# Realizing radical innovation in established high-tech companies : a micro-institutional perspective

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## A micro-institutional perspective

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*Dedicated to all innovators*
*that try to make this world a better*
*and more sustainable place to live*

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# Chapter 1 Introduction

## 1.1 Radical innovation in established high-tech companies

*A real life example*

In September of 2007, the author of this thesis visited the research department of OmegaCom to discuss some preliminary results of the case studies conducted for this PhD thesis. He would meet with Ed Greenland, former senior director of technology strategy at AlphaSys, who just switched jobs and returned to the research department to head the research group on DaXo. Ed's group was located at the end of one of the large new research buildings of OmegaCom. It was a modern building, functional and transparent, with large glass windows on all sides, and matt steel beams supporting the upper three floors. Thru the orange windows at ground level, you could see a group of white suited scientists standing in front of a blackboard. Ed was sitting in his office and it seemed a hectic afternoon. Two scientists were still standing in his doorway discussing unexpected prototype test results with him and how they should proceed. After they had left, Ed welcomed the author and Ed's secretary brought a cup of coffee. He finished a final email before turning towards his visitor and just when they wanted to start the discussion, the door of his office opened and senior scientist Hank Abbot came in and apologized for disturbing the meeting. Hank, one of the promising and dedicated scientists that was interviewed in the previous period, seemed agitated and said:

> "Ed ... this morning we gave a great presentation of the final results of our tests to upper management with the request for an increase of our budgets for the next quarter... and they still doubt whether we should continue with it! It seems that they still don't get it... it's like talking to a brick wall sometimes. What we are doing is absolutely new, nobody is doing this and the potential is great... you know that. I still wonder whether they really understand it and are aware of the impact it can have. It don't think they believe that we really can do it and that it belongs to us... and they are too focused on short term results and all the things going on in the business units... it doesn't work that way. We need time and I need to hire people to make it a real success. They have so much money available, so why don't they want to support it? I want to make it work, and I know we can do this... what should we do? Should I go to Corporate for this? Or should we get Professor Lee to try convince upper management? Maybe, you could speak to them again ... This is good, this is new, and until now we have achieved all our targets... if it's necessary I will bluff my way through instead..."

This PhD thesis is about innovators like Hank and the struggles they encounter when trying to convince established parties within their organization to support their radical innovation ideas. It is about the different strategies that innovators like Hank can follow to augment the legitimacy of their ideas vis-à-vis established interests, norms and beliefs within the organization, and about the opportunities within established organizations that enable them to do so. This PhD thesis will show that although the existing structures and dominant logics of established companies can severely constrain radical innovation initiatives, they also offer ample opportunities for the legitimation of radical innovation and change.

*The importance of radical innovation for established high-tech companies*

Radical technological change and innovation can reshape the bases of competition in technology intensive industries. Companies that are able to seize the opportunities of radical technological change and innovation can build up new businesses and competencies, and can secure and sustain their competitive position for the future. Empirical studies show that when radical technological innovations appear at the industry stage, newcomers usually develop or take up these innovations much quicker and grow their market share much faster than already established companies in that particular industry (Anderson & Tushman, 1990; Henderson & Clark, 1990; Christensen, 1993; Henderson, 1993; Bower & Christensen, 1996; Tripsas, 1997; Sull, 1999; Tripsas & Gavetti, 2000; Sood & Tellis, 2005). These studies show that established companies frequently go into economic decline after radical technological change, because their existing technologies cannot meet the same level of performance as the new technologies. Consequently, they lose their dominance to industry newcomers that are founded on the novel technology. Google shook up the Internet industry with its highly efficient and advanced search engine and severely challenged established companies like Yahoo! and Microsoft. Also the founding of Genentech, which pioneered recombinant DNA-technology to develop advanced therapeutics and novel medicines, reshaped the bases of competition in the human therapeutics and drug discovery industry and challenged established companies. For the survival of established high-tech companies it is thus crucial to develop the capabilities to internalize and develop radically new technologies and innovations during periods of technological change.

