the companies. However, these similar ideas have not let to a shared vision or collective action. The two largest developing companies, LioniX and Micronit, have been each other and continue doing so. This has the effect that no single company has the resources or the base of commitment and trust of other important companies to lead the group in collective action.

After shaping the concept of the three phases, the process of forming Phase 1 was initiated. Companies were contacted to express their commitment, projects were arranged and proposals were written. In spring 2007, the grouping of the companies was started by asking people in the network of MESA+. Due to the shared nature of the plans for the High Tech Factory and the subsidy which was applied for, all projects were required to include multiple parties cooperating. Participating companies called 'known associates' when they realized cooperative aspects were required in their projects. The companies were introduced through the existing network.

> *"In the meantime I went looking, who wants to participate, and it's the network. Medspray talks to Nanomi about participation. In the lunch we meet SmartTip and talk about the developments and plans. That's the way it is going around. I contacted Medimate and Micronit, project 1 and 2. I also asked SolMateS.* ***(Miriam Luizink)***

Not only companies for which the High Tech Factory is being created were asked for Phase 1, but also companies that could contribute the development of the High Tech Factory rather than make use of it when it's finished. They were asked because it was easier to ensure their commitment through a project than with additional meetings.

> *"We wanted IMS, Demcon and Bronkhorst on board because we wanted those companies involved with the High Tech Factory. That is better done by having a project than asking them to come together for a meeting."* ***(Miriam Luizink)***

There is a preference for regional cooperation among the participating companies for their technological development. These preferences have also been suggested in the PP MN study. The companies in general have formed an intimate social network. The University of Twente also underlines this regional contribution.

> *"We want to develop products and technology together in a context where we have our partners close and speaking the same language. The same language can be difficult as don't have Dutch customers. But for the technological development it is very convenient to have your partners close.* ***(Interviewee, Medspray)***

> *"Our boss, Dennis Schipper, has many connections in the region and he knew about the High Tech Factory. He had heard from different people, among them Miriam Luizink, that there are possibilities.* ***(Interviewee, Demcon)***

> *"The regional aspect is very important, that's what we are doing it for."* ***(Kees van Ast, University of Twente)***

5.4 Participation

Most companies that started a project had ongoing activities or a particular project for which they required additional funding and they regarded the High Tech Factory to be at the right place and the right time. The majority of the companies that started a project indicated they would also have conducted these activities without the High Tech Factory, be it in another way or to a lesser extent. Project 6 was the only project created from scratch, which was initiated by the MESA+ institute. The activities, timeline and planning in the project were based on the company leading the project and molded to fit with the High Tech Factory.

> *"The topic is entirely our work, it's the only thing we do and we have a very clear rule at Medspray: When we do a subsidy project, it is for activities that are 100% in line with our own research and nothing else. If it isn't the case, it's nice to get the subsidy, but it is only distracting you. It is important to keep your focus clear; I would never have allowed it if we were to do things that aren't advantageous for us."* ***(Interviewee, Medspray)***

> *"You hear what they are trying to do, and so you shape what you want to do, to have it aligned with what the High Tech Factory wants to do."****(Interviewee, SmartTip)***

> *"We had the choice not to participate. But it fitted that well with our business that it would have been an awful mistake not to participate. Just take a look at the project and how much we are using it and the extent of the financial advantages, for us it's very convenient.* ***(Interviewee, Medimate)***

After the companies had agreed to participate there was a diverse collection of companies assembled, in size, activities, age, and technology. This diverse composition was deliberate with the final content

and objectives of the High Tech Factory in mind. It was expected that when the High Tech Factory would be established with a narrow focus it would be much harder to find new companies willing to join the High Tech Factory as well. The High Tech Factory requires both groups of companies, the existing (and familiar) and the new ones.

> *"It was chosen to keep Phase 1 broad on purpose; ultimately we want the shared production facility and that shouldn't be based on a narrow technology basis. … The ultimate facilities need to be sufficiently broad, we don't choose for only glass technology or only thin films, on the contrary. This is the way it is set up, as an open initiative. It is not only for companies coming from here, or only for companies participating in Phase 1. It is also for new companies, and therefore we need a broad technological basis."* ***(Miriam Luizink)***

The group participants, or members, are those companies that agreed to participate in Phase 1 of the High Tech Factory: Bronkhorst, Demcon, EnablingM3, Encapson, IMS, LioniX, Medimate, Medspray, Micronit, Nanomi, Ostendum, Phoenix, SmartTip, SolMateS, and TSST. These companies can be categorized in two types, developing companies and supporting companies.

The supporting companies and institutions are those participants that have supporting roles in the development of the High Tech Factory. These parties act as a supplier of products or knowledge and have generally less direct interest in the, to be developed, shared facilities. The following are classified as supporting companies: IMS, Demcon, BHT and EnablingM3. The supporting companies, particularly IMS and EnablingM3, see the micro- and nanotechnology based companies in Twente as one of their customer groups.

The developing companies are those companies that are actively working on the preparation of their production processes for possible incorporation in the High Tech Factory facilities. There is a strong regional preference among the developing companies for their technological development. The developing companies are all located in Twente and have formed an intimate social network. These regional preferences have also been suggested in the PP MN study, where the companies stated to be working towards a state of production and they have the High Tech Factory in mind as preferred location. As the developing companies operate in the high tech field of micro- and nanotechnology their developmental trajectories towards (pilot) production are long and expensive.

5.5 The proposal for Phase 1

The project proposal for Phase 1 consisted of a general part and the collection of project descriptions as appendices. Over the summer of 2007, the general part was written centrally and the project descriptions of the companies were written by the companies themselves. To some of the initiating

companies feedback was in the process of writing these project descriptions, on the extent of cooperation with partners. No feedback was given regarding the technological content of the projects.

> *"I wrote the central part. When you regard the application there is a central part with a summary of the projects and as appendices there are the descriptions of the projects. The evaluator looks at the central part and thinks 'splendid, it looks good and there is a thick appendix', and then he will put it away."* ***(Miriam Luizink)***

Early in the fall of 2007 the project proposal for Phase 1 was finalized. It was submitted to the 'Pieken in de Delta' (PIDON) subsidy program of the Dutch government in October 2007. Lobbying was regarded to be a very important step in the process of setting up Phase 1. Subsidy institutions and the powers behind them were convinced to give the High Tech Factory the grant.

> *"The largest part of the work is done prior to the application, everywhere you are presenting your plans; that's always a coherence of MESA+, the spin-off companies and the new plans for the High Tech Factory. I have presented it in many places and on many occasions, not only in the region, but also in The Hague and for entrepreneurs. … It is not a matter of applying and being done with it; much lobbying and presentations, talking about it, representation, it's all part of the preparation. You never know what will follow, but without it you won't succeed."* ***(Miriam Luizink)***

> *"From my point of view they [the management of the High Tech Factory] had a very important role in the creation of this project, truly a crucial role. I am talking about the creation of the proposal, and checking if everything is correct. Then, when it is submitted with the province, it has to be lobbied for, which is important again. If you don't have a strong party like Miriam, you won't make it."* ***(Interviewee, Medspray)***

The official start of Phase 1 as noted in the proposal was November 2007. The subsidy was granted in April 2nd 2008 by the Dutch government and the Province of Overijssel. The Province of Overijssel is particularly proud of the current developments in Twente regarding the spin-off companies and their cooperation.

> *"The High Tech Factory is very important when you look at our nanotechnology plans and the time and effort we have invested in it, you can see the importance. All projects are parts of the larger machine; the High Tech Factory is one of them. But it is a project we are very proud of. We are proud of the companies that we have here, but also of their cooperation."* ***(Interviewee, Province of Overijssel)***

5.6 Start-up of Phase 1

After the subsidy was granted a kick-off meeting was organized on April 11th 2008, for the highest representatives of all companies that initiated a project. This group agreed to meet twice a year until the entire project would be finished in 2011 and was called the Project Coordination Committee

(PCC). This PCC was installed not only with Phase 1 in mind, but also later phases, hence the emphasis on directors having a seat rather than project managers.

> *"In most cases the director is the one to have a seat in the Project Coordination Committee (PCC). In organizing the PCC we have specifically appointed them with their names, it is clear who is expected at the meetings. Incidentally someone can be represented, but I don't want to end up with a committee of replacements. In Phase 1, I want to talk to those people that also matter in the organization of Phase 2, 3 and 4, and that's the way the PCC is organized."* ***(Miriam Luizink)***

In the summer of 2008 Monique Snippers was appointed as Project Manager for the High Tech Factory. The management of the High Tech Factory now consists of Miriam Luizink as Statutory Director and Monique Snippers as Project Manager. Miriam Luizink provides experience of managing subsidy projects and Monique Snippers learning to do so.

> *"It's not new to me to run a subsidy project, I have been in the position of project assessment and that does matter. I am providing that experience. Monique has a more executive role and she is also the first contact for companies."* ***(Miriam Luizink)***

When the subsidy was granted some projects were already started and other projects waited for the funding, to commence their activities. The creation of Phase 1 was regarded as the most important activity for Phase 1 by Miriam Luizink. When it was set in motion it was a matter of proper execution. The activities of the High Tech Factory management related to Phase 1 are summarized in the term project management: The combination of financial supervision, steering in reporting and spokesmanship towards funding institutions concerning changes. Phase 1 isn't regarded as 'the High Tech Factory' but merely as a step which is needed to be taken.

> *"Now it is the management, not the content: Purely management of the project. The companies now do their jobs. … From my perspective is it [the High Tech Factory] something what we want to achieve and the PIDON project, or the funding, is a tool. It is a fabulous tool, an extensive tool, but it isn't goal in itself, to no one."* ***(Miriam Luizink)***

In November 2008 the first PCC meeting after the start-up was held. These PCC meetings consist of general announcements, discussion of the report of the previous PCC meeting, updates and feedback from the management of the High Tech Factory regarding interim reports, finances and communication, updates of all projects about their progress, a presentation of the contents of two projects; updates of the management of the High Tech Factory regarding the future phases, and a tour by the host and something to drink. For the companies leading the projects the PCC meetings' main purpose is financial feedback and future related updates are also important. The presentations at the PCC meeting are for fun and the opportunity is a nice addition.

"Communication about the current situation and also especially about the future is in my opinion the most important role of the PCC: How are we going to continue and how are we doing right now? Problems may arise, for example, when partners that keep using less of their budget than planned are delaying the entire project." ***(Interviewee, Micronit)***

"It is a very good method to keep up to date on the activities of others, and it's a place for networking. It also creates a feeling of collectiveness. To go into the contents of the projects is not necessary in this context, but it is interesting. The meetings are also important for the tuning of the project and its successors. For reports and expense accounts it is a moment to discuss the planning and feedback on earlier cases." ***(Interviewee, Nanomi)***

5.7 Management of Phase 1

The deadline for the first interim report was set on February 16th 2008. After the PCC meeting of November the participating companies started to work on their parts of the interim reports. In these interim reports financial and collaborative issues are addressed, and feedback was sent back to all project leaders. Being a subsidy project the participating companies, represented by the project's leading company, suffer strong accountability for their actions taken.

"They receive our report. Then they check whether it is the right format and complete. Once I forgot to sign one form, it will then be returned for the signature." ***(Interviewee, Medimate)***

It is recognized that it is a very important part of the job of the spokesman, and not without reason, as there have been many mistakes that have been corrected. An extensive revision process is important because mistakes cannot be made, it will have a negative impact on the image of the project at the funding institutions. This externally focused task is one of the primary concerns of a spokesman for a subsidy project.

"They [the companies] check their reports, Monique checks them, but I also check it. I know that these are the moments that also I need to do it myself, it needs to be correct. It is a very formal moment where you need to present yourself to the funding institution in the best way possible. If there happen to be many unnecessary mistakes in it there will be much turmoil and resentment related to the project, which is harmful. … To do this right is particularly a job for the spokesman or project manager. … It contained many mistakes; it's a very important role." ***(Miriam Luizink)***

The active role of the spokesman of the High Tech Factory in the administrative work, such as the reports, is regarded very pleasant by the participating companies. It concerns an extensive and time consuming role which would normally distract companies from their development.

"For us as a company they take away quite a bit of the pain of the communication with Economic Affairs and the Province. For the other project, the 2006 project, I did that all myself. So I can see the difference.

In the end we still have to make our reports, and financial reports, and all that. But of course it's easy that they do that part. And of course they did a tremendous job in lobbying this proposal, before we got it. So I guess the role there is quite large." ***(Interviewee, SmartTip)***

During the projects there is communication between the management of the High Tech Factory and the companies when something is not going as planned. The funding institutions require strict adherence to the proposals and any changes larger than 10% are to be proposed officially by the High Tech Factory spokesman. This requirement allows the management to monitor the progress of the companies in their development. There has been contact between the management and several companies concerning their progress, but no official changes have been issued. Concerning the content there has been no interaction with projects from the High Tech Factory management, which is regarded as positive by both the participants and the High Tech Factory management. The management of the High Tech Factory doesn't want to be involved in the content of the projects as it is time consuming and undesirable. The companies agree, they want to be left alone as their activities are close to the core of their company. Contact between project's leading companies and the management of the High Tech Factory related to Phase 1 is kept minimal, although some project leaders (8 and 10) have been requesting information concerning financial issues.

"The agreement is that if there are changes or the project isn't running smoothly, no matter what reason, then we are to be notified. If no one notifies us everything is going according to plan. And no one has officially notified us so far." ***(Miriam Luizink)***

In the spring of 2009 Monique Snippers takes over more and more activities of Miriam Luizink in the management of Phase 1 and by June 2009 she is first in line for everything related to Phase 1. At this time Miriam Luizink is entrusted to a high extent by all involved parties.

"I think many people trust me and have confidence in successful progress. Entrusted by executives, funding institutions and university representatives, I need to do my best at the points where it matters most. I do this, for example, at the reports, and then I leave the communication to Monique." ***(Miriam Luizink)***

5.8 Continued development

Shortly after the start of Phase 1 in April 2008 the focus in the development was shifted towards further steps. In 2008 the plans for Phases 2 and 3 of the High Tech Factory were formed and a proposal was submitted for subsidy in October 2008. Although the focus shifted to Phases 2 and 3, the spokesman was still the representative of Phase 1 for internal and external parties.

"I think that executives and people from outside see the High Tech Factory and Phase 1, and then relate it to me. Right now it is running, and only project management. We need to do that, but I am focusing on

Phase 2 and 3. We need to get that equipment fund and make sure that the building will get there." ***(Miriam Luizink)***

In preparation of Phases 2 and 3 all participating companies were asked if they have been planning on making use of the equipment fund and what kind of shared equipment they would like to have in the production facility. Most companies would like to see an open room with microscopes and some other testing facilities. After this feedback activities were continued in figuring out how to organize the equipment fund and the production facilities. This process of requesting feedback, being it through meetings or an email, followed by making plans and then asking feedback again was executed by Miriam Luizink.

"Concerning the building and its content have we met with a couple companies quite early on, before we had a program of demands. These companies were those that either had the best perception on the development, or are the most depending on it. We discussed what we would need to do. Then I do some homework and after that I put some people together again, and putting my plans on the table. What I really want to prevent is too many meetings and too little feedback. What I want is to make advances to get forward. I don't want to talk to large groups because 'it is time to do so'. I rather present new developments when they are there." ***(Miriam Luizink)***

The High Tech Factory management is listening closely to their most important customer in the process of organizing the later phases, Micronit.

"Micronit, for them the High Tech Factory is very important; putting pressure on our planning, especially Phase 3 the redevelopment of the building. ... We have a very important customer and for that customer we are of increasing importance as well, we need to organize with this in mind." ***(Miriam Luizink)***

The plans for the future of the High Tech Factory and its management plans are being shaped and executed. There are two separate aspects being worked on, the organization around the equipment fund and the management of the actual facilities. Not only organizational aspects are addressed, but administrative processes are already being discussed.

"On the one hand is there the technical organization managing the building and its infrastructure. In this case that's quite complex as it includes a cleanroom. There will be a technical role for the quality control, maintenance, additions and changes, management of the actual building. On the other hand, there is a fund to be managed. If we have an equipment fund, than companies, which are making use of the building, can consider financing their equipment with the lease fund. A business plan should be proposed with elaboration on how this financing step fits in. Someone should organize that plans will be proposed, communication and interaction with companies is required. Next there will be a board of advisory for the assessment of the proposals and for advising the management of the fund." ***(Miriam Luizink)***

In July 2009 the subsidies for Phases 2 and 3 were granted. A ceremony was organized were the Minister of Economic Affairs presented the grant to the High Tech Factory. Many representatives of the participating companies and the board of the University of Twente were present at this ceremony expressing their commitment, for the most of the people present (including the minister) the ceremony was during their vacation.

In the spring of 2009 further steps were taken in the development of the organization that should enable the creation of Phase 2 and 3, and execute its activities and tasks. The High Tech Factory ordered the University of Twente to redevelop the cleanroom facilities, and contractors and project managers were appointed. Also the managerial organization is being extended and will keep developing.

> *"Monique will be working 3 days a week for the High Tech Factory, that's more than just Phase 1. We have also appointed a project manager for the construction activities. High Tech Factory BV has officially ordered the University of Twente to redevelop the building, a joint project manager has been appointed, Jaap Nieuwenhuizen. Then you need someone to represent the High Tech Factory in this process, which will be done by Gerard Roelofs from MESA+. We are building an organization; the supervisory board is being extended, the enterprise is being built, and we are making financial arrangements with the university. The development is running and I am hoping to have some more people in a few months. At the moment it's an organization under construction, and it will stay that way for a while."* ***(Miriam Luizink)***

The High Tech Factory has been becoming a company with a structured organization more and more. This development is in line with the vision of the University of Twente as the shareholder, which regards the High Tech Factory as a company that needs a more extensive organization.

> *"Look, the High Tech Factory is scaling up, with that the risks are rising and the administrative burden is growing, in such a situation you need to consider the organization. We consider the High Tech Factory to be a company; when the company is growing, you need to expand the organization as well."* ***(Kees van Ast, University of Twente)***

5.9 Future perspectives

The expected development of the High Tech Factory points towards that of an independent company, which will be commercially exploited. A consensus among the participating companies has not yet been established concerning the desired content of the actual facilities. However, the companies appear to be willing to cooperate in these shared facilities, where they may have been avoiding each other earlier.

In the long run the High Tech Factory may further evolve into a company on its own. The cleanroom will be commercially exploited and as such it may become an organization independent from the university and MESA+.

> *"It is very well possible that after a while the High Tech Factory will become independent. Maybe other parties will be able to buy shares. It could be commercially exploited. … For the time being the University of Twente is the only shareholder, and it will stay this way, the question is: what do we want in the future? When the High Tech Factory is running it may not be obvious at all that it is owned by the University of Twente, it is possible that other external parties will become involved."* ***(Kees van Ast, University of Twente)***

The University of Twente regards the High Tech Factory as being successful when the companies use the technologies developed in Phase 1 also in later phases of the High Tech Factory. Only when companies have truly scaled up their production processes or increased its efficiency will Phase 1 be truly a success.

Miriam Luizink has been in contact with companies outside the group of participants of Phase 1. There have been a number of companies that contacted her about the developments of the High Tech Factory. Some companies have expressed the desire to participate in a project similar to the projects in Phase 1, if such a project would be organized in the future.

The perceived future of the High Tech Factory, as it is regarded by the participating companies, concerns three aspects: The location and its content, the network and communication, and the management of the High Tech Factory (See appendices for the statements). Effectively all companies who expressed a vision on the location and content of the future High Tech Factory have (at least) a single building in mind. Regarding the filling-in of the space the companies have converging views, but not completely the same. All companies expect to see the High Tech Factory partially filled with company specific areas were the facilities are shared (such as the water and air systems). There is no consensus yet on the rest of the High Tech Factory space and how 'open' it should be. Some companies emphasize on complete restriction on access to their part for other players, while other companies envision facilities to be rented by companies to other players. The companies already located outside the campus of the University of Twente stated they will keep their main offices. Other companies, like SolMateS, urged for the possibility for all companies to rent office space at the High Tech Factory.

A more abstract vision of what the High Tech Factory could be is the image presented to the outside. The opinions of companies on this topic are spread over a continuum; from seeing the High Tech Factory as a tool they can use, to regarding it as a system they become part of and should be promoted as such to the outside world. The companies expressed the importance of communication and PR of

the High Tech Factory. Some companies see a role for the facilities to promote the entire production chain and the companies participating in the High Tech Factory.

> *"I would more look to the outside. It's hard to make yourself known to Asia, to Europe, to the Netherlands. I would say that that's a function that should be done at top level."* ***(Interviewee, SolMateS)***

The University of Twente is also driving towards a situation where the High Tech Factory is more than a building; it is an image that is sent out.

> *"The University of Twente is motivated by the creation of an image. We want to connect research and commerce. Whether there is a building or not, it is about the image."****(Kees van Ast, University of Twente)***

Regarding the management virtually all companies stress the importance of smoothly operated facilities and value a good operations management. Regarding the other aspects of the management of the High Tech Factory the visions diverge. Selection is generally seen as unnecessary as companies will only apply when they fit in, but synergy is highly valued. Participating companies think it is unlikely that there will be issues with competition, although some participants feel healthy pressure. It was suggested to use an agreement that is signed by companies before joining the High Tech Factory, concerning cooperation, IP and the use of facilities. The exit-strategy companies should have is considered of less importance as companies will leave by themselves.

> *"People have thought about it a lot and very wise words are declared about it. Ultimately it will be something you just need to work out operationally. This means that when there is a conflict, technical or organization, you find a solution. When processes strengthen each other, then that's the case, it is that simple. … I do feel that when you chose to start here with a product and pilot production, then you need to have the objective to end up here as well. It is my vision that in the end, when Medspray has grown to 100 million nozzles ten years from now, we won't fit anymore. I have long built a factory on my own, but I will still be a part of the High Tech Factory,"* ***(Interviewee, Medspray)***

> *"Competition over equipment will not be a problem, when something is important to a company they will want it for themselves. Companies making the same things are already present, which is only healthy. Another form of competition could be related to specific locations being rented in the cleanroom, we would like to rent space next to our current location, it would be great if that can be taken care of. Every entrepreneur should have the dream to have his own building with his own cleanroom, so companies will move out themselves when they become too big. Maybe it should be in the contract you cannot rent more than x% of the cleanroom."* ***(Interviewee, Micronit)***

6 Analysis

6.1 Model of analysis

In chapter 2 the process of institutional entrepreneurship has been introduced as a sequence of three steps, the use of discursive strategies, resource mobilization and the design and implementation of new institutions. The identification of these three steps is the result of earlier studies in this field. Implicitly, these studies argue that in the creation of new institutions the process of institutional entrepreneurship is gone through once. Based on the findings in this study a more elaborate process is presented, where three consecutive cycles of the process institutional entrepreneurship are recognized. This model of multiple cycles is depicted in figure 6.1.

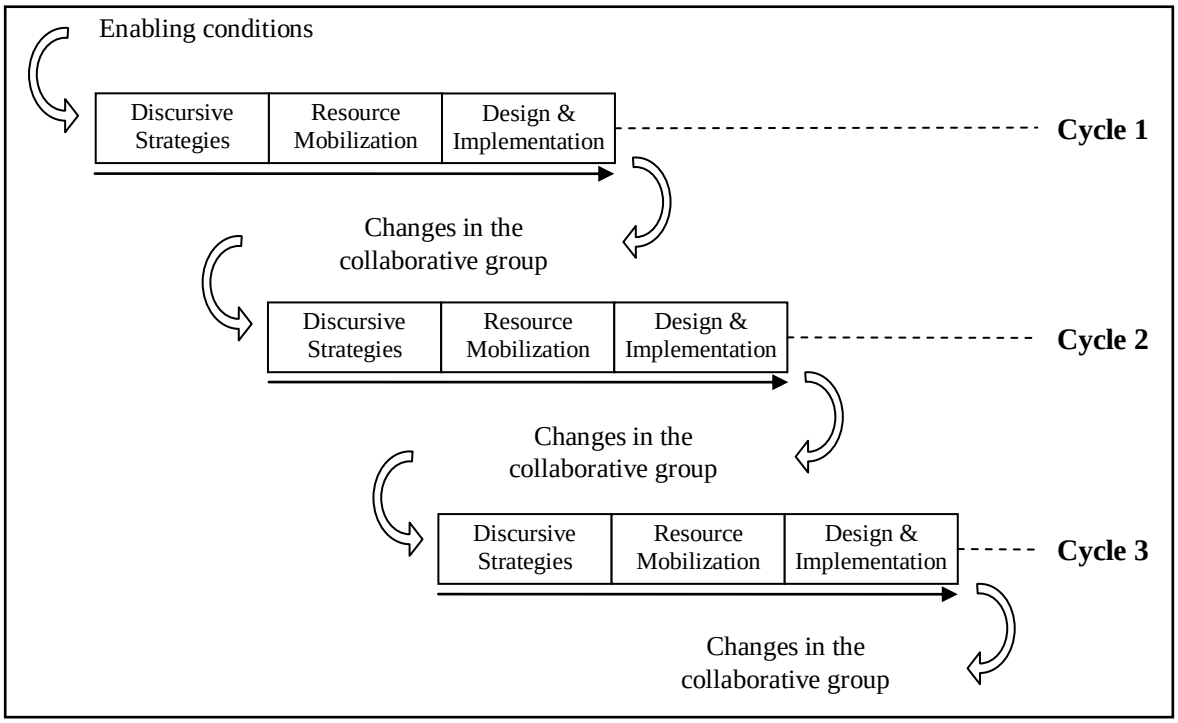

Figure 6.1. The model of three consecutive cycles of the process of institutional entrepreneurship. In which each cycle provides the necessary changes in the collaborative group to continue with the next cycle.

In the depicted model three cycles are shown. The first cycle is introduced through the enabling conditions for institutional entrepreneurship. Each of the cycles consists of the three steps that have been identified in the process of institutional entrepreneurship. The use of discursive strategies concerns the commitment of allies and encompasses three types of activities, framing, specification and justification. The mobilization of resources characterizes the important resources and how they are activated. And the design and implementation of institutions concerns what new institutions are created, how existing routines, norms and values are linked and how these institutions are sustained. Each of these steps has effects on the aspects of the collaborative group and particularly the companies in it. After each cycle the effects of discursive strategies, activated resources and new institutions have changed the collaborative group. These changes are identified through the levels of trust, commitment

and goal consensus. The changes in these levels have been required for the next cycles of institutional entrepreneurship. With the model of figure 6.1 is postulated that without the changes in the aspects of collaborative groups the activities of the next cycle could not have been performed, which prevented the realization through a single cycle of institutional entrepreneurship.

The development of the High Tech Factory was structured in four phases. Phases 1, 2 and 3 have distinct developmental purposes and contents, and the related activities have an overlap in time. The process behind these phases appears to be sequential. After the start of Phase 1 the focus shifts in the organizational structure of the management of the High Tech Factory. After the realization of the equipment fund and when the building is redeveloped another shift in the focus and change in organizational structure is expected. These shifts and changes are indications for new steps the in process, and as such three cycles are defined. Cycle 1 is the formation process prior to Phase 1. Cycle 2 is the realization of Phase 2 and 3. Cycle 3 is the establishment of the final production facilities and the organization of the High Tech Factory. The situation prior to the first cycle is characterized by the enabling conditions, which are presented in table 6.1. The activities in the steps of the three cycles and their effects on the collaborative group are presented in table 6.2.

Organizational field	Social position of institutional entrepreneur	Characteristics of institutional entrepreneur
• Challenges in cooperation, low levels in trust, commitment and goal consensus • Contextual actors that are very important (resources)	• Prominent and central position in social network	• Intentions and capabilities • Access to resources

Table 6.1. The enabling conditions for institutional entrepreneurship.

Cycle	Discursive strategies	Resource mobilization	Design & implementation	Changes in the collaborative group
1: Formation	• Identification with challenges • Development of plans, with companies and University of Twente • Long- and short term incentives	• Creation of subsidy proposal, supportive role for companies • Lobbying process, supportive role for University of Twente	• Rules and regulations on cooperative, administrative and financial aspects • Installation of PCC • (NAO type governance mechanism)	• From social network to collaborative group • Increase in trust and commitment of companies
2: Realization	• (Cyclic process) Requesting feedback, discussion, adaption of plans, and requesting feedback again	• Subsidy proposal • Arrangements with University of Twente	• Extension of activities of High Tech Factory • Extension of formal organization of High Tech Factory	• Higher level of goal consensus • Mutual dependency
3: Establishment	• Maintaining internal and external legitimacy	• Commitment of the companies • Self selection and incentives	• Extending organization • Formalization • Commercialization	• No longer based on social network • From collaborative group towards commercial facilities

Table 6.2. The activities in the steps of institutional entrepreneurship and their effects on the collaborative group.

6.2 Enabling conditions

The emergence of institutional entrepreneurship is characterized by its enabling conditions, the organizational field, social position and the characteristics of the institutional entrepreneur. These enabling conditions form the starting point for the process of institutional entrepreneurship and the appearance of challenges can be predicted based on these conditions.

6.2.1 Organizational field

There are three challenges that prevent the companies from cooperation in a collective action and thus provide the basis for institutional entrepreneurship. Among the developing companies in the social network micro- and nanotechnology there is no clear or formal structure that binds them in a group. The absence of such structure gives a challenge in coordination of collective efforts and is an indication of a low level of goal consensus. There is no company with the ability to take the lead, based on the availability of resources and commitment of other companies. The lack of commitment of other companies can be related to issues with trust between two large players and insufficient goal consensus, which adds up to a challenge concerning norms of reciprocity. The third challenge is the short exchange horizon of the companies. There are indications that the involved companies only collaborate when there is immediate and direct added value, even when they realize that cooperation

can provide indirect added value. Collective action is, on the other hand, a long term investment that will cost money and bring uncertainty on the short term. This short-term focus is an indication of a moderate to low level of trust.

6.2.2 Contextual actors

The University of Twente and the MESA+ institute have important roles in the initiation of the process. It can be argued that their involvement is driving and leading the process, rather than merely relevant to the opportunity for institutional entrepreneurship. These contextual actors may have more to win with the realization of the High Tech Factory then the companies. The creation of the institutions of the High Tech Factory gives the contextual actors a better image, it allows them to bind and control the companies, and existing resources of these actors are 'recycled'. The Province of Overijssel is motivated by a collection of nanotechnology arrangements and tries to establish Twente as a new technology region. The Province of Overijssel is able to fund promising projects that stimulate the local economy. They are proud to have projects like the High Tech Factory, which provide publicity for the management of the province.

6.2.3 The social position of the institutional entrepreneur

The institutional entrepreneur, director of the MESA+ institute, occupies a very prominent position within the University of Twente and is located at the centre of the social network of local companies in micro- and nanotechnology. Within MESA+ and the network of companies the Technical-Commercial director is in a position of social and formal authority.

6.2.4 The characteristics of the institutional entrepreneur

The characteristics of the institutional entrepreneur appear to be suitable in every dimension. The ideas for the High Tech Factory were coined by the institutional entrepreneur and let to the conclusion of the PP MN study. The institutional entrepreneur was able to carefully plan the trajectory on beforehand and knowledge of subsidy project leadership was previously acquired. The institutional entrepreneur has thus expressed the intention to create the High Tech Factory, as well as possession of the necessary skills to do so.

6.2.5 Conclusion

The enabling conditions form a prerequisite for institutional entrepreneurship. The favorable conditions are an indication for few challenges are expected to appear in relation to the starting position of the institutional entrepreneur. When there are appearing challenges these are likely to be related to a change in the organizational field or to the process of institutional entrepreneurship itself.

6.3 Cycles of institutional entrepreneurship

6.3.1 Cycle 1: Formation

Discursive strategies

The first step in process of institutional entrepreneurship is the use discursive strategies, which combines the framing, specification, justification of and ensuring commitment for the proposition.

The framing activities concern the creation of empathy for the cause of the institutional entrepreneur. With the central position in the social network and the connection to the companies the institutional entrepreneur was able to identify with the states and relate to the interests of others. A high level of empathy with potential allies was reached by building on the existing cases of companies with the desire to grow. When the plans for more back-end production steps where introduced the companies picked this up and used it for the conclusion of the Pilot Production for Mirco- and Nanotechnology (PP MN) study.

The specification type activities are related to the creation of plans and the establishment of a common ground. A common ground was found among the interests of the different actors by brainstorming of the institutional entrepreneur with the University of Twente and the companies that were involved in the PP MN study. Particularly the two companies that have the highest need of production facilities have been actively involved in the formation, of which one is by far the largest of the current customers. The University of Twente has been an active partner in the creation and development of the plans.

Justification of the promoted project is achieved through activities that are focused on promotion and gaining legitimacy. The companies needed to be convinced to participate in the group and this was done by presenting plans with incentives on the short term and long term. The short term incentives consisted of the Phase 1 subsidy projects, with an exchange horizon of a couple years this incentive is based on what the companies need. The long term incentives were the shared facilities of the High Tech Factory, with an exchange horizon of at least ten years, which is based on what the companies want for the future. By getting companies to join Phase 1 the commitment of the companies to the development of the High Tech Factory was increased. The institutional entrepreneur started asking known micro- and nanotechnology based companies to join Phase 1, and they spread the word. The selection of participating companies was performed through the local network.

Resource mobilization

In the first cycle the important resources that were mobilized were the subsidy to support the coalition of participating companies and the lobbying capabilities to acquire it. The institutional entrepreneur

had the lead and the participating companies supported. The part of the companies was evaluated and provided with feedback to raise the standard of the proposal. After the proposal was submitted the lobbying process began, which was the employment of possessed intangible resources. The institutional entrepreneur put great effort in this lobbying process based on formal authority at MESA+, through the social network and the created legitimacy. The board of the University of Twente lobbied as well, underlining their commitment to the project and acknowledging the important position of the institutional entrepreneur. Thus, the access to the tangible resource of the subsidy was prepared through a joint effort of the involved actors, who employed intangible resources in doing so.