Fortunately, even though the studies mentioned earlier showed that established companies struggle with technological change and radical innovation, there are some promising examples that show that established companies *are* able to transform and sustain their competitive advantage on the long term. IBM transformed itself from a manufacturer of punch-card machines, to a producer of large mainframes, to personal computers, and now delivers many IT-related services (see for instance Buderi, 2000). Corning Inc. transformed itself from a producer of glass light bulbs and cookware, to a producer of optical fibers for telecommunication and liquid crystal displays. And Nokia started as a wood-pulp and paper mill, extending into rubber products and (electric) cables, and later

became one of the largest mobile network and cell phone producers. Intel shifted in an evolutionary way from its strong position in semiconductor memory business to a new and dominant position in the microprocessors business (Burgelman, 1994, 1996; Jelinek & Schoonhoven, 1990). This demonstrates that when established companies are able to seize the opportunities of technological change, they also can sustain competitive advantage on the long term.

The previous examples and studies show that the capability of established companies to internalize radical technological change and develop radical innovations is of crucial importance to the long term growth and competitive advantage of these companies. The question of how large established companies can remain innovative and cope with radical technological change is one that has been of great concern to both managers and organizational scholars. It is also the main concern of this thesis. In this study we will try to better understand why the development (or internalization) of radical technological innovation is difficult for established companies. Moreover, we will explore in detail the actions and strategies used by innovators within established companies to overcome these difficulties and realize successful radical innovation. This thesis will amongst others show that established high-tech companies are indeed able to internalize technological change and realize radical technological innovations if their innovators are allowed to persevere and do just this.

*The difficulties of radical innovation within established high-tech companies*

Organizational scholars have investigated different reasons for the failure of established companies to explore radical technological innovations. Before we go into some of these explanations, it is important to define radical technological innovation more precisely. Radical technological innovation involves the development and internalization of knowledge (methods, principles, models) that is *novel* to the established company, and is based on different knowledge bases or the recombination of established knowledge bases with novel domains (Hill & Rothaermel, 2003). The term 'novel' is used relative to the history, experiences and established competencies of a particular organization (*cf.* March, 1991; Levinthal & March, 1993). Incremental technological innovation instead builds upon the established technological knowledge base of a company, and improves this existing knowledge base to offer (product) solutions and functionalities to its customers. In this thesis, we define radical technological innovations as products that a) embody novel technologies or technological principles; b) that address established or novel application areas; and c) that focus on familiar or novel market segments. Radical technological innovation projects consequently entail higher technological uncertainty and higher technical inexperience, potentially higher business inexperience, and potentially higher technology costs and longer development times (Green *et al.,* 1995 in McDermott *et al*., 2002; Leifer *et al.,* 2000; Gatignon *et al.*, 2002).

Organizational scholars have viewed the difficulties of realizing radical technological innovation by established companies from different theoretical perspectives. Generally speaking, we can distinguish four different approaches based on: 1) economic/strategic considerations; 2) organizational learning and problem solving notions; 3) organizational design and structure characteristics; and 4) (micro-)institutional perspectives. From an economic and strategic perspective several authors argue that for established companies the incentives to exploit existing competencies and technologies are usually much stronger than to explore alternative novel technologies. Short term economic considerations favor protection and improvement of existing technologies and competencies as they show more certain and immediate financial returns and match better with the needs of mainstream customers (Christensen & Bower, 1996; Hill & Rothaermel, 2003). Besides, radical technologies that substitute or cannibalize existing technologies endanger the rent generation of the company (March, 1991; Henderson, 1993; Hill & Rothaermel, 2003).