Design and implementation of new institutions

New institutions were created after the subsidy was granted and the resources for the short term incentives were provided. In the projects of Phase 1 cooperative efforts are included, setting the norm for a future of shared production. A contract was signed by all participants that included rules and regulations about cooperative, administrative and financial aspects of the cooperation. The Project Coordination Committee (PCC) was created and installed, incorporating the directors of all companies. For their participation the companies were required to express the intention to join the final High Tech Factory. The creation of these institutions indicates that long term perspectives are involved as well.

6.3.2 Cycle 2: Realization

Discursive strategies

The primary activities in framing, specification and justification for the second cycle of the High Tech Factory had already been a part of the process in the formation of Phase 1. Whereas the first cycle had to build trust, commitment and goal consensus, the second cycle of institutional entrepreneurship builds on these establishments, through created the institutions. Therefore, rather than sequentially frame, specify and gain justification, the use of discursive strategies was an interactive and cyclic process. In this process the institutional entrepreneur requested feedback, discussed with companies and representatives of the University of Twente, adapted the plans, and then asked feedback again. Typical in this process was the focus on the most important (future) customers, rather than the entire group of companies. The entire collaborative group was addressed in the PCC meetings where updates were given on the developmental process.

Resource mobilization

In the second cycle a second proposal for subsidy was submitted to mobilize tangible resources. In contrast with the first cycle less emphasis was put on the lobbying activities and on the involvement of the companies in the preparation of the proposal. The subsidy institutions had granted the subsidy for

Phase 1 with the final production facilities in mind, which contributed to the process of acquiring further subsidies. Next to the subsidy application, financial arrangements were made with the University of Twente. There was already a high level of commitment of the University of Twente, which is partially based on the commitment of the participating companies. In the process of accessing these new tangible resources earlier acquired intangible resources were employed, in the form of authority and commitment.

Design and implementation of new institutions

The design of new institutions of the second cycle had partially been part of the process of making the plans. In contrast to the first cycle, where the newly created institutions focus on the interaction with companies, the second cycle is more focused on the High Tech Factory and its organization. A second difference is that new institutions are created in three different directions, rather than different means to the same goal. The three directions are the extension of day to day management, a structure for newly developed activities and an investment in image and expertise. The day to day management was extended in order to stabilize interactions. New positions have been created for the project management in the High Tech Factory as well as the building activities. Additional activities created with the revolving fund, Phase 2 of the High Tech Factory. The implementation will start later on, as it is intended to fund equipment for the companies when the production facilities have been realized, but the supporting organization is being created. In order to prepare for future developments the image of the High Tech Factory is formalized and the supervision on the organization of the High Tech Factory was extended with additional expertise. To extent the supervision on the activities in the creation of the shared facilities and bring in additional expertise the supervisory board was increased. Additionally, the MTV BV changed its name to High Tech Factory, which marks the creation of the High Tech Factory as a formal organization rather than merely plans and a subsidy project. This establishment allows the increase in positions and activities. Were in the first cycle long term perspectives are indicated, the activities and created institutions in the second cycle suggest that a mutual dependency has been developed between companies and the High Tech Factory.

6.3.3 Cycle 3: Establishment

Discursive strategies

In the third cycle, similar to the second cycle, the activities of framing, specification and justification are intertwined and the justification activities are the most prominent. In contrast with the second cycle are the activities in the third cycle directed internally as well as externally. After the redevelopment of the cleanroom facilities and the creation of the equipment fund the High Tech Factory will be further developed and reach its realization. At this point the High Tech Factory needs to maintain its legitimacy among its members, internal legitimacy, and to the outside world, external legitimacy.

Internal legitimacy is achieved through the activities and institutions of the first two cycles of institutional entrepreneurship, where mutual dependency was developed. In these cycles the institutional entrepreneur has been close to the development of the participating companies. The commitment of the companies and the University of Twente is the basis for internal legitimacy. External legitimacy is given attention to through promotional activities, as companies outside the collaborative group are becoming aware of the possibilities and advantages. Goal consensus remains an important issue in this cycle, as the balance between individual and partially shared equipment is still being discussed, as is the extent to which a collective image should be promoted.

Resource mobilization

In the third cycle the mobilization of resources is focused on the companies that need to join the High Tech Factory. In the first cycle a subsidy was the most important resource, in the second cycle the focus started to diverge towards other actors and in the third cycle the subsidies have a much less prominent position. The first set of customers will consist of participants of the collective group, which are committed to the High Tech Factory. For the mobilization of this first set of customers the created mutual dependency is employed. Other companies are expected to come to the High Tech Factory as soon as it is being promoted. To stimulate steps towards production for companies in micro- and nanotechnology more developmental projects such as Phase 1 may be organized. With the establishment of the collaborative group and development of the organization, the social network has become less important as companies are contacting the High Tech Factory as well.

Design and implementation of new institutions

The design and implementation of new institutions in the third cycle is the materialization of the plans that have been developing through the first and second cycle. Where in the first cycle the newly created institutions focus on the interaction with companies, the second cycle is more focused on the organization and in the third cycle is focused entirely on the High Tech Factory through its facilities and organization. The envisioned organization is being built on the foundation of the earlier constructed institutions. A second difference with the prior cycles is the focus on commercialization of the organization, in contrast to cooperation in the first cycle and development in the second cycle. This organization will consist of a technical organization and the management of the equipment fund. These institutions will be implemented gradually. Important is the consent and support of the shareholder, the University of Twente. The realization of the High Tech Factory and thus its organization is an objective of the University of Twente and they would like to build it in such a way that in the long run the High Tech Factory may even further evolve into a company on its own.

6.4 Development of the collaborative group

As a result of the three cycles of institutional entrepreneurship institutions have been created and implemented, and these institutions characterize the development of the collaborative group. The effects of the institutional entrepreneurship are directly related to changes in the group-aspects and the development of the governance mechanism. In this section the creation and the development of the collaborative group and its governance mechanism is analyzed.

6.4.1 Formation

After the first cycle the collaborative group of companies was created and particularly the levels of trust and commitment were increased. Building on the social network of the organizational field the collaborative group is created consisting of participating companies that pursue collective goals as well as own goals. All companies are, to some extent, committed to the realization of the shared production facilities next to their own goals which are embedded in the projects.

A Network Administrative Organization (NAO) type governance mechanism is introduced. It is established through subsidy project construction where a spokesman is required for the entire group and evaluating reports are required. The Project Coordination Committee (PCC) is established with a board construction in which the managers of the companies with a project have a seat. As part of the governance mechanism the PCC facilitates efficient operation of the larger governance mechanism by the involvement and commitment of the participating companies. This PCC creates a membership feeling among the companies; it makes them feel as a group.

The tradeoff between internal and external legitimacy for governance mechanisms was handled through strategic involvement of these actors. However, based on the enabling conditions in the organizational field, the largest contribution to external legitimacy was already guaranteed. The external control of the institutional entrepreneur over the subsidy project provided the participating companies with a professionalized management, which increased their trust and commitment. The particular setup of the governance mechanism provided long term commitment of the companies through short-term actions.

6.4.2 Realization

The NAO governance mechanism was established for the coordination of a collaborative group in the first cycle. The higher levels of commitment and trust allowed the extension of the governance mechanism and building an organization around it. Without the rise in trust and committed of the first cycle the activities in the second cycle couldn't have been performed. The most important effect in the second cycle of institutional entrepreneurship is that mutual dependency is established between

participating companies and the High Tech Factory. Through coordination the companies were strategically employed in the developmental trajectory. The established governance mechanism provided the institutional entrepreneur with required the flexibility. The level of commitment is, in response to the activities of the institutional entrepreneur, further increased. Through the operation of the PCC the level of goal consensus is improved to the level that is required for the higher level of commitment. The successful activities in the second cycle further improve the trust of participating companies and contextual actors in the institutional entrepreneur.

6.4.3 Establishment

Through the third cycle the governance mechanism has become part of a larger organization and the focus has shifted to administrative efficiency, which supports the transition to an independent organization. This envisioned organization is being built on the foundation of the NAO and without the first two cycles the condition that are required for the activities in the third cycle wouldn't have been met. The organization will consist of a technical organization and the management of the equipment fund. These institutions will be implemented gradually. Important is the consent and support of the shareholder, the University of Twente. The realization of the High Tech Factory and thus its organization is an objective of the University of Twente; they would like to build it in such a way that in the long run the High Tech Factory may even further evolve into a company on its own. The mutual dependency between the High Tech Factory and some participating companies will provide the High Tech Factory its launching customers. A large collection of companies, partially based on the participating set of Phase 1, is expected to use the High Tech Factory. Through the structure of the High Tech Factory the challenge in norms of reciprocity are resolved, which is supported by the higher levels trust and commitment. After three cycles the High Tech Factory has developed its own identity and no longer needs to build on the enabling conditions of the institutional entrepreneur.

7 Conclusion

7.1 Central question

Intended in this study was to contribute to the set of solutions for creating and maintaining the governance mechanism for a collaborative group. The study aims to give insights around the activities of the institutional entrepreneurs and how the process of the institutional entrepreneurship is evolving with the development of the collaborative group. The following central question has been formulated to structure this research:

> *How does the process of institutional entrepreneurship evolve through the development of a governance mechanism in a collaborative group?*

This studies shows that complex processes of institutional entrepreneurship, such as the development of a collaborative group, are executed with multiple cycles of institutional entrepreneurship rather than a single one. In case of the collaborative group and its challenges of creation not all developments can be performed in a single cycle, because the initial levels of trust, commitment and goal consensus aren't high enough to support the developments. After each subsequent cycle the collaborative group is changed and a step is taken towards the envisioned situation, the new situation provides the opportunity for the next cycle of institutional entrepreneurship.

The evolution of the process of institutional entrepreneurship is given by the development of the focus of the several cycles. Based on the development of the collaborative group, the institutional entrepreneur can, after each completed cycle, direct its activities towards the next goals. The new goals build on that which has been created in the previous cycle(s), and are advancing towards the envisioned situation. The three directions of focus have been formation, realization and then establishment. The different goals and the changes in the collaborative group required different activities of the institutional entrepreneur. The change in activities is best represented by the development of the use of discursive strategies. In the first cycle the three types of activities in the use of discursive strategies could be distinguished clearly. With the development of the collaborative group in the second and third cycle this distinction vanishes and the activities become intertwined. This development can be explained through the idea that the use of discursive strategies in the first cycle the institutional entrepreneur had already created an important basis for the framing, specification and justification activities of the second and third cycle.

The second point that represents the evolution of process of institutional entrepreneurship is the direct involvement of companies. The number of companies that is directly involved in the process of development is decreasing with every cycle, where one could have expected to that more companies would be involved due to the rise in the levels of trust, goal consensus and commitment. This can be

explained by the favorable short term incentives that were used in the first cycle to commit companies to the long term perspective. In the second and third cycle the activities of institutional entrepreneurship are increasingly addressing companies as a resource as well as partners in the development of the collaborative group. In the third cycle the commitment of companies as customers of the created organization becomes the primary resource. The effect on the process of institutional entrepreneurship is that the envisioned institutions are directed towards establishment and commercialization, and the activities are actions to gain and maintain internal and external legitimacy, rather than cooperation.

A very important point in the development of the collaborative group was the creation of mutual dependence between the envisioned institutions and the companies in the collaborative group. Through the creation of mutual dependency the challenges related to collaboration are avoided as the companies will be cooperating primarily with the collaborative group rather than with the other companies. With the dependency of the collaborative group on its participating companies the conditions are provided for higher levels of trust, goal consensus and commitment. And in turn the fact that the companies are becoming dependent on the collaborative group provides the collaborative group with internal legitimacy and a basis for external legitimacy, as well as the resources for further development. The creation of mutual dependency was a crucial point in the evolution of the process of institutional entrepreneurship.

7.2 Discussion

7.2.1 Multiple cycles

The process of institutional entrepreneurship is a complex process that combines a diverse set of activities of different actors. The steps and activities that compose this process have largely been captured by researchers in this field (Leca et al., 2008). The portrayal of the process of institutional entrepreneurship itself on the other hand is relatively new. Based on the findings of this study the existing perception of the process of institutional entrepreneurship can be further refined.

The contemporary view of the process of institutional entrepreneurship is that of three sequential steps, first the use of discursive strategies, secondly the mobilization of resources and thirdly the design and implementation of institutions. The activities in these steps have been thoroughly studied and can very well be defined and described. There are distinct types of activities that have been identified that define and unravel the three steps that compose the contemporary view on the process of institutional entrepreneurship. With these steps it has been made possible to construct a model of the process of institutional entrepreneurs. However, this model has only been coined recently, by Leca et al. (2008) and it is to be further developed. This is where this study finds its primary contribution.

Instead of portraying the process of institutional entrepreneurship as a sequence of the three steps, a more complex model for the process of institutional entrepreneurship is presented. In this model various cycles of institutional entrepreneurship follow after each other. In each of these cycles activities of the three steps are sequentially executed, and institutions are created. These institutions provide the changes in the context of the process of institutional entrepreneurship that are required for the next cycle to be performed. In case of High Tech Factory three cycles that build on each other are employed in the creation of the envisioned organization. An example of an earlier study that supports this model is the single case study of Jain and George (2007), who investigated technology transfer offices. Although they didn't model the process of institutional entrepreneurship, they do distinguish three different phases in the studied case. And, just like in this research, these phases differ from each other in goals, activities and focus of the institutional entrepreneur. Both our studies describe phases that build on each other in the sense that institutions are created that provide the changes required for further activities.

I postulate that when the creation of new institutions is studied, one will find that multiple cycles of institutional entrepreneurship will follow after each other, rather than that the institutions are created in one single run of the three steps. The number of cycles is not inherently linked to the application of the model. One does not necessarily need to distinguish three cycles. On the contrary, any researcher applying this model should choose the number of cycles on basis of case(s) he is studying. By using this model the process of institutional entrepreneurship can be described more accurately. Such an improvement will give researchers in this field to opportunity to apply a more detailed structure to their studies, which may lead to stronger claims.

7.2.2 Shift in focus of institutional entrepreneur

In this study the evolving focus of the institutional entrepreneur has been observed. These developments in the focus are in direct relation with the cyclic nature of the process of institutional entrepreneurship. Through the development of the High Tech Factory different activities are performed and the goals and methods have been changed by the institutional entrepreneur. This is represented by the position of the companies that changed from cooperators in the development towards resources of the High Tech Factory and the goals of the institutional entrepreneur that shifted more towards formalization and commercialization with each cycle. The cyclic model that is introduced in this research provides the tool to unravel the development of the focus of the institutional entrepreneur.

The notion that the role of the institutional entrepreneur changes over time in the development of the pursued institutions was introduced by Lawrence et al. (2005). These authors argue that the process is changed at particular moments under the influence of power and politics. In her dissertation Patterson

(2007) describes an evolutionary process of an institutional entrepreneur. This process develops with the changing role of the institutional entrepreneur. Similarly, Jain and George (2007) discussed three roles of technology transfer offices. And again the role of the institutional entrepreneur changes on basis of earlier developments. All these authors describe a changing role of the institutional entrepreneur, as a part of the process of institutional entrepreneurship. In itself, the fact that the role of an institutional entrepreneur will evolve is not striking, considering that the organizational field is changing. What I would like to contribute to the literature on institutional entrepreneurship is that it's not merely the focus of the institutional entrepreneur that shifts in the process, but that separate cycles of institutional entrepreneurship can be defined and in each cycle the institutional entrepreneur has a distinctive and different role.

Existing research on the causes for the shifts in the focus of the institutional entrepreneur is only loosely coupled to the actual process of institutional entrepreneurship. The model presented in this research can be used to combine the causes and as such be placed in the more general perspective of the process of institutional entrepreneurship. Existing scholars have explained the evolving role of the institutional entrepreneur by their characteristics (Jain and George, 2007), emergent strategies, reactionary behaviors and intentional development (Patterson, 2007). The characteristics of the institutional entrepreneur are related to enabling conditions, and the emergent strategies, reactionary behaviors and intentional development are part of the process of institutional entrepreneurship. Causes for shifts in the role of the institutional entrepreneur that have been identified are readily part of the model for the process of institutional entrepreneurship. After each cycle the situation of the institutional entrepreneur can be predicted based on the steps of using discursive strategies, mobilizing resources and design and implementation of resources.

Based on my model not only research can be structured but the focus of the institutional entrepreneur can be predicted on basis of the process, particularly based on the institutions that are created in the preceding cycle.

7.2.3 Mutual dependency

Institutional entrepreneurship creates a mutual dependency between the collaborative group and the companies. This mutual dependency is developed by the institutional entrepreneur through the use of one or several cycles of institutional entrepreneurship, and by applying cooperative, interactive and adaptive strategies in these cycles. Rather than merely creating and implementing institutions and letting other actors act upon it, institutional entrepreneurs bind the organizational field to the new institutions during its creation. This mutual dependency perspective sheds new light on three existing discussions in the field of institutional entrepreneurship. First, the discussion on the use of discursive strategies as a means to achieve legitimacy is taken to a higher level in the process of institutional

entrepreneurship. Second, the mutual dependency perspective provides further refinement of the statement that previously earned legitimacy can be a central asset in the further development. And third, the mutual dependency perspective provides additional insight in the implementation of the institutions. By discussing these three contributions I implicitly show that mutual dependency is of high importance in the understanding of the entire process of institutional entrepreneurship, the creation of legitimacy, mobilizing of resources and implementation of institutions.

Scholars in institutional entrepreneurship have particularly focused on the efforts of an institutional entrepreneur to establish legitimacy through the use of discursive strategies or enforcement (Déjean et al., 2004). The extensive emphasis on the use of discursive strategies as a means to achieve legitimacy has been criticized recently (Déjean et al., 2004; Leca et al., 2008). In the quest for legitimacy discursive strategies can be used to create a feeling of mutual dependency among actors. These methods have significant disadvantages because the use of discursive strategies is a complex political and cultural process and enforcement is often met with severe resistance (Leca, et al., 2008). My research suggests that legitimacy is successfully created with the emergence of mutual dependence. The creation of mutual dependency is part of the entire development trajectory and not a distinctive step that the institutional entrepreneur needs to plan, schedule, allocate resources and execute. Therefore, when an institutional entrepreneur builds legitimacy by the creation of mutual dependencies the disadvantages of the use of discursive strategies are avoided. Mutual dependency can be created by adapting the approach of multiple cycles that is developed in this study. This model provides institutional entrepreneurs an alternative to the use of discursive strategies to gain legitimacy.

The creation of mutual dependency facilitates the mobilization of resources when it binds the actors to the developed institutions. Mutual dependency has, by developing legitimacy, paved to road for the mobilization of resources. The actors that are affected by mutual dependency will also direct their efforts to contribute in the mobilization of external resources, and these actors can internally be seen as resources themselves. This notion is in line with the statement of Leca et al. (2008) that previously earned legitimacy can be a central asset in the further development and that of Durand and McGuire (2005) that institutional entrepreneurs must build on the established legitimacy in order to benefit from it. With the results of my research these statement can be further refined. An additional variable, the mutual dependency, is introduced that has not been taken in account by earlier studies. Earlier studies have highlighted the importance of building on existing legitimacy by examining maintenance and extension of legitimacy, but have left the refinement of the relation with further development to further studies (Durand & McGuire, 2005). The relation between legitimacy and the mobilization of resources by the creation of mutual dependence further specifies the statements of Leca et al. (2008) and Durand and McGuire (2005), allowing more specific application of these relations.

The created mutual dependency gives insight in the implementation of the institutions in the organizational field by structuring the implementation process. This structuring becomes visible when the activities one of the mutual dependent actors is adapted by that of the other. Patterson (2007) emphasized the importance of timing of the implementation in her doctoral dissertation. Mutual dependency reduces the complexity of timing, as the actors of the organizational field and the institutions are closely tied to each other and their actions will be linked. As a result the timing is much more likely to be 'correct' as the involved actors and developers of the institutions are acting on the others' actions. Philips et al. (2000) take the position that the implementation of institutions in collaboration will depend on the power of the members of the collaboration. When mutual dependency is created the developers of the institutions have a way to drive the members, individually but also as a group, and stimulate implementation of the institutions in this group. A second effect is that when the institutions are implemented in this group, external implementation will also be smoother. The implementation of institutions is structured by mutual dependency, the dependency on the power is decreased and the chances of successful implementation are higher.

7.2.4 Use of resources

Although the use of resources has not been the focus of this research some suggestions with relevance for the field of institutional entrepreneurship can be formulated. It is relevant because other scholars are calling for insights on this point. *"How institutional entrepreneurs use material and immaterial resources is another dimension that warrants further analysis (Battilana and Leca, forthcoming; Wijen and Ansari, 2007)"* (Leca et al., 2008: p. 21). This particular call is opted on basis of the need for closer attention to practices beyond discursive strategies.

Based on this research it can be suggested that material resources can be the driver for the initiation of the process of institutional entrepreneurship and the basis for mutual dependency. The starting sequence in this research indicates that existing material resources of contextual actors can drive the initiation of institutional entrepreneurship. The material resources that existed at the start were used leverage tool at the contextual actors, owning the resource, and as a means to frame the plans of the institutional entrepreneur to other actors, internally and externally. Following this argument the existing material resources provide the basis for the creation of mutual dependency between the institutions and cooperating companies. Immaterial resources are effects of the institutions that are created in cycles of institutional entrepreneurship. In subsequent cycles they are employed as the means for the activities in the use of discursive strategies and the mobilization of other resources. The analysis of the use of material and immaterial resources therefore points back to the cyclic model of institutional entrepreneurship.

7.3 Limitations and directions for future research

The present research into the process of the institutional entrepreneurship in the development of a shared production facility through a collaborative group has presented interesting findings, but as with every research setting there are some directions left unexplored. In this section I will present the most important limitations of this study, which provide some very interesting opportunities for future research.

The process of institutional entrepreneurship has been the focus of this study. The research design was adjusted this focus. The setting with the micro- and nanotechnology based companies has been reviewed retrospectively, providing an overview of the intentions, desires and evolution of the group of companies since 2002. The activities of the institutional entrepreneur and the University of Twente, however, have only been analyzed since their involvement with the development of the High Tech Factory. One of the contributions of this study is that the material resources and the contextual actors are the initiators and their added value is an important driver. These findings and the gap in my analysis leaves an option for other scholars to investigate the process that precedes the decisions to become an institutional entrepreneur or its supporter and how existing material resources influence this process.

In the development of the High Tech Factory Phase 1 was introduced by the institutional entrepreneur for various reasons, all contributing to the development and realization of the shared production facilities. Phase 1 isn't finished yet and, although there are strong indications that Phase 1 will be successful, there is no evidence that Phase 1 will continue to develop itself in this way. It will be interesting to see whether Phase 1 will have increased the need for cleanroom space, or whether its role in binding the companies for the time being was more important for the development of the High Tech Factory. Events with considerable impact on the High Tech Factory could happen in the further development, including adapting new co-evolutionary paths if, for example, Micronit would suffer mayor delays. If the realization of the High Tech Factory would fail and the development of the shared facilities is stalled, it would be of great interest to investigate how to explain such a development. Ring and Van de Ven (1994) offered four reasons for such dissolution: (a) excessive legal structuring and monitoring of the relationship, (b) conflicts between role and interpersonal behaviors of organizational parties, (c) conditions for violations of trust, and (d) escalating commitments to failing transactions. Studies involving institutional entrepreneurs that have failed in their quests are particularly rare, the unlikely scenario where the development of the High Tech Factory is stalled would provide researchers with a very interesting opportunity and this study could be a valuable basis.

A single case is presented in this study. As explained in the methodology chapter this research design provides a deeper perspective than multi-case studies do. However with the gathered knowledge from

the development of the High Tech factory it would be very interesting to make a comparison with other shared facilities in micro- and nanotechnology production. Such a facility is MiPlaza in Eindhoven (NL), which was initiated by Philips, a large multinational company in consumer electronics (Doppen, 2008). MiPlaza tries to identify itself as a facilitator for open innovation. The facilities were started with shared research and it proves to be difficult to shift to a commercial attitude. MiPlaza has difficulties with expressing its identity as being separate from Philips. The High Tech Factory, on the contrary, is being created for small companies by an actor not taking direct interest as a customer of the organization. The High Tech Factory will be required to position itself with a strong image, as the participating companies do not have the resources to do so. Additionally the High Tech Factory is being developed for production purposes directly and organization was built to be a commercial entity. These two facilities and their future development and successes can provide a very interesting setting for a comparative longitudinal study.

The development of the High Tech Factory as a shared production facility provided the setting to investigate the process of institutional entrepreneurship. During the study different goals and drivers have been identified and with the discussion on what the High Tech Factory should ultimately become still going on it is unclear when the High Tech Factory is considered to be a success. The collection of goals and conditions for success include but are not limited to recycling the MESA+ cleanroom, being a production facility, having shared facilities, offering opportunities to spin-offs who have little other options, open innovation, amplifying the image of the region and university, and increasing the growth of established SMEs. The process of institutional entrepreneurship and its evolution through the development has been analyzed, but it is difficult to evaluate it as long as the goals and success conditions are unclear. Additionally, some of the goals can only be evaluated a relatively long time from now.

One could argue that because the focus of this study was on the development of the High Tech Factory and the collaborative group, a gap is left on the level of companies, which has only been addressed from the perspective of the High Tech Factory. The evolutionary process of individual firms as part of such a group could give further insight in the driving forces behind the decisions they make. Such drivers may be different among industries and can therefore be used to predict in what industries organizations such as the High Tech Factory can arise. The partnerships are based on known companies, what we don't know is where they know them from and how the relations are kept. In this study is stated that the institutional entrepreneur occupies a prominent position in the social network, further studies could investigate if institutional entrepreneurs have particular roles of facilitators in keeping these networks.

In this study only the participating companies that started a project were represented. Companies that are merely partners in projects may feel entirely different dynamics. No large effect is expected for the

supporting companies, as these are less committed to the developments. There are, however, a few co-developing companies involved in the projects (Encapson, TSST and LioniX), that are developing companies themselves. These companies may go through different but interesting evolutionary paths compared to the companies that are more actively involved in the development of the High Tech Factory. Another group of companies that has been given little attention is the group of companies that are not involved in the development of the High Tech Factory. A study comparing these three groups of companies could provide valuable insights for managers of spin-off companies in high tech fields, regarding decisions on the pursued strategies.

The last direction for continuing and extending this research is into the differences of the participating companies. On basis of the acquired data I can make no categorization on size, life span or degree of focus on production, in relation to the success of the company in the High Tech Factory and its commitment to the realization. I find this intriguing and it would be very interesting to see if the collection of different companies is the reason for success of Phase 1 and the realization of the High Tech Factory in general. Related questions that come to mind are whether the participation of large companies is reason for the small ones to participate, as they can learn from them, or because of higher chances of success compared to only young companies. Is the reason for participation of large established companies, the participation of small? They may be the key to the future of the network and group, or perhaps they are considered future customers by the established companies.

7.4 Recommendations

7.4.1 Managerial implications for company executives

Following the findings of this study some points of advice can be given for managers. This study addressed a collection of companies that are facing barriers on growth due to the uncertainty which is related to their high tech field. Without doubt managers are aware that small high tech companies rarely do everything by themselves, there is always cooperation. Based on the conclusions from this study point three directions are suggested that are relevant for executives. The indirect advantages of belonging to a social network are highlighted. The cyclical character of the process of institutional entrepreneurship is important for managers of companies to comprehend and adapt to. The creation of mutual dependency between companies and the envisioned institutions directly affects the company's strategy as well as the role of the manager itself.

Earlier studies on cooperation and social capital have emphasized the importance of positioning in a social network extensively. This study contributes to this perspective by highlighting the social network as one of the enabling conditions for the process of institutional entrepreneurship. The companies in the network around MESA+ were the ones contacted for participation in Phase 1.

Similar strategies for initiation of the process of institutional entrepreneurship can be expected to be employed by future institutional entrepreneurs operating in other fields.

After initiation the process of institutional entrepreneurship is executed through cycles. Each cycle is new process in the development of a collaborative group and is connected to the shifting focus of the institutional entrepreneur. Company executives should be aware that this development affects them in several ways. The shifting focus of the institutional entrepreneur results in changes in the way that the companies are addressed. In the development of the High Tech Factory the companies ware addressed as collaborators in the first cycle and in later cycles the focus changed towards regarding companies as resources and customers. This means that the advantages and disadvantages of (in-) active collaboration will be different over time, and changes are expected with every new cycle. Additionally, companies contribute in the process of developing a collaborative group. This role, which is expected of the companies, will change with the shifting focus of the institutional entrepreneur.

In regard to this dynamic character of the process of institutional entrepreneurship it is important that company executives consider when it is best for their company to (in-) actively participate. Some companies participate from the beginning to end, while others join later or leave in between. As a company you have freedom in the decision when to join in the development of a collaborative group. Executives should keep in mind that the chances of having influence are higher early in the process of institutional entrepreneurship, as the institutional entrepreneur focuses on the companies as cooperators. In subsequent cycles the influence will be more specific and the possible impact is larger because the institutional entrepreneur is expected to focus on realization and commercialization. Particularly because institutional entrepreneurship is structured in cycles, executives can, and should, decide in what cycle their company should participate and to what extent. However, in the process of institutional entrepreneurship mutual dependency is created that binds the participating companies to the institutions that are being developed. At some point the company's strategy may become dependent on the collaborative efforts and the development of the collaborative group, which will have a (large) impact on the participating company. Managers should realize this on beforehand, both with their company's strategy in mind but with their own role as well. At this point the executives should also be particularly alert on the actions of the institutional entrepreneur. An unsuccessful creation of the envisioned institutions or termination of the project could be very harmful to the participating, and dependent, companies.

7.4.2 Managerial implications for future institutional entrepreneurs

On basis of the results of this research also some recommendations can be given for those envisioning the creation of a collaborative group through the process of institutional entrepreneurship. This advice

is pointed at three directions in relation to the position and activities of the institutional entrepreneur. The enabling conditions are discussed according to the findings in my analysis. The cyclical process and its requirements are discussed with particular emphasis on the shifting focus of the institutional entrepreneur. The third direction of advice concerns the mutual dependency that is being created and its effects on the institutional entrepreneur.

In order to launch a successful developmental trajectory through institutional entrepreneurship a solid starting position is required. This starting position is directly related to the need for institutional entrepreneurship and available resources, material and immaterial. The existing resources of contextual actors have been driving the initiation process, future institutional entrepreneurs should start with evaluating what their driving force is and adapt to it. The challenges that the group of companies was experiencing related to trust, goal consensus and commitment provide institutional entrepreneurs with the window of opportunity. The immaterial resources are represented by the formal and social position of the institutional entrepreneur. These actors that are envisioning becoming an institutional entrepreneur should be particularly adaptive to the opportunities that are offered to them.

Based on the starting position objectives can be formulated and a trajectory can be designed. In this process multiple cycles of the institutional entrepreneurship process are likely to be employed. The cyclical composition requires careful planning on a reasonably long timescale. Within this planning similar activities are expected to appear at different points in the process. The institutional entrepreneur should realize that it will take several cycles of using discursive strategies, mobilizing resources and implementing institutions to complete the process. It is important that all relevant actors are committed at the appropriate time and that the necessary resources are available. After the cycles created institutions and participating companies will become resources that the institutional entrepreneur should employ in the realization and establishment of the envisioned objectives. With these changes in character of institutions and actors the focus of the institutional entrepreneur is changing. This is an important point that the institutional entrepreneur should realize, during the process the focus keeps a forward orientation. The inability to shift the focus after the completion of a cycle will lead to the loss of precious time, or worse.

The creation of mutual dependency between the participating companies and the envisioned institutions is what institutional entrepreneurs should be trying to achieve through the early phases of their developmental process. The creation of mutual dependency will facilitate the establishment and maintenance of legitimacy, the mobilization of resources and implementation of institutions. The participating companies become dependent on the organization that is being developed. This development is a very important point of advice, but at the same time the creation of mutual dependency can become the largest threat to the process of institutional entrepreneurship. Not only does this development restrict the freedom of the institutional entrepreneur, it brings the participating

companies in strong bargaining positions. Failure of the institutional entrepreneur to recognize the situation of mutual dependency or to adequately address it can lead towards the termination of the project, which may have severe consequences for the participating companies.

7.4.3 Advice for the High Tech Factory and the participating companies

On basis of the interviews and the findings of this research I would like to state a few recommendations for the current participating companies, as well as on the further development and the operation of the High Tech Factory.

First and foremost should the current participating companies be aware of their position in regard of the created mutual dependency. In my interviews I have asked the participating companies about their dependence on the developments. Based on these interviews only a small selection of the companies appeared to be directly dependent on the development of the High Tech Factory. The indirect dependence of the participating companies, however, stretches much further. All other companies should evaluate how dependent they are on the effects of successful and unsuccessful realization of the High Tech Factory and to what extent others are depending on them. Based on this evaluation the companies may be required to adjust their strategy regarding the current developments. At the moment of this study the second cycle in the process of institutional entrepreneurship is being executed, which has several implications that the company executives should be aware of. The situation, including the relationship between the participating companies and the institutional entrepreneur, is going to change at least one more time. The institutional entrepreneur is focusing on the organization of commercial facilities and the design and implementation of the institutions is being carried out. This is the opportune moment for companies to have invoice in the developments.

This study has focused on the process of institutional entrepreneurship and its evolution. The cyclical approach in the design of the trajectory has proven itself to be very robust. The development of the High Tech Factory has been going as planned and the further developmental path is relatively fixed. Especially in these situations the institutional entrepreneur and participating companies should be very alert on unexpected and undesired developments. The creation of the institutions related to the High Tech Factory is intended, but other changes may occur as well and intended developments may have unforeseen negative effects. To prevent the High Tech Factory from falling in a success trap continued attention is required. Additionally, the involved actors, the institutional entrepreneur in particular, should be aware that with the creation of the High Tech Factory things will change in the organizational field, and that these changes are not limited to the direct effects of the shared facilities. The institutional entrepreneur needs to consider that her position in the social network is changing. With the creation of commercial facilities and the organization behind it the social network will be

subject to irrevocable change. In the process of developing the collaborative group the institutional entrepreneur should keep reconsidering the chosen path frequently to verify it's still the right one.