Authors focusing on organizational learning and problem solving argue that another important source of rigidity in dealing with radical technological innovations is that organizational structures and organizational routines are usually based and organized around the established technologies and its dominant design (Henderson & Clark, 1990; March, 1991; Leonard-Barton, 1992; Levinthal & March, 1993). Problem-solving and decision making routines are specialized and simplified for reasons of efficiency and bounded rationality, and reflect past experiences of the company with its existing technologies (and products). Established routines direct managerial attention and tend to constrain solution finding to what is already known and what is near to solutions that have worked in the past (Clark, 2005; Ahuja & Lampert, 2001; Levinthal & March, 1993). These routines and structures enable the company to perform efficiently in a stable environment with established technologies, but limit its ability to absorb major technological changes or explore and develop radical technological innovations (Leonard-Barton, 1992).

From an organizational design stance, authors argue that the mechanistic organizational designs that enable efficiency in stable environments with established technologies and low amounts of uncertainty, are less effective in technological turbulence when radical innovations must be developed. Radical innovation requires organic, decentralized, less formal and more loosely coupled organizational designs that facilitate autonomy, experimentation and flexibility in an uncertain world (Brown & Eisenhardt, 1995; Tushman & O'Reilly, 1996; Sheremata, 2000; Benner & Tushman, 2003; Gibson & Birkenshaw, 2004; Smith & Tushman, 2005; Jansen *et al.,* 2006).

From an institutional perspective, established companies face major difficulties because radical technological innovation initiatives can be *illegitimate* with respect to the institutionalized practices and institutional logics of the company. Innovations can violate prevailing practices and professional norms within the

company, and the roles and behavioral expectations of both internal and external actors (customers, financial institutions, or regulatory agencies) (Dougherty & Heller, 1994). Empirical work on the illegitimacy of innovation shows that established organizational routines and dominant logics inhibit innovation not only because they 'pay off', have worked in the past, or are rational; but also because they are infused with socially shared norms and beliefs about what is real, right and appropriate in both a particular organization and the larger societal system (Aldrich & Fiol, 1994; Dougherty & Heller, 1994; March & Heath, 1994; Kaplan & Henderson, 2005; Vermeulen, *et al.*, 2007). Consequently, the exploration of radical technological innovations can conflict with institutional logics and practices, which results in institutional pressures for conformity. As radical technological innovations imply strategic changes at different dimensions of the organization (new technological competencies, new businesses, new organizational processes and structures, and new value networks with new external actors), these too can conflict with commonly held perceptions of both internal and external actors about what the company is, should be, and how it should act accordingly. Radical innovation ideas' lack of legitimacy within established companies leads to less support and commitment of institutional decision makers within (and outside) the organization and consequently limits access to necessary resources, knowledge and people, which hinders innovative actors in the successful realization of radical innovation.

In this PhD thesis we will extend recent micro-institutional approaches of radical innovation within established companies to provide a more fundamental and comprehensive explanation of the inertia of established companies with regard to radical technological innovation. We think a micro-institutional approach complements (and partially integrates) recent research findings based on either economic/strategic considerations, organizational learning or organizational design approaches, because it has a strong focus on the enabling and constraining effects of institutional logics and structures that are infused with established interests, norms and beliefs, on radical innovative action within established companies. The next section reviews in more detail the main tenets of institutional theory and the state of the art of (micro-) institutional research on (radical) innovation.

## 1.2 Recent institutional research on innovation

*Institutional theory*

Institutional theory has a long and diverse history in economics (from Veblen, Commons and Mitchell, to Schumpeter, Polanyi, Galbraith and Coase), political science and sociology (Spencer and Sumner, Cooley and Hughes, Marx, Durkheim, Weber, Parsons, Mead, Berger and Luckmann). Following in the footsteps of Merton, Selznick, Simon and March, the application to organizations occurred during the mid 1970's (*e.g.* Zucker, 1977; Meyer and Rowan, 1977; DiMaggio and Powell, 1983; March & Olsen, 1989) (for a thorough historical overview see Scott,

2001). Central tenet of institutional theory is that human conduct, and social and economic action do not occur in a vacuum, but are governed, enabled and constrained by widely shared regulative, normative and cognitive-cultural conventions. These conventions are embodied within durable social structures (i.e., institutions) and acquire a high degree of resilience to change, thus providing stability and meaning to social life. Institutions are made up of symbolic elements, social activities, and material resources and are reproduced and maintained by human behavior (Scott, 2001; Giddens, 1984). As such, institutional theory has helped to answer a variety of questions about the world of organizations and organizational behavior: e.g. why do organizations of the same type located in widely scattered locales so closely resemble each other (hospitals, schools, financial institutions)? How are we to regard behavior in organizational settings? Does it reflect the pursuit of rational interests and rational choice, or is behavior primarily shaped by conventions, routines and habits? (Scott, 2001).