Mutual dependence has come forward as an important development through the process of institutional entrepreneurship. The High Tech Factory is depending on the participating companies in its creation and particularly in its successful establishment. The question remains if the participating companies will be able to answer this call. At the moment of this study Micronit rents approximately one quarter of the space that will be available when the High Tech Factory is opened. In Phase 1 only two considerable customers have presented themselves as such (Micronit and Medspray) and there have been a few other companies who are likely to rent some space (Medimate, SolMateS, LioniX). For a cost effective organization the High Tech Factory will probably require more companies that will be renting considerable amounts of space. As such, the High Tech Factory should increase the size of the group of involved companies, new participants should be attracted. In order to extent the pool of potential participants the High Tech Factory could include companies that aren't in the initial social network on which the High Tech Factory is based. This implies that extra effort should be invested to (1) reach these companies in the first place and (2) build internal legitimacy for the added companies among the existing set of participants.

Mutual dependence also reflects in the relation with the contextual actors, with whom the High Tech Factory is also in a close relationship. The involvement of these contextual actors can become the basis for another point of. In the directions for further study I discussed MiPlaza with its difficulties of creating its own image. The institutional entrepreneur should beware of ending up at the other end of the spectrum with the High Tech Factory. Where MiPlaza has difficulties to position itself next to Philips, the High Tech Factory may suffer the same with the University of Twente. When we consider the developmental trajectory it can be expected that the University of Twente and the MESA+ institute will keep close ties to the High Tech Factory and formal linkages may be installed. Some of the interviewees suggested that it can be harmful to cooperate with academia when it comes to production. To prevent a harmful image from being developed, the desired image for the ultimate facilities needs to be considered while the High Tech Factory is still in development.

One of the interviewees expressed his concern about the lack of a clear mission statement at the moment, during the second cycle. In this study I concluded that especially during the second cycle the commitment of the companies is essential, because it is used as a resource. For a sufficient level goal consensus during the development process a clear mission is required and communication about the discussion concerning the content is essential. The current discussion takes place with a few partners at a time when the institutional entrepreneur requires input. This mechanism is effective in the development process of the organization, as it focuses on a stream of information from the companies to the High Tech Factory. However, this decentralized and unstructured approach could be damaging

to the levels of goal consensus and trust in the collaborative group in general. The discussion on ‘what the High Tech Factory is’ can become a threat to the actual realization, if the levels of trust and goal consensus are lowered. Rather than organizing more input meetings, a meeting could be organized were the current state of affairs in the development of the organization behind the High Tech Factory is presented and were is explained what the characteristics of the shared facilities will actually be.

The role of the participating companies is considerable in the realization cycle and emphasized by the created mutual dependence. A very active role can become too time-consuming for companies and may lead to conflicts of interest, the amplification of competition, or undesired behavior of companies. The institutional entrepreneur should be careful with assigning these companies large roles in the organization that is being developed. On the other hand, the institutional entrepreneur should stay far from ignoring these prominent companies. An intermediate solution is presented by the concept of the network administrative organization that is discussed in the theoretical framework, an advisory board through which the participating companies can give advice. Because the companies are regarded as customers no active selection is necessary. As long as the High Tech Factory invests in the promotion and organization of the shared production facilities, companies will apply when they are interested in joining the facilities. These companies can decide for themselves whether they are interested to share their production facilities with other (spin-off) companies. A contractual agreement that is signed upon entry can be advantageous in, for example, preventing issues concerning IP, management of the use of shared facilities and management of the maximum amount of space one company can rent.

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10 Appendices

10.1 Company descriptions

10.1.1 Demcon BV

Demcon provides R&D as well as prototyping and small scale production for high tech mechatronic problems in markets such as semicon, medical, life sciences en defense.

Demcon only participates in project 9, where Demcon is project leader. In this project a fabrication oriented design is investigated for a MEMS-based micro-coriolis flow sensor. This project is one of the projects Demcon is working on and it has no particular close relation to the core of their business. The partners in this project are university groups for research purposes and Bronkhorst for the customer specifications.

Phase 1

According to Demcon the High Tech Factory is now a collection of projects. The project leader at Demcon has no contact whatsoever with the management of Phase 1. Within Demcon the PCC is regarded as a financial meeting, which is regretted by Rini Zwikker (project leader Demcon):

> *"[On the PCC] our financial executive is representing us there, not the technological. I have asked whether I should attend those meetings, 'no, those are for project progress' was the answer. … [On possible interactions] it may very well be the case that others are developing a 'HTF production technology' which we are in need of."*

High Tech Factory in the Future

Demcon sees the future of the High Tech Factory in a single building. In such a building meetings can be held and cross fertilization can be facilitated among different companies. In MST the production technology is limiting your abilities, therefore you need to be at the very front. A physical entity is crucial in such a setting. Rini Zwikker on the role of the High Tech Factory for Demcon:

> *"We develop something that could be built in a High Tech Factory, it is a flow sensor that can measure very small flows. With this project we are creating jobs in this region. Everyone is doing mechatronics these days, but mechatronics on MST scale, that's the future we as Demcon should focus on. We are trying to stay at the front and the High Tech Factory plays an important part in this development."*

Demcon would like to add a program officer to the organization of the High Tech Factory for content related involvement, Rini Zwikker explains:

"I do think that someone with vision should be in a leading position, someone like Dave Blank. In the organization of the High Tech Factory there should always be someone looking ahead, a governing role making sure that all that is necessary is taken care of."

Rini Zwikker gives his vision on cooperation and participation of other companies:

"Talking about selection is tricky. However I would like to say that you shouldn't have participants who do not contribute, you need to accept only companies with potential. There are many of these companies and such entrepreneurs, like Jeroen Wissink, who are doing new things. … Competition will be present, and may prevent mutual development: it is doing so already. We just have to find a way to handle it. In MicroNed and probably it is the same in the High Tech Factory, that there are agreements on non-disclosure, reciprocal knowledge investment, background knowledge, and so on, which is all carefully agreed on. It is just a matter of coming to an agreement: When one partner wants commercialize this knowledge, that good agreements are made with the other partner. When good agreements are in place, both parties will profit. At some point one company will give something to the other, and some other time it will be the other way around. I think that it should be a single general agreement the High Tech Factory in which all these issues are handled. When such an agreement is in effect, cross-fertilization is ensured, all parties with their own specialties, and new products will be created."

10.1.2 IMS BV

IMS develops and builds production and assembly equipment, and is specialized in the assembly of many small mechanical parts. IMS envisions an extension of their activities into the area of micro- and nanotechnology products, and for this reason IMS is participating in the High Tech Factory, Ronald Haveman explains:

"We see that IMS can bring added value in making products producible. Spin-offs often have some ideas how their products should work and how they can improve their products. However, they don't take into account how such a product is to be constructed later on, and that's the part where we come in, where we halve knowledge and skills. We make from a functional product and product that is also well producible."

IMS is participating in three projects. In Project 1 and 4 IMS is putting in their knowledge of automation and production equipment for product focused companies, a way to show what IMS can and new create customer groups. In project 10 IMS is project leader, in this project a product and its production process is being developed together with LioniX. All three projects have a relation to one of the areas of company its core business. However, IMS is acting more as a supplier rather than a co-developer in the projects.

Phase 1

IMS regards the current setting as a set of projects by product focused companies, who are developing products and their production processes. The companies who are participating in the High Tech

Factory are for IMS representing a set of customers. Ronald Haveman explains it is difficult to grasp the extent of the Phase 1 project:

> *"I find it difficult, and that goes for the other project as well, to grasp the scope of the project. I did have a couple conversations with Micronit, and also for the other project, of which some where also with the spokesman. I also read the description in the proposal for the High Tech Factory. You learn some things. I do have the idea that the urgency at this moment is not really high."*

The vision on management is focused on contact about changes and reports, nothing more. Peter X (function?) elaborates on the moments of contact and the importance of the PCC:

> *"An example, we are facing a shift in the costs and we have had contact with the management about this; how to handle it and how to communicate. This is something going on at this moment. You contact them when there is something going on. Additionally you do have the standard reports.[Regarding the PCC] it is some feedback on the taken actions, also the actions of others. You are working on your own project and in the PCC you are presented an overview of the entire project. It is very good that also agreements are reached on the plans for the future; the directions and regulations."*

High Tech Factory in the Future

Ronald Haveman doesn't have a vision what the High Tech Factory should become, regarding its role for IMS he explains:

> *"It isn't that important for us, it is more a way to present ourselves, but we can do so in other ways as well. We don't need the High Tech Factory to make our products. That's the difference as many of the other companies need the High Tech Factory to be able to produce their product, and we most certainly don't. As a matter of fact our stake isn't that big."*

The cooperation and participation of other companies within the High Tech Factory Renald Haveman has some advice:

> *"The High Tech Factory will make sure that the equipment is arranged in such a way that companies can do their own things, without others walking in on them. On the other hand could it be that, when they are working in different fields, they will learn a lot from each other. A role for the management could present itself when two companies are working on the same technology, the management should either facilitate in the separation or in the merging of these activities. Or, when different projects have need for the same facilities, the High Tech Factory could offer a binding role."*

10.1.3 Medimate

Medimate produces disposable Lab-on-a-Chip for testing at the point of care by the patients themselves. Scaling up to mass production is essential as the intended market requires millions of products a year and full automated production is required. Packaging and assembly is regarded as the bottleneck in commercialization of these MST products.

Phase 1

Medimate is participating in two projects, 1 and 2. In project 2 Medimate is project leader, the project is focused in the transition from a non-automated through semi-automated to a full-automated production line. Project 2 concerns the primary activities of Medimate as it is the development of their own production process. In project 1 Medimate validates the processes of Micronit, Steven Staal explains:

> *"We participate to examine the chips they supply, its simply a part of our process. They produce the chips and we check whether we are able to use them."*

The partners in project 2 are Micronit and Enabling M3. Enabling M3 brings in a set of knowledge of controlling production processes, which is of great value when scaling up. Micronit is included as the most important supplier:

> *"You aren't only working on your own design, you are so close in the process that you need to look together with Micronit what is done in the production process: How did you make the chips? What are the tolerances on the production process? What are the consequences of these tolerances for us? The cooperation with them in this project is very logical and together we try to successfully produce our chips."*

High Tech Factory Phase 1 is little more than the projects from the perspective of Medimate. About the participation in Phase 1 and the role of the management:

> *"We had the choice not to participate. But it fitted that well with our business that it would have been an awful mistake not to participate. Just take a look at the project and how much we are using it and the extent of the financial advantages, for us it's very convenient. … Concerning the content we don't consult with Miriam and Monique, they are only there for the organization and communication to the subsidy institutions. We have brieved them when we foresaw that our changes in the production design would cause delays in our project."*

High Tech Factory in the Future

Medimate envisions shared facilities as the future of the High Tech Factory. A cleanroom you can enter as a company in the startup phase, with an hourly rate and a collection of equipment one can use,

comparable to the current setting. Additionally, companies should be able to rent a part of the cleanroom themselves, their own location. The cleanroom itself should be managed by the High Tech Factory, it should be running smoothly. What companies do in with their space is up to them, it will dependent on the phase they are in.

The High Tech Factory is only moderately important for Medimate, which is based on their primary supplier. For Medimate brings the High Tech Factory only a small advantage:

> *"We have a problem if Micronit has a problem, in that way the development of the High Tech Factory brings a risk for us. The High Tech Factory has a large impact on Micronit. We only need a small amount of cleanroom space: 20 – 40 m2, one could just create this somewhere, we are flexible. We could go somewhere else, like we are doing now, we are not part of the High Tech Factory in terms of location and we are having our own cleanroom. This is working fine, but we want to professionalize. When you can enter the High Tech Factory your company is covered for these issues and you can focus on the stuff you want to work on: your product and its development."*

Companies will leave when they are doing well, no company should have the intention to stay. Medimate will stick around Micronit for the time being. Regarding the management thinks Medimate everything should be kept simple; High Tech Factory rents space to companies, companies pay. Medimate is a little skeptic on the shared facilities, when one company cannot justify an investment chances are multiple companies won't be able to do so either, as it is just as easy to mail your samples for measurements. A common space with basic microscopes would be of added value.

10.1.4 Medspray

Medspray develops spraynozzles for various applications and integrates them in usable devices. For Medspray is important to have a supplier for high volumes of the glass and silicon parts. The integration with the rest of the product is of crucial importance. Methods for mass production are under study and being developed are chip assembly technologies.

Phase 1

Medspray participates as a partner in projects 1 and 5, and is project leader of project 4. In project 1 Medspray delivers user input for Micronit. In project 5 Medspray acts as a supplier of technology for Nanomi. Project 4, where Medspray is project leader, concerns the development of production technology for Medspray's core technology. The relation between the project and the company's core business is high. In this project IMS is included to help with the creation of the production equipment, Micronit is included as supplier, and Ostendum and Nanomi are included to give feedback on Medspray technology. Jeroen Wissink, managing director, elaborates on his project:

"The topic is entirely our work, it's the only thing we do and we have a very clear rule at Medspray: When we do a subsidy project, it is for activities that are 100% in line with our own research and nothing else. If it isn't the case, it's nice to get the subsidy, but it is only distracting you. It is important to keep your focus clear; I would never have allowed it if we were to do things that aren't advantageous for us. Well, there are those interactions with other companies; it's not particularly useful to us. Indirectly does it further develop your technology, you learn from it."

Jeroen Wissink thinks it is very important to share your technology with others in order to advance it, the High Tech Factory facilitates in this process:

"Technology is a set of knowledge and skills to make a product industrially. A product is something one uses and can be bought, which a user pays for using. Technology has thus to do with making a product, how to make it for the right price with the right quality. Technology is not developed in a single day; it's an entire set of gathered knowledge and skills. Skills are thoughts on how to do things, in the end a machine will take over your skills in making the product. Knowledge is about the challenges that are still present, to solve these. When you take a step in the development process, knowledge is created. There are many questions to ask, for example about what is the right temperature. You need answers to all these questions; otherwise you won't be able to make a million of your products. To get solutions to these questions one can use their own products, but you can also do it with products of others. That is what is done in the High Tech Factory, which is making the plan even better. Often you have solved your own questions, but others will have some relevant ones as well, so it is very good to share your technology with others."

Medspray considers Phase 1 to be projects for the partners and development of High Tech Factory for management. Regarding this management Jeroen Wissink explains:

"I am not bothered by it, which is a good sign. From my point of view they had a very important role in the creation of this project, truly a crucial role. I am talking about the creation of the proposal, and checking if everything is correct. Then, when it is submitted with the province, it has to be lobbied for, which is important again. If you don't have a strong party like Miriam, you won't make it."

The PCC meetings are formal get-togethers; if you need something you just take the phone. At the PCC meetings projects are presented, that's enough, at the end you will know what has happened. Whether this mutual knowing is important:

"Utterly unimportant, I am just interested from a personal point of view. The project is too large to really do something with it. I do think that in the bigger plan, the realization of the High Tech Factory, it is important to know what parties are participating."

Medspray has a considerable background in the history of the High Tech Factory and its predecessor and working in the network of companies in this region.

"We, here at Medspray, started with a predecessor of this project. That project was called Pilot Production Study, for us it was about realization of the nozzles. This Pilot Production study was a project to investigate how we could produce the Medspray product, the spray nozzles. … Kees Eijkel had supervised and guided the Pilot Production project and showed commitment to it. In any case, the ultimate goal, also of MESA, is to make products and to keep the production. We are really pleased by this because we don't want to produce anywhere else."

"I have been doing developmental work for almost 15 years, only in this area. I used to think that formal cooperations were important to companies, but I don't think that anymore at all: It is a matter of knowing the right people. When you are then in the position to make formal arrangements it has to be done as well, but you need to know where the knowledge is first. Some people are acting very complicated about knowledge, they try to keep it internally all the time, but that's not my way. I don't cooperate with this kind of people."

High Tech Factory in the Future

The High Tech Factory should become more than a building, but it should be embodied in a building. Medspray invested their most important technology in the High Tech Factory, it's very important. If it were up to Medspray:

"We are going to put our assembling machine somewhere in that cleanroom. There will be some people walking around doing nothing else then inserting plastic on one side and wafers on the other. The process will be assembling, checking, packaging and then sending it away. … We will also have a small lab where we can do some research and to do some tests."

Regarding the management Medspray would like to keep it simple:

"People have thought about it a lot and very wise words are declared about it. Ultimately it will be something you just need to work out operationally. This means that when there is a conflict, technical or organization, you find a solution. When processes strengthen each other, then that's the case, it is that simple."

Medspray has committed itself to the realization of the High Tech Factory and would like to grow out:

"I do feel that when you chose to start here with a product and pilot production, then you need to have the objective to end up here as well. It is my vision that in the end, when Medspray has grown to 100 million nozzles ten years from now, we won't fit anymore. I have long built a factory on my own, but I will still be a part of the High Tech Factory,"

On competition Jeroen Wissink was clear, it shouldn't be present, nor should it be a problem. The companies participating need to bundle their forces and focus on the rest of the world.