Institutional theorists have not only been interested in the content side of institutions (what are the symbolic elements and rules that embody regulative, normative and cultural-cognitive conventions and meanings?) but also in the processes that create, maintain and change institutional structures and logics. A dominant focus has been to explain the processes that sustain stability and similarity of organizational forms within industries, sectors and institutional fields. DiMaggio and Powell (1983) distinguished three mechanisms (coercive, mimetic and normative) that explain the persistence of practices, beliefs and structures within a field of organizations. The similarity of organizational structures (structural isomorphism) within an organizational field is a consequence of these coercive, mimetic and normative mechanisms:

> "...Coercive isomorphism results from both formal and informal pressures exerted on organizations by other organizations upon which they are dependent and by cultural expectations in the society within which organizations function... [Mimetic isomorphism results from organizational and environmental uncertainty]. Uncertainty is a powerful force that encourages imitation. When organizational technologies are poorly understood, when goals are ambiguous, or when the environment creates symbolic uncertainty, organizations may model themselves on other organizations. The advantages of mimetic behavior in the economy of human action are considerable; when an organization faces a problem with ambiguous causes or unclear solutions, problemistic search may yield a viable solution with little expense... [Normative isomorphism] stems primarily from professionalization... we interpret professionalization as the collective struggle of members of an occupation to define the conditions and methods of their work... and to establish a cognitive base and legitimation for their occupational autonomy... Two aspects of professionalization are important sources of [normative] isomorphism. One is the resting of formal education and of legitimation in a

> cognitive base produced by university specialists; the second is the growth and elaboration of professional networks that span organizations and across which new models diffuse rapidly..." (DiMaggio & Powell, 1983: 150-152).

The persistence of structures, practices and beliefs stems from their conformation to (institutional) regulative, normative and cultural-cognitive systems, which grants them legitimacy (Scott, 2001).

Institutional theory has been very apt at explaining the stability of institutional systems and the isomorphism of organizations within institutional fields. However, institutional theory has been criticized as overly deterministic regarding human conduct, leaving actors with little room for agency and choice, and allowing little room for the explanation of institutional change (and its internal dynamics) that have been identified in the real world (Scott, 2001). In response, Scott (2001) incorporates the structuration notions of Giddens (1984) into his analytic framework of institutions to loosen up the deterministic nature of institutional theory:

> '... Structuration theory views actors as creating and following rules and using resources as they engage in the ongoing production and reproduction of social structures. Actors are viewed as both knowledgeable and reflexive, capable of understanding and taking account of everyday situations and of routinely monitoring the results of their own and other's actions. Agency refers to an actor's ability to have some effect on the social world, altering the rules or the distribution of resources... All actors, both individual and collective, possess some degree of agency, but the amount of agency varies greatly among actors as well as among types of social structures [institutions]. Agency itself is socially constructed... Between the context and response is the interpreting actor. Agency resides in "the interpretative processes whereby choices are imagined, evaluated, and contingently reconstructed by actors in ongoing dialogue with unfolding situations"...' (Scott, 2001: 76; referring to Emirbayer and Mische, 1998: 966).