"I think that for a concept such as the High Tech Factory it is important that everyone trusts each other, you are exchanging knowledge after all. It should be a condition for the High Tech Factory to have strong relationship and competing activities are not part of this. I don't have any idea how this should be conceptualized, but it should be a starting point. I think that companies who think they are competing should make an agreement about this as well, or you need to choose for not going in the High Tech Factory together. Anyway, Medspray isn't bothered by this. When someone else is going to make nozzles, I am going down there and I'll be very angry. A real danger is, however, that an external competitor will be trying to get to our knowledge through other High Tech Factory participants."

10.1.5 MESA+ Cleanroom

MESA+ cleanroom is obviously not a participating company, but it does operate of of the projects. In project 6, additional equipment for the cleanroom is being developed. The partners are Phoenix and LioniX. Phoenix has the abilities to make the equipment workable and LioniX is one of the main users of the cleanroom at this moment, both were logical choices.

Phase 1

Gerard Roelofs, manager of the MESA+ cleanroom, communicates with the management of the HTF in the hallways. The PCC meetings are very useful to regain your focus, according to Gerard Roelofs, take another look at the activities required, such as reports and actions, as well as the developments of others:

"It is a great opportunity to see how other projects are doing, what progress they are making. I consider this to be very pleasant. With a couple teams we have less contact because they are located elsewhere."

High Tech Factory in the Future

Gerard Roelofs has a clear vision on what the HTF should become:

"In an ideal situation we would have a building here, were there are just neat technological facilities, both cleanroom and others. In this building one could do production. This facility should have a great and standing image. The facilities should be maintained well. Companies should have the opportunity to have their own sites as well as generally available facilities. It would be the best if the entire structure would be open. It is a shame that at a certain moment great things are being done, for example at Micronit, but that these activities cannot be shared with the whole group. Unfortunately this doesn't happen as they make deals with their customers."

A very important point for the future development of the HTF is related to communication. Gerard Roelofs:

"The buildings and so on do have some charisma, but it isn't clear what is happening inside. That's a very important item, and I think there lays a very important role in communication. I give may tours

around the MESA+ cleanroom from my position, to high schools and parents. After half an hour there are always some of them how say 'I didn't know these things were all happening here'. All these companies are working on amazing stuff, if we are able to show these examples, we should do something. The coordinating role is thus very important, the charisma and communication to the outside."

10.1.6 Micronit

Micronit supplies microfluidic chips on demand to companies and research groups around the world. Additionally, Micronit has several own products, such as micro-mixers.

Phase 1

Micronit participates in several projects. In project 1 of the High Tech Factory is Micronit project leader. The project encompasses the further development of primary processes of Micronit. In project 2, where Medimate is project leader, Micronit is participating as primary supplier. Micronit also participates in project 4 as a supplier. Project 1's content is closely related to the core of Micronit's activities. Micha Mulder, CEO, explains:

"The project has direct influence on our strategy, in the project the processes of production for our largest customer are scaled up and made more efficient. We have a bunch of customers who 'don't know it yet' when they require large scale production, we could get a high demand at once. We would like to be prepared and that's what we are doing in this project. We can already see its effects."

The partners in project 1 have a relatively small share and they were mostly incorporated based on existing cooperations. With one partner a less close relation was kept and this relationship is growing, so next to facilitation of an existing cooperation, something extra is being started. Micronit regards the current state of the High Tech Factory as being the subsidy project, which occupies a central role in the company. Micronit envisions that the results from their project will directly and indirectly be advantageous for other participants in the High Tech Factory. Micronit's vision on management in Phase 1 is focused on the efforts prior to the awarding of the subsidy and the preparations for later phases. Marko Blom, R&D manager, is very laudative on the preparatory activities:

"The spokesman has been extremely important in the setup of the projects. The whole project is gigantically important for microtechnology in Twente, so there has Miriam delivered very good work. How this is all been put together, wonderful, nothing but praise."

Current activities of the High Tech Factory management are of less importance and the involvement concerning the content should be kept to the minimum. Regarding the PCC is Micronit glad that there is no content related guidance as the project is very diverse and competing companies are involved. The only thing others outside project 1 should be concerned with is that it stays within the boundaries of the proposal. Marko Blom does see the PCC as an important communication method:

"Communication about the current situation and also especially about the future is in my opinion the most important role of the PCC: How are we going to continue and how are we doing right now? Problems may arise, for example, when partners keep using less budget than planned are delaying the entire project."

High Tech Factory in the Future

Within Micronit Micha Mulder and Marko Blom have converging views on the High Tech Factory. Micha Mulder envisions a single building, with shared facilities and a place for small companies to grow. In Marko Blom's vision:

"I don't see a single High Tech Factory, the processes are too different, competing companies participate, I don't believe something shared will be created. I do see several factories with partial and joint overlap. Something shared could be a machine, on a participants own location. It isn't necessarily all separated, although that may be more practical, but I don't see a single factory were all partners are located. The whole of multiple parts is also a High Tech Factory: A collection bundled processes, some processes by one party and other processes by another party, as a whole still presented as being the High Tech Factory to the outside. A customer can go to the High Tech Factory and internally there will always be a party who can offer the right process."

The High Tech Factory will be very important for Micronit, who is ready to move in as soon as possible. Micronit has an urgent need for more space in the cleanroom, which can be created through additional cleanroom space or by moving equipment outside the cleanroom. The operational management is very important for Micronit, making sure that all facilities are running smoothly. Regarding selection and strategic management Marko Blom would prefer the companies staying in charge of coordination and is anxious of the High Tech Factory being a commercial and administrative entity in itself. Micha Mulder thinks that only serious companies should be considered which will be self selective as serious rates for cleanrooms are present. On competition and exist strategies Micha Mulder points out:

"Competition over equipment will not be a problem, when something is important to a company they will want it for themselves. Companies making the same things are already present, which is only healthy. Another form of competition could be related to specific locations being rented in the cleanroom, we would like to rent space next to our current location, it would be great if that can be taken care of. Every entrepreneur should have the dream to have his own building with his own cleanroom, so companies will move out themselves when they become too big. Maybe it should be in the contract you cannot rent more than x% of the cleanroom."

10.1.7 Nanomi BV

Nanomi develops membrane emulsification processes and equipment for production of high quality micro- and nanospheres and particles. Nanomi supplies various clients, mostly multinationals. Nanomi is focusing on the production and sales of spheres for the life sciences market.

Nanomi works on two projects: In project 4 Nanomi performs a feasibility study of Medspray technology for Nanomi applications. In project 5, Nanomi's own development project with a collaboration component with Medspray and Encapson, the core business of Nanomi is further being developed. Nanomi would have also liked to participate with another company outside the region, but was unable to do so due to the conditions of the subsidy.

Phase 1

The role of project 5 in company is considerable, as it has quite a financial importance. Gert Veldhuis, managing director of Nanomi, has a clear view on what the High Tech Factory is at the moment:

> *"The High Tech Factory is loose sand; it is a collection of separate projects under a shared denominator. This is our own project and we have no overlap with others, it was set up this way."*

Nanomi's vision on management consists of facilitation in administrative and financial aspects of the subsidy project, and taking the lead in developing further phases. Nanomi also emphasizes the PR aspect of the HTF the management should be, and is, taking care of. Communication with the management is related to these aspects and in general not related to the contents of the project. The PCC has a function in keeping partners up to date and in touch with the others, Gert Veldhuis explains:

> *"It is a very good method to keep up to date on the activities of others, and its a place for networking. It also creates a feeling of collectiveness. To go into the contents of the projects is not necessary in this context, but it is interesting. The meetings are also important for the tuning of the project and its successors. For reports and expense accounts it is a moment to discuss the planning and feedback on earlier cases."*

High Tech Factory in the Future

Nanomi has one particular condition which needs to be fulfilled before joining the ultimate High Tech Factory, a chemical laboratory. Shared cleanroom infrastructure, such as the pumps and water supply, is at the very core of sharing a cleanroom. Every company should definitely have its own section; customers of Nanomi require confidentiality which can never be offered if all cleanroom space is shared. A common collection of basic facilities would be a great addition, including microscopes, glassware etc. Technical, or operational, management is most important, and the common space should be managed. Selection is for later stages, first priority is getting all space occupied. When there

is enough demand for participation the management can go look for synergy. Nanomi isn't sure yet if and how the future's of the High Tech Factory and Nanomi will meet:

> *"We are already doing this and we need to be sure that if the High Tech Factory is not working for us we will have other options. We are aware of the risks and advantages. There are other ways to reach our goals. Remember our need for a chemical laboratory. The importance of the High Tech Factory for Nanomi will depend on its future form. Synergy among the participants would be very good. Nanomi may then be one of the companies least fitting, we don't make chips. Upon selection we might be one of the first dropouts, as we are using other technologies."*

10.1.8 Ostendum

Ostendum is a company that has been founded at the end of March 2008 and before that it was a project under the UT International Ventures umbrella. Ostendum is in Phase 1 developing a fit-for-purpose low cost lab-on-a-chip system from its early prototype.

Phase 1

Ostendum is project leader in project 3 and participates as a partner in project 4. In project 4 a feasibility study of using Medspray technique for packaging of silicon chip is executed. In project 3 the core technology of Ostendum is further developed to make the concept ready for production. The partners in this project are UT International Ventures, which previously supervised Ostendum as one of its projects and is now responsible for the project management, and the other partner is the UT's BPE research group.

Paul Nederkoorn (UT International Ventures) reflects on Phase 1 of the High Tech Factory as an important additional way of financing a project, which is precisely what is important for Ostendum:

> *"I can tell a long story about how great it is to have all these companies cooperating and the involvement of the University Twente. But when you consider why the High Tech Factory is truly important and successful you need to understand it is a smart way of attracting additional funding. … For Ostendum it has been important that all the individual proposals were combined within the High Tech Factory, whereas a collective proposal stands a higher chance of getting approved. Next to preparing and organizing the initiative, Miriam has done a great job in facilitating the necessary reports and guiding the companies through this."*

A further comment Paul Nederkoorn wished to make was that the session with the accountants was a waste of time. Not because it was a bad idea to organize such a session. On the contrary, it would have been very valuable if the accountants would have been prepared. Paul Nederkoorn was not impressed by the disappointing performance of the invited accountants.

High Tech Factory in the Future

In the future Ostendum will likely make use of the High Tech Factory, although the particular contents of such a commitment is not yet clear. What the organization of the High Tech Factory in the future should think about is how to handle issues with IP and production capacity:

> *"For sure we want to, we are already talking a lot about Phase 2, the equipment fund, we would like to use that. For later phases it is too early to say anything … The production capacity and IP are topics where the organization needs to look into very carefully, but for me that's all stuff for the future."*

10.1.9 SmartTip BV

SmartTip specializes is the development, fabrication and sales of probes. These probes are very small needles and / or electrodes which are used to characterize structures on the nanoscale.

SmartTip participates in one project, 7, in which it is project leader. In this project SmartTip is developing a tool, which they can use for their production. On the other hand, SmartTip is learning a lot from this project about making tools in general. It is very close the core business of SmartTip. SmartTip makes probes, and will continue doing so, for this, they need a tester. As an advantageous side effect is SmartTip setting up a second business based on this project. Daan Bijl, director of SmartTip, explains how the project was formed and how the partners were chosen:

> *"You hear what they are trying to do, and so you shape what you want to do, to have it aligned with what the High Tech Factory wants to do. … [Regarding the partners] It was clear that SmartTip could benefit from their specific experience and knowledge. Even when this project didn't exist we would have cooperated with the TST group."*

Phase 1

Daan Bijl elaborates on what the High Tech Factory is:

> *"It depends, the HTF has many faces: It has the face of this project, in that sense it's a very useful project I can develop technology that is essential for SmartTip. HTF is also MTF providing my space here, in that respect it's a very helpful organization to house companies very close to the facilities."*

The role in the company is considerable; it has a central position in the daily activities of SmartTip. Daan Bijl (director):

> *"It fits me well and it facilities for production, to develop special infrastructure for production: it does match the stage that my company is in. We are gearing up, we are increasing production. So in that way it fitted really well."*

SmartTip considers the role of the management regarding Phase 1 to be limited to the project meetings. The PCC is there to keep the companies focused as far as they are not focused. SmartTip articulates on the importance of news and practical information, what is required in terms of subsidy reports etc. SmartTip is also fond of the exchange, as it's nice to see what other people are doing. At least they make the meeting less boring. On the overall development it is more important. Daan Bijl:

"For the overall project it's crucial. The whole motivation, the whole move to set this project up came from Miriam. For us as a company they take away quite a bit of the pain of the communication with Economic Affairs and the Province. For the other project, the 2006 project, I did that all myself. So I can see the difference. … As far as the joint effort, you can say that's the publicity to the outside world. I guess it's relevant from a political point of view, the province and Economic Affairs. But for me as a company, for my specific project, it's of less importance, of less interest."

High Tech Factory in the Future

SmartTip considers itself as one of the companies benefitting from this process, but not driving it. Daan Bijl:

"In the future HTF being the facilities here, but maybe also close to the other laboratory, it will probably play a role in a function of housing my company, office space and maybe some laboratory space. HTF, being the cleanroom facilities being redeveloped and the infrastructure, it's difficult to say what it exactly goals is going to be for SmartTip, but at this time I can imagine that by that time I could have some of my quality control or the last phase of production somewhere there. … It would be nice if it really worked out: if it would be, apart from office space, a facility that has shared infrastructure. The question remains whether I would need it. But if they really do well, they will have something like the MESA+ cleanroom facility now. But then in a different setup, a different infrastructure for companies set up. It would be great if it were open for me when I need it. … If you envision a shared fab, what I see happening now is that still a lot companies have their own stuff right now. Realistically speaking it is not going to be a shared fab. It's going to be shared space were companies are able to use each other's production lines. I think that's what's going to happen. Because, some of the production lines, the companies that have the largest interests in those production lines will want to have control over them. Already now they either own them or have control over them. So I think it's going to be a difficult task to make a completely open infrastructure."

The focus in the further development should be on operational management and solutions for exit strategies, Daan Bijl:

"I don't think you will need that much management in terms of who can participate. You would need some lower, say operational, management around the facility. But again it depends if it is a completely shared or half shared facility. You don't need a manager to judge who can use it. If companies see a possibility they will take it anyway I think. Growing out is a point of concern: Given the skills we have and the amount of money it takes to build such an infrastructure none of us is able to move ourselves. On

conflicts between partners, if there is a conflict, they have to fight it out somewhere. And maybe then it's even better when they are not in some kind of board."

10.1.10 SolMateS BV

SolMateS is a developer of innovative coatings for industrial applications, as well as a consultant on issues related to materials science in general.

In project 8, the only project in which SolMateS participates, SolMateS is project leader. In this project medical coatings and coating equipment for medical applications is being developed. The project was at the start not related to the core business of SolMateS. However, if the project is successful it will become the core business. The project is operated with TSST as partner, their supplier of coating equipment.

Phase 1

At this moment SolMateS considers the High Tech Factory to be a good initiative to bundle the forces of the university in a bigger way; by having a set of participants applying for money, in a joint big project. As SolMateS has adapted its strategy to the High Tech Factory the role in the company is large. Arjen Janssens, CEO SolMateS, presents its vision on the current management and their role in project 8 through the PCC meetings:

"Personally, I am always interested in how things go. Not only but what they have to do, but also the process of the funding, is everything ok with the declaration, is everybody spending what they should be. Or maybe people spending more money or less. What are the next steps, is there another project being initiated or not, how are the declarations seen by SenterNovem, are there issues with them or not."

High Tech Factory in the Future

SolMateS hopes to see a place where companies can easily go from prototyping to production. The role in company is considerable, Arjen Janssens:

"I think it is very important, we are dependent on this project because it is one of the biggest projects we do. It is changing our company very much, hopefully for the good. Because of this project, were we received a lot of money, we could take a high risk, which we couldn't take without the funding. We are very dependent. It is evident; it is pushing big on us."

Arjen Janssens explains his vision on the management:

"I would more look to the outside. It's hard to make yourself known to Asia, to Europe, to the Netherlands. I would say that that's a function that should be done at top level, maybe also to attract new funding from government. Making sure that the environment here is perfect for these companies, as it is not something that these companies themselves can do."

10.2 Project descriptions

10.2.1 Project 1: Towards a Lab-on-a-Chip production platform

Project leader: Micronit

Partners: Medimate, Medspray, IMS , UT: MESA+

The cooperation in project 1 is considered to be quite dynamic according to Marko Blom:

> *"These are dynamic collaborations you are working with. We are located close to one another and the directors know each other well. They will have thought about an experiment and said 'it should be funny to see whether that would work'".*

The communication in the project and the intensity of cooperative activities is strongly dependent on the focus at the time. There is no regularity, when Micronit is making a batch of chips for Medimate for example, then communication will be tighter. Concerning the absence of conflicts Marko Blom explained:

> *"We all know each other well, it's a small world. Everything and everyone is going along fine."*

The interaction with other projects is limited to projects 2 and 4.