Several researchers have taken up the challenge to integrate different notions of agency and change with institutional theory. Oliver (1991) for instance, has identified different strategic responses of actors to institutional pressures and the institutional factors that predict the occurrence of these responses. The strategic responses of active organizational resistance to institutional pressures vary from passive conformation to proactive manipulation. Suchman (1995) developed an integrated framework of strategic institutional approaches to legitimacy of organizations vis-à-vis institutions, which presupposes agency and choice in organizations. Greenwood and Hinings (1996) identified different institutional and intraorganizational factors that enable a variety of responses to institutional pressures regarding radical organizational change. More recently, Seo and Creed

(2002) used a dialectical perspective to develop a framework for understanding institutional change. In their view the occurrence of institutional contradictions that stem from inefficiency, nonadaptability, interinstitutional incompatibilities and misaligned interests activate potential institutional change agents who mobilize collective action to change established institutions. George, *et al*. (2006) developed a framework that integrates prospect theory and the threat-rigidity hypothesis with institutional theory to focus on the cognitive micro-foundations of institutional theory to explain different responses to institutional pressures. Central tenet of their framework is that patterns of institutional persistence and change depend on whether decision makers within organizations view environmental shifts as potential opportunities for, or threats to gaining legitimacy.

Besides these particular attempts, a related institutional research stream investigated the notion and role of institutional entrepreneurs in processes of institutional change, as suggested by DiMaggio (1988). Institutional entrepreneurs are actors who envision institutions as a means of advancing interests they value highly, yet which are suppressed by the established institutional logic. Institutional entrepreneurs command resources which can be applied to influence institutionalized rules and thus can change institutional structures and logics (DiMaggio, 1988; Fligstein, 1997; Beckert, 1999; Maguire, Hardy & Lawrence, 2004; Greenwood & Suddaby, 2006; Leca, Battilana & Boxenbaum, 2006; Leca & Naccache, 2006; Lawrence & Suddaby, 2006). Several researchers have investigated how institutional entrepreneurs emerge and accrue agency and influence and change dominant institutional arrangements, based on their control over resources, social and political skills, embeddedness and network position within institutional systems (e.g., Dorado, 2005; Garud, Jain, Kumaraswamy, 2002; Garud & Karnoe, 2003; Battilana, 2006; Greenwood & Suddaby, 2006; Garud, Hardy & Maguire, 2007).

It is easy to see that institutional theory can provide promising explanations for established companies' difficulties with radical technological innovation. Long established companies can be viewed as micro-institutions themselves with institutional logics and rules infused with regulative, normative and cultural-cognitive elements. As the actions and ideas for radical technological innovations clash with established institutional logics and structures, the proponents of the innovation will experience strong institutional pressures to conform. The more recent institutional approaches also account for agency and change within institutions, and offer novel explanations of the processes and strategies that can be used by proponents of radical innovation to resist, transform, or incorporate the institutional pressures to augment the legitimacy of their ideas to realize successful radical innovation. In the remainder of this section we will review a number of recent articles that have adopted institutional theory to explain (radical) innovation.

*Institutional theory, innovation and legitimation*

Some of the studies investigating (radical technological) innovation within institutions focus on macro-levels of analysis, new business creation, new ventures and new technology introduction by companies within industrial environments. The focal object in these studies is the organization (or new venture) and its interaction with its institutional environments (Singh, Tucker & House, 1986; Aldrich & Fiol, 1994; Suchman, 1995; Hargadon & Yellowless, 2001; Lounsbury & Glynn, 2001; Zimmerman & Zeitz, 2002; Suddaby & Greenwood, 2005; Zott & Huy, 2007). Although these studies have not investigated institutional aspects of radical innovation *within* established companies, they can shed light on some important institutional processes and aspects relevant to (radical) innovation. In particular, these studies point to the crucial role of acquiring legitimacy through different strategies of legitimation, to access resources, knowledge and key stakeholders. Another smaller collection of micro-level studies considered innovation *within* established companies from an institutional perspective (notably, Dougherty & Heller, 1994; Vermeulen, *et al.*, 2007). Both the macro and micro level studies are relevant to the focus of this thesis. We will shortly review the main findings of these studies and several important limitations in the next section to establish the point of departure for this thesis.