Timeline

Date (m/y)	Incident	Source
Feb-07	Communication Micha Mulder & Ronny van 't Oever with Miriam Luizink about participating in High Tech Factory	Interview M. Blom
Apr-07	Micha Mulder & Ronny van 't Oever creation of project	Interview M. Blom
May-07	Micha Mulder & Ronny van 't Oever participation in other projects, based on existing alliances	Interview M. Blom
Jun-07	Contact IMS about starting partnerships	Interview M. Blom
Oct-07	Extremely important steps of Miriam Luizink to get the subsidy	Interview M. Blom
Oct-07	Defining open planning for project, to keep flexibility in this large project	Interview M. Blom
Nov-07	Official Start of Phase 1	Project proposal
Apr-08	Subsidies are granted and have become available	Interim Report, general part
Apr-08	Kick-off meeting	Minutes of Kick-off meeting 11 April
May-08	Optimalization lithography required much more effort than previously anticipated	Interview M. Blom
Jun-08	From 5 to 6 inch substrates, large challenge, success was important for project	Interview M. Blom
Jul-08	Informal meeting directors Micronit & Medspray about additional joint activities, induced by neighboring locations	Interview M. Blom
Aug-08	Supplier couldn't provide promised services for quality control (trajectory 3), discussions followed	Interview M. Blom
Sep-08	Parts of trajectory 3 are stopped, other methods have gotten full attention	Interview M. Blom
Oct-08	Informal contact with Subsidy supplier	Interview M. Blom
Nov-08	PCC Meeting Discussion about subsidy contact	Minutes of PCC meeting 27 November
Dec-08	IMS contacts to start the cooperation	Interview M. Blom
Feb-09	Deadline Interim Report	Minutes of PCC meeting 27 November
Apr-09	PCC Meeting	Observation

10.2.2 Project 2: Automatic production line disposable Lab-on-a-Chip

Project leader: Medimate

Partners: Micronit, EnablingM3

The cooperation in project 2 is dynamic, the participating companies work together when needed, now is a busy period, and therefore they have more activities in their project. Communication within the project is found in the 'hallways', the partners call and e-mail, regular meetings are never planned. Conflicts and problems haven't presented themselves in project 2. However, the partners do keep each other sharp as Steven Staal explained:

> *"A continuing negotiation with Micronit, you could say so, otherwise we would simply pay too much."*

Interaction with other projects isn't present, Steven Staal:

> *"We are busy with our company and our project; I don't care about the other projects. Those are their projects and I have nothing to do with not, nor with the content nor on the business side. It is nice to be informed, but nothing more."*

The communication and interaction with the Phase 1 management is also kept minimal according to Steven Staal:

> *"They receive our report. Then they check whether it is the right format and complete. Once I forgot to sign one form, it will then be returned for the signature."*

Timeline

Date	Incident	Source
Apr-07	Asked by Miriam for participation in the High Tech Factory	Interview S. Staal
May-07	Decision is made to participate. Cooperation with Micronit and EnablingM3 was already established, the choice to include them as partners was a logical one.	Interview S. Staal
Jun-07	IMS was considered for participation, but rejected. The product and therefore the production development weren't considered ready for incorporation of a partner for the development of production machinery.	Interview S. Staal
Nov-07	Official Start of Phase 1	Project proposal
Jan-08	Hiring of additional employee for production development for this project	Interview S. Staal
Jan-08	Product deficiencies came to light	Interview S. Staal
Jan-08	steps for product redesign were initiated	Interview S. Staal
Apr-08	Subsidies are granted and have become available	Interim Report, general part
Apr-08	Kick-off meeting	Minutes of Kick-off meeting 11 April
May-08	Kick-off Meeting Project 2: Going through the plans and activities	Minutes of Kick-off meeting project 2
Jul-08	Indications that product redesign was successful	Interview S. Staal
Nov-08	PCC Meeting	Minutes of PCC meeting 27 November
Dec-08	Production works, production process development can launch entirely	Interview S. Staal
Jan-09	Purchase of logistical software package	Interview S. Staal
Feb-09	Deadline Interim Report	Minutes of PCC meeting

		27 November
Apr-09	PCC Meeting	Observation

10.2.3 Project 3: Young Interference chip for detection of micro-organisms

Project leader: Ostendum

Partners: Ostendum R&D, UT International Ventures and UT: BPE

Timeline

Date	Incident	Source
Apr-07	Ostendum speaks informally Miriam Luizink	Interview P. Nederkoorn
May-07	Ostendum decides to participate	Interview P. Nederkoorn
Nov-07	Official Start of Phase 1	Project proposal
Jan-08	Delay as money is required	Interim Report, project 3 part
Apr-08	Official start	Minutes of Kick-off meeting 11 April
Apr-08	Kick-off meeting	Minutes of Kick-off meeting 11 April
Aug-08	Autoalignment is tested in a temporary set-up	Interim Report, project 3 part
Sep-08	Test structures used to test the wave-guides	Interim Report, project 3 part
Sep-08	Third phase is started	Interim Report, project 3 part
Oct-08	A mold is designed for the PDMS	Interim Report, project 3 part
Nov-08	PCC Meeting	Minutes of PCC meeting 27 November
Dec-08	Accountants meeting	Interview P. Nederkoorn
Jan-09	Selection of antibodies and precoating of chips	Interim Report, project 3 part
Feb-09	Deadline Interim Report	Minutes of PCC meeting 27 November
Apr-09	PCC Meeting	Observation

10.2.4 Project 4: Spray nozzle assemblage

Project leader: Medspray

Partners: Nanomi, Micronit, IMS, UTIV

Cooperation in project 4 was based on rigid objectives and the methods to reach these goals were adapted during the project. During project 4 the core idea changed to something IMS had more knowledge about, but the cooperation stayed the same as Jeroen Wissink explained:

> *"No, we had made the agreement that we would have the responsibility for the process and they for the automation. That agreement holds. We agreed that Medspray will get a setup for the new technique. Then we will go through the entire process with the new technique. We are going to build up all the knowledge again."*

The communication in the project considered mostly of 1 on 1, 1 on 2 or 1 on 3 meetings, there have been many such of small meetings. There has also been a project kick-off with all partners, and occasionally Medspray has a meeting with all participants of project 4. Conflicts and problems have been avoided in the hierarchical setup of the project. Changes were dictated to the partners, both to the

supplying IMS and Micronit, as well as the customer side clients Nanomi and Ostendum. Jeroen Wissink explains this based on the example of the changed core idea:

> *"Well yes, it could have considerable impact on them as well, but we have no decision strategy which includes them. We have done this on purpose; it would be very unfavorable for Medspray if a partner could veto a decision, resulting in a technological problem for Medspray. It is our technology, and the interactions are derivatives, not the other way around. Of course do we keep it in mind, but it didn't matter that much to them."*

Within project 4 the relation with Micronit was changed. Medspray could have removed them from their project, but decided to assign new tasks. In this new role technology is used which is developed in project 1, Micronit's project. Jeroen Wissink has a clear vision on the interaction with other projects:

> *"At the beginning I was afraid to would ballast, but ultimately it turned out not to be that way. The other projects don't have direct influence, not that I know of. At least I don't suffer from them, which is already a considerable positive result. I think the collection of these projects will bring quite some indirect results; You are cooperating with all the companies together to redevelop MESA as it is to the High Tech Factory."*

Timeline

Date	Incident	Source
Jan-07	Considerable chatting of Jeroen Wissink and Miriam Luizink about subsidies	Interview J. Wissink
Feb-07	Miriam envisions a bigger plan than Medspray	Interview J. Wissink
May-07	Miriam convinces Jeroen Wissink to cooperate in a bigger plan with other projects.	Interview J. Wissink
Jun-07	Participation IMS in the Medspray project, based on earlier cooperation	Interview J. Wissink
Jun-07	Participation Nanomi in the Medspray project, based on relations (Nanomi is spin-off Medspray)	Interview J. Wissink
Jul-07	Participation Ostendum: The director of Ostendum came by with some questions when Medspray was still located in MESA+. During the conversation both companies showed similar had similar goals and objectives.	Interview J. Wissink
Jul-07	Participation Micronit in the Medspray project, based on earlier cooperation and relationship	Interview J. Wissink
Aug-07	Conferring of Medspray with participating companies about what they could do, result: little feasibility studies.	Interview J. Wissink
Sep-07	IMS shows that Medspray process X is difficult to scale up	Interview J. Wissink
Sep-07	Start of project 4	Interview J. Wissink
Sep-07	Budget section of project proposal need to be revised	Interview J. Wissink
Sep-07	Medspray disagrees with how budgets are handled, but is convinced by Miriam and Monique	Interview J. Wissink
Nov-07	Official Start of Phase 1	Project proposal
Dec-07	Technical and commercial project managers of IMS leave the company	Interview J. Wissink
Jan-08	Ronald Haveman takes over, IMS ready again	Interview J. Wissink
Jan-08	IMS: Robert Molenaar and Kees Holijzer come into view	Interview J. Wissink
Feb-08	IMS proposes alternative to process X Medspray opposes IMS convinces Medspray	Interview J. Wissink
Feb-08	New melting method for process is chosen	Interview J. Wissink
Mar-08	Test setup is build	Interview J. Wissink
Mar-08	Crucial role of Miriam in getting the subsidy	Interview J. Wissink
Apr-08	Subsidies are granted and have become available	Interim Report, general part
Apr-08	Kick-off meeting	Minutes of Kick-off

		meeting 11 April
May-08	Medspray wants to change product → IMS needs to stop	Interview J. Wissink
May-08	New product no more glass → Micronit extra plastic part → IMS	Interview J. Wissink
Jun-08	Micronit will now also make silicon parts	Interview J. Wissink
Jul-08	IMS had designed test setup with protection screen → Medspray wants unguarded setup	Interview J. Wissink
Jul-08	Discussion between IMS and Medspray about producing unsafe setups, result: unguarded setup is designed, Medspray purchases the setup	Interview J. Wissink
Jul-08	Membranes of Nanomi break often, product is redesigned	Interview J. Wissink
Aug-08	UNeedle wants to join the club	Interview J. Wissink
Sep-08	Jeroen Wissink and Miriam Luizink drink a cup of coffee to discuss how to incorporate UNeedle	Interview J. Wissink
Sep-08	Ostendum shows delays and isn't ready for the feasibility study	Interview J. Wissink
Oct-08	Jeroen Wissink and Wilbur philosophize about UNeedle products and come up with a new idea for a Medspray product	Interview J. Wissink
Nov-08	PCC Meeting	Minutes of PCC meeting 27 November
Feb-09	Deadline Interim Report	Minutes of PCC meeting 27 November
Apr-09	PCC Meeting Medspray and IMS discuss who will purchase the laser Medspray asks whether the machine of project 6 is available for use yet, after a presentation	Observation
Apr-09	Laser for test setup is ordered	Interview J. Wissink

10.2.5 Project 5: Process installation for functional life-science micro- en nanospheres

Project leader: Nanomi

Partners: Medspray, Encapson

The dependence of Nanomi on the other partners is intentionally low, because Nanomi wants to be in control. Within the project the two partners next to Nanomi operate independent from eachother, Gert Veldhuis explains:

> *"Nanomi has by far the largest share: The entire project is 600k€ of which Nanomi takes 500k. Nanomi is in control. There is no cooperation between Medspray and Encapson, those are different trajectories. This is done on purpose, as it isn't relevant. These two parties and their tasks in the project have nothing to do with each other."*

Concerning the communication in the project, Gert Veldhuis said:

> *"When we are working with the materials of a partner the cooperation is closer and we have more communication. This is strongly dependent on when we perform what activities."*

> *"There are no fixed meetings planned, we meet when it is necessary. We do have meetings related to daily business when we need to do something or in case of problems. Based on these meetings actions are*

formulated, these actions are taken care of in the next weeks, it's how we work. We don't really make minutes, the actions are registered, but that's just the way we do it."

"[Regarding problems and mistakes] we immediately look forward, nobody is makingmistakes on purpose. We are immediately looking for directions to solve the problem and how we are learning from it."

Project 5 is suffering little from conflicts according to Gert Veldhuis:

"The discussion are not so bad, there are heavy discussion concerning the content though, for example regarding how the physics are in particular cases. These heavy discussions are actually of high added value and much is learnt from it. There have been no collisions among the partners. In other projects outside the High Tech Factory I have had conflicts. In this case there is just a very good personality match, which is very important to me. In other projects it has been different."

There is little interest from Nanomi in the other projects, except for project 4, and there have been no significant issues with the management of the High Tech Factory. Gert Veldhuis:

"There has been one discussion between Nanomi and the High Tech Factory management. I thought they were paying too late. I called them asking where my money was. It didn't get out of hand, we talked about it, nothing special."

Timeline

Date	Incident	Source
Mar-07	Nanomi has a project for which it wants funding	Interview G. Veldhuis
Apr-07	Nanomi contacts Oost NV about PIDON and is directed to Miriam Luizink	Interview G. Veldhuis
May-07	Nanomi calls Miriam Luizink and joins High Tech Factory	Interview G. Veldhuis
May-07	Medspray is called and says yes immediately	Interview G. Veldhuis
Jun-07	Feedback of Miriam to make project larger	Interview G. Veldhuis
Jun-07	Encapson is called, are reluctant	Interview G. Veldhuis
Jul-07	Nanomi convinces Encapson	Interview G. Veldhuis
Jul-07	Nanomi writes proposal with small input Encapson	Interview G. Veldhuis
Nov-07	Official Start of Phase 1	Project proposal
Nov-07	Kickoff meeting with Encapson	Interview G. Veldhuis
Nov-07	Kickoff phone call with Medspray	Interview G. Veldhuis
Apr-08	v Phase 1 subsidy was granted	Minutes of Kick-off meeting 11 April
Apr-08	Finish design of lab scale tool	Interim Report, project 5 part
Apr-08	Finish selection of model particles	Interim Report, project 5 part
Apr-08	Start membrane design and fabrication	Interim Report, project 5 part
Apr-08	Kick-off meeting	Minutes of Kick-off meeting 11 April
May-08	Ordering parts	Interim Report, project 5 part
Aug-08	Assembling tool	Interim Report, project 5 part
Aug-08	Process works, big success, additional investigations are started as a result	Interview G. Veldhuis
Aug-08	Polymers don't work, synthesis part is prolonged	Interim Report, project 5 part
Aug-08	Membranes are fabricated	Interim Report, project 5 part
Sep-08	Testing and problem solving	Interim Report, project 5 part
Oct-08	Finished tool design for spray-dry process (1b)	Interim Report, project 5 part
Oct-08	Delays in selection model particles for spray dry process, temporary choices are made	Interim Report, project 5 part
Nov-08	Work on capsules and particles is changed by focus on university groups in Canada and the UK.	Interview G. Veldhuis

Nov-08	Parts for spray dry tool are ordered	Interim Report, project 5 part
Nov-08	PCC Meeting	Minutes of PCC meeting 27 November
Dec-08	Making capsules and model parts encounter challenges and delays, task is prolonged	Interim Report, project 5 part
Feb-09	Challenges in spray dry process, tasks of Nanomi and Medspray prove more interrelated, activities are affected	Interview G. Veldhuis
Feb-09	Deadline Interim Report	Minutes of PCC meeting 27 November
Feb-09	Communication about payment with Monique / Miriam	Interview G. Veldhuis
Mar-09	Spray dry process is put on hold, other project part is more important	Interview G. Veldhuis
Apr-09	PCC Meeting	Observation

10.2.6 Project 6: Spray coating process for MST applications

Project leader: MESA+

Partners: LioniX, Phoenix

In project 6, lead by MESA+, the partners have considerable tasks and influences, compared to MESA+. PhoeniX is a co-developer of the technology and LioniX is one of the primary customers. The partners have monthly discussion of which minutes are made. In these meetings actions and the progress are discussed, these meetings often are highly technical in character. There have been no conflicts, not even when an employee of LioniX left and started working for MESA+.

There has been no considerable interaction with or influence from either other projects or the High Tech Factory management.

Timeline

Date	Incident	Source
May-07	Announcement by Miriam	Interview G. Roelofs
Jun-07	Discussing what additional technologies are desired	Interview G. Roelofs
Jul-07	Choice for spray coating, because it is necessary for the future	Interview G. Roelofs
Aug-07	Decision for partnering with LioniX and Phoenix	Interview G. Roelofs
Nov-07	Official Start of Phase 1	Project proposal
Jan-08	Start definition of requirements with users (LioniX & MESA+)	Interview G. Roelofs
Apr-08	Subsidies are granted and have become available	Interim Report, general part
Apr-08	Kick-off meeting Phase 1	Minutes of Kick-off meeting 11 April
May-08	Presentation by supplier of machine: additional options prove to be desired	Interview G. Roelofs
Jun-08	Completion of requirements, with a 3 month delay	Interview G. Roelofs
Jun-08	Relocation scheduled for mid 2009 is pushed back 6 months, a change in time schedule for project is the result	
Jul-08	Ordering of machine	Interview G. Roelofs
Oct-08	Delivery of machine	Interview G. Roelofs
Nov-08	PCC Meeting: Interim Report is announced, other projects present their progress	Minutes of PCC meeting 27 November
Dec-08	Micronit starts experimenting with the machine, experiments of the project are adjusted to additional users	Interview G. Roelofs
Dec-08	Employee of LioniX starts working for MESA+, LioniX has temporarily a personnel shortage, adequate solution	Interview G. Roelofs
Feb-09	Deadline Interim Report	Minutes of PCC meeting 27 November
Mar-09	Invitation for next PCC meeting by Monique: Request for information and	Observation

	documents	
Apr-09	PCC Meeting: Medspray wants to use machine as well	Observation
Apr-09	Monthly meeting of partners	Interview G. Roelofs

10.2.7 Project 7: Development of a Universal Probe Tester

Project leader: SmartTip

Partners: UT: TST

Daan Bijl explained that cooperation with the TST group was already planned:

> *"Even if this project wouldn't have existed we would have cooperated with the TST group. Now to a larger extend, now that we have the budget."*

Collaborative projects always have a dynamic character according to Daan Bijl, which subsidy institutions haven't been able to comprehend so far:

> *"Somehow in any subsidy project, they always think everything is sequential. In every project I write they want to see a timeline, a planning, they want to see milestones. I mean, real life doesn't work that way. Several parts of the projects go parallel, some turn out to be less interesting or less important, so you spent less time on them."*

Regarding the communication in the project and the conflicting commercial and academic mentalities:

> *There aren't regulated meetings, but there will be once the post doc gets there. I mean, the technician is here, so we see each other. He is here on a daily basis.*

> *"In general, in projects with university, there is additional need extra focus on commercial relevance. It depends on your level of influence. I think my level of influence in this project is pretty high. Nevertheless I mean you can force them in a certain direction, but I am not sitting with them at their desks all the time. They could be studying literature they think is related to the subject and you don't know about it. And maybe I don't want to know."*

Interaction with the other has been limited and the interest of SmartTip is explained by Daan Bijl:

> *"I have no particular interest. It's always nice to be informed. If your question is more geared towards if there is anything going on there that is going to be of use for us, then that will be the interesting part. I don't think that it's the case at the moment. But that's of course the interesting part, are there things being developed that are of use to other companies as well. At the moment I don't see anything that could be interesting for me."*

"We just had a discussion with a possible client, about mounting an AFM probe on a piece of plastic. This comes kind of pretty close to what Medspray is doing. Already before this project, but also in this project, about producing silicon and plastic and getting it together, so I see some similarities there."

Concerning the High Tech Factory management, official contact has been pretty limited, only the project meetings. The main focus of the management was administrative Daan Bijl explains:

"For us as a company they take away quite a bit of the pain of the communication with Economic Affairs and the Province. For the other project, the 2006 project, I did that all myself. So I can see the difference. In the end we still have to make our reports, and financial reports, and all that. But of course it's easy that they do that part. And of course they did a tremendous job in lobbying this proposal, before we got it. So I guess the role there is quite large."

Timeline

Date	Incident	Source
Apr-07	2007 PIDON round is announced, SmartTip gives itself little chance	Interview D. Bijl
May-07	Joint effort for PIDON with other companies	Interview D. Bijl
Jun-07	Not among the first companies, but when heard stepped in	Interview D. Bijl
Jul-07	Crucial activities of Miriam in getting the grant	Interview D. Bijl
Oct-07	Very little feedback on written proposal	Interview D. Bijl
Nov-07	Official Start of Phase 1	Project proposal
Dec-07	Informally asking whether the grant was received yet	Interview D. Bijl
Jan-08	Starting hiring people	Interview D. Bijl
Apr-08	High Tech Factory Phase 1 subsidy was granted	Interview D. Bijl
Apr-08	Start of project 7	Interview D. Bijl
Apr-08	Kick-off meeting	Minutes of Kick-off meeting 11 April
May-08	First hired people started	Interview D. Bijl
Jun-08	Project linked to video rate AFM didn't work out, pressure on the video rate AFM part of High Tech Factory project becomes less high	Interview D. Bijl
Jul-08	Temporary results are decided for phase A1 and A2, so that the project can continue	Interview D. Bijl
Sep-08	Earlier start electrical read-out	Interim Report, project 7 part
Nov-08	PCC Meeting:	Minutes of PCC meeting 27 November
Jan-09	CIPT probe testing part worked	Interview D. Bijl
Feb-09	Doing extra work on software, unsure if it can fit in the project	Interview D. Bijl
Feb-09	Deadline Interim Report	Minutes of PCC meeting 27 November
Apr-09	The delaying open post doc position may be filled soon	Interview D. Bijl
Apr-09	PCC meeting	observation

10.2.8 Project 8: MediSol: Solutions for Medical coatings

Project leader: SolMateS

Partners: TSST

Project 8 was started somewhat slowly. After deciding on participation the supplying partner TSST cooperated in setting up the project, Arjen Janssens:

"We were contacted with 'hey there is a new project going on and you should take a look at it, it's very interesting for you as well.' We were too busy to react. So I think Miriam even wrote us an email with like 'please hurry up, we are already late.' Then we started writing a proposal together with TSST: To join the group. … TSST does the hardware and we do the process and the testing of the samples itself."

The project is quite dynamic and has shifted in its main direction. The cooperation is smooth the partners see each other every day, and then they tell each other what is going on. Guus Rijnders, associate professor, is actively involved. He is one of the founders of SolMateS and director of TSST. It is all very informal. Concerning problems and discussion Arjen Janssens stated:

"There are discussions. We are depending on TSST, and we are in a hurry. They are also in a hurry. Sometimes this leads to some small conflicts. An example, we had contact by phone 'why is it not there yet?' We put some pressure on it, but not much."

Interaction with other projects could come into existence based on interest, but is not present at the moment, Arjen Janssens:

"Yes and no. Yes, they have my interest. I see they buy some equipment that might be of interest for us later on. I think they are of interest because of the bigger picture. I like the idea of more companies working here in the lab, especially when the research is moving, for that reason yes. I am interested. But when you ask: am I interested in their applications, no. Well maybe from my interest, but not for the company."

Communication with the High Tech Factory management for Phase 1 is only concerning financial and administrative issues according to Arjen Janssens:

"I do have contact with them. Recently a lot, because of a problem we have with the expense account we did, then I contacted them. The discussion we have is about the depreciation. For example the heater we bought, it's a test heater, which is proven by the fact that its already broken. But we say it's a test heater, not right to say it will last 5 years. It's research equipment which you write off the moment you get it. They agree, but SenterNovem doesn't. We always have to go through them; we have a conflict with SenterNovem, that's why I speak to Monique a lot."

Timeline

Date	Incident	Source
May-07	Guus got email from Miriam concerning project	Interview A. Janssens
May-07	Guus came to me with "hey there is a new project going on and you should take a look at it, it's very interesting for you as well".	Interview A. Janssens
Jun-07	SolMateS too busy to react	Interview A. Janssens
Sep-07	Miriam even wrote us an email with like "please hurry up, we are already late."	Interview A. Janssens
Sep-07	writing a proposal together with TSST	Interview A. Janssens
Nov-07	Official Start of Phase 1	Project proposal
Nov-07	Kickoff meeting and start project 8	Interview A. Janssens
Dec-07	End preliminary investigation	Interim Report, project 8 part
Dec-07	Start Design and Realization	Interim Report, project 8

		part
Jan-08	Designing and ordering	Interview A. Janssens
Feb-08	P. has left the company, Arjen took over backoffice	Interview A. Janssens
Apr-08	High Tech Factory Phase 1 subsidy was granted	Interview A. Janssens
Apr-08	Kick-off meeting	Minutes of Kick-off meeting 11 April
May-08	Project expanded with extra materials and applications, based on potential client	Interview A. Janssens
Jun-08	Strategic change of company due to change in idea and project (the project expansion)	Interview A. Janssens
Jul-08	Extra pressure on SolMateS	Interview A. Janssens
Aug-08	We use a heater, which got delayed for 4 or 5 months. The supplier didn't do what he promised	Interview A. Janssens
Oct-08	Heater heats not just sample up, but entire chamber: system is changed	Interview A. Janssens
Nov-08	Close relations with Oce and RU Nijmegen about product specifications Pressure from Oce Delay from RU	Interview A. Janssens
Nov-08	PCC Meeting: questions triggered for IMS by problems described by other partners	Minutes of PCC meeting 27 November
Dec-08	End phase 3, first deposition runs	Interim Report, project 8 part
Feb-09	Deadline Interim Report	Minutes of PCC meeting 27 November
Feb-09	Negative feedback from SenterNovem on interim report, financial part	Interview A. Janssens
Mar-09	Contact between Guus and Monique	Interview A. Janssens
Mar-09	In absence of Guus, Arjen has contact with Monique	Interview A. Janssens
Apr-09	Heater broke down	Interview A. Janssens
Apr-09	PCC meeting	
May-09	Meeting planned with Miriam to discuss future housing	Interview A. Janssens

10.2.9 Project 9: Fabrication of Micro-Coriolis flow sensor

Project leader: Demcon

Partners: Bronkhorst, UT: TST, UT: WA

In project 9 several companies and university groups are working together; Demcon functions as the project leader and integrator; The TST group has substantial experience with the development of production processes and is contributing on this aspect; Bronkhorst helped to define the project and to validate at the end; The WA group has the same role as Demcon. Bronkhorst wanted LioniX to act as contractor, based on earlier collaborations, even though Demcon thought Micronit to be more advanced. LioniX is now playing a role in the actual realization.

During the kick-off meeting an extensive planning was created, multiple hierarchical layers were defined, and rules for the project have been defined. There are plenary meetings twice a year and irregular meetings and communications with phone and email when the situation requires this. The project itself is quite dynamic according to Rini Zwikker:

> *"Regrettably the planning is being changed continuingly; I now see that we are running a month behind on the schedule we made half a year ago. So yes, I am actively working to make sure we, Demcon and the partners, have a working product at the end."*

The project is running without major conflicts although there has been one issue with one of the university groups. Rini Zwikker:

> *"There have been discussions, although these were actually situated outside the HTF project. The university wanted to publish results, which Bronkhorst considered to too important for their business to allow publication because they wanted to base a product on it. The agreement was reached that first a patent application would be submitted, and then publication was allowed. This was carried out this way, but not before the 29th of December 2007 a meeting with the patent expert was scheduled to get to the correct text. So it was mainly stress, rather than a big issue. … In the previous project we have gotten to know one another. In the High Tech Factory we only needed to get used to each other again. We are focused on results and the university on research and publications."*

Interaction with other projects is limited. Rini Zwikker would have liked it to be different:

> *"In the High Tech Factory everyone is isolated in their own projects … We are project 9 and I hardly hear anything what projects 8 and 10 are doing. It would be good to do a presentation, a small symposium, some time with everybody, to see where everyone's working on."*

The management of Phase 1 could have been allowed a more active role in facilitating interaction, right now it is too limited, Rini Zwikker:

> *"[On content related interaction] nothing at all is done, which is quite a difference with MicroNed. I have asked our managing director, Dennis Schipper, whether this was correct. I always invited a representative of the organization to our half year meetings in MicroNed, and these representatives always came. The people attending our meetings were called program officers. These were the people who had a technological background and feeling for the projects, they were able to ask sharp questions. Additionally, the program officers kept the larger picture in mind and, for example, said 'You are doing this and in Delft they are doing that, you should meet with the people in Delft and see whether you can profit from their project.' Apparently it isn't organized this way in the High Tech Factory."*

Timeline

Date	Incident	Source
Jun-07	Communication Dennis Schipper with Miriam Luizink about participating in High Tech Factory	Interview R. Zwikker
Jun-07	Participation in High Tech Factory, to continue an existing alliance	Interview R. Zwikker
Jul-07	Dennis Schipper asks Dannis Brouwer to write a proposal	Interview R. Zwikker
Sep-07	Informal contact between Dennis Schipper and Miriam Luizink, about contribution of Micronit or LioniX, who do not work together well	Interview R. Zwikker
Oct-07	Decision to include neither Micronit, nor LioniX, by Demcon, BHT & UT	Interview R. Zwikker
Nov-07	Official Start of Phase 1	Project proposal
Apr-08	Subsidies are granted and have become available	Interim Report, general part
Apr-08	Kick-off meeting	Minutes of Kick-off meeting 11 April
May-08	BHT want LioniX in the project, because they already work together	Interview R. Zwikker
Jun-08	Start first post-doc	Minutes of meeting 20080116 kickoff
Jul-08	Kick-off meeting project 9	Minutes of meeting 20080116 kickoff
Oct-08	Start second post-doc	Minutes of meeting 20080116 kickoff

Oct-08	Technical kick-off meeting: planning change, more focus on sensing	Interview R. Zwikker
Nov-08	PCC Meeting	Minutes of PCC meeting 27 November
Dec- 07	Issue with UT-group: publication vs. patent (in MicroNed)	Interview R. Zwikker
Feb-09	Deadline interim report	Minutes of PCC meeting 27 November
Feb-09	UT-TST notices problem with etching due to error in mask design	Interview R. Zwikker
Feb-09	UT-TST (Remco Wiegerink) reports problem to designer at Demcon	Interview R. Zwikker
Feb-09	Designer informs project leader (Rini Zwikker): one month delay	Interview R. Zwikker
Mar-09	Planning of LioniX activities	Interview R. Zwikker
Apr-09	Meeting with 'some' people about new batch tubes (all partners but BHT)	Interview R. Zwikker
Apr-09	PCC Meeting	Observation
Apr-09	Plenary meeting: also with LioniX	Interview R. Zwikker

10.2.10 Project 10: Fiber-Chip coupling assemblage

Project leader: IMS BV

Partners: LioniX

The cooperation of LioniX and IMS in project 10 is based on LioniX's activities with optical chips. IMS is investigating how to make the interface of optical chips. Communication is based on visits of employees at the other company and contact by e-mail or telephone, IMS regards it as a matter of pragmatic solutions. The moments of interaction are irregular and based on the activities present at that time, although IMS always works towards deadlines. Ronald Haveman explains:

> *"It doesn't happen often, but occasionally people visit us on a daily basis, for example when we were working on the proof of principle. We also had some milestones and some reviews, and these are evaluated at that time. We don't plan meetings beforehand; we take action when the results of our activities require so."*

> *"When we have agreed on a deadline, then we will make sure we make that deadline. Or, at least we will do everything in our power in order to make it. However, we do have higher priorities for projects for which customers have paid 100%, in comparison to projects in which we have to invest as well. … Every time we reflect on our priorities; which projects have priority and where can I shift some activities or manpower. In general, when we have agreed on completion at a certain moment, we make sure it is then completed."*

Regarding conflicts and problems Ronald Haveman stated:

> *"We haven't had conflicts. On the other hand, discussions are inherent to projects like this one. Currently we are discussing future activities. It could be that based on this discussion we will change the direction of the project."*

Interaction with other projects is absent and the management of Phase 1 from the High Tech Factory is considered to be only guiding.

Timeline

Date	Incident	Source
Jun-07	Technical and commercial project managers of IMS start projects	Interview R. Haveman
Nov-07	Official Start of Phase 1	Project proposal
Dec-07	Technical and commercial project managers of IMS leave the company	Interview J. Wissink
Jan-08	Ronald Haveman takes over	Interview R. Haveman
Jan-08	Phase 1 (feasibility study) of project 10 is started by IMS & LioniX	Interim Report, project 10 part
Feb-08	Graduating student is introduced for the project	Interview R. Haveman
Apr-08	Subsidies are granted and have become available	Interim Report, general part
Apr-08	Kick-off meeting	Minutes of Kick-off meeting 11 April
Jul-08	Phase 1 (feasibility study) of project 10 is finished by IMS & LioniX	Interim Report, project 10 part
Jul-08	Phase 2 (Proof of Principle) of project 10 is started by IMS & LioniX	Interim Report, project 10 part
Sep-08	Challenges in building the test setup	Interview R. Haveman
Nov-08	PCC Meeting: questions triggered for IMS by problems described by other partners	Minutes of PCC meeting 27 November
Dec-08	Setup successful	Interview R. Haveman
Jan-09	Phase 2-1 (Design and building test setup) of project 10 is finished by IMS	Interim Report, project 10 part
Jan-09	Phase 2-2 (Design and building optical chips) of project 10 is finished by LioniX	Interim Report, project 10 part
Jan-09	Meeting about how to go further discussion about polishing part between IMS and some LioniX members	Interview R. Haveman
Jan-09	Project is temporarily frozen	Interview R. Haveman
Jan-09	Consulting original project proposal of different parties	Interview R. Haveman
Jan-09	Ronald Haveman contacts project starters of IMS	Interview R. Haveman
Jan-09	LioniX contacts project starters of LioniX	Interview R. Haveman
Jan-09	Peter contacts Monique about possible project change in terms of planning and costs	Interview R. Haveman
Feb-09	Phase 2-3 (Iteration steps) of project 10 is started by IMS & LioniX	Interim Report, project 10 part
Feb-09	Deadline Interim Report	Minutes of PCC meeting 27 November
Mar-09	Decision not to do the polishing part	Interview R. Haveman
Apr-09	PCC Meeting	Observation