Aldrich and Fiol (1994) published an important theoretical article on the liabilities of newness of new venture creation in new industries. We will examine it in more detail than the other articles, because it introduces the concepts of *legitimacy* and *strategies of legitimation,* and their influence on resource access and stakeholder support, concepts widely adopted since publication. They state that entrepreneurs who want to start up a new venture in a relatively new industry face different and more complex challenges than entrepreneurs who simply carry on within an established industry with many predecessors. They argue that innovating entrepreneurs have to overcome the relative lack of socio-political and cognitive legitimacy in their venture to raise capital, recruit employees, gain access to markets and maintain the support of key constituencies. The legitimacy of new ventures is determined by a) how taken for granted a new venture is, and b) the extent to which a new venture conforms to recognized principles or accepted rules and standards. Aldrich and Fiol (1994) proposed different strategies used by entrepreneurs to build legitimacy and promote new industry development. In their view social (and institutional) contexts present entrepreneurs with many constraints, yet also offer windows of opportunity for change and legitimation. Through processes of social construction, the entrepreneur can develop new meanings to alter institutional norms. Institutional contexts are social contexts, representing not only patterns of established meaning, but also contexts for the renegotiation of meaning.

Aldrich and Fiol (1994) identified several entrepreneurial strategies that build trust, reliability, reputation and institutional legitimacy. At the organizational level, they propose three different strategies that help build legitimacy; 1)

entrepreneurs have to behave "as if" the new venture and its activities were already a reality, in order to convince others of the tangible reality of the new venture where there is a lack of history to make accurate predictions about risk/reward trade-offs. Moreover, 2) entrepreneurs may frame the new venture using high levels of abstraction and ambiguity, seeking to encompass existing knowledge, in order to appear more legitimate. They point to a similar strategy of technological champions as investigated by Howell and Higgins (1990) as "appealing to larger principles or unassailable values about the potential of the innovation for fulfilling an organization's dream of what it can be." And, 3) in order to develop trust in the new venture, founding entrepreneurs must use alternative forms of communication, such as consistent narratives, to make a case that their ventures are compatible with already established sets of activities in the industry environment. The use of coherent narratives, free of contradictions, helps to establish a new "truth" surrounding the new venture that can be trusted. Again, they refer to a similar finding of Howell and Higgins (1990): "the fundamental components of a champion's capacity to introduce innovations successfully are the articulation of a compelling vision of the innovation's potential for the organization, the expression of confidence in others to participate effectively in the initiative, and the display of innovative actors to achieve goals."

Building on the work of Aldrich and Fiol (1994), other researchers have theorized the relationship between entrepreneurship, legitimacy, resource acquisition and new venture success. Most studies focus particularly on the *strategies* that new ventures use to augment the legitimacy of their venture. Lounsbury and Glynn (2001) developed a process model of a particular strategy, named 'cultural entrepreneurship,' that enables legitimation of new ventures. Cultural entrepreneurship is the process of storytelling that mediates between extant stocks of entrepreneurial resources and subsequent capital acquisition and wealth creation. They developed a framework that explains how entrepreneurial stories facilitate the crafting of new venture identity as the basis upon which legitimacy may be conferred by investors, competitors, and consumers, opening up access to new capital and market opportunities. In their view entrepreneurial narratives play an important role in legitimacy building to acquire resources and network access. These narratives aim to align new venture identity with institutionalized rules, norms and practices from which legitimacy flows. A similar line of inquiry was followed by Hargadon and Yellowless (2001) in their analysis of the mediating role of design between innovations (i.e., Edison's electric light) and established institutional fields. They identified the use of 'skeumorphs' or design elements that serve no objectively functional purpose but do facilitate the public's understanding of the relationship between the innovation and the technology it replaces. The skeumorphs were used strategically by Edison in his design of the electric light system to mimic features of the well established gas lighting system. In doing so, Edison "sought to replace the technology of gas lighting [with electric lighting] without requiring dramatic changes in the surrounding understanding and patterns of use" (Hargadon & Yellowless, 2001: 498). Consequently, the use of skeumorphs as a *design strategy* enhanced the cognitive *legitimacy* of the electric light

system, enabling an easier adoption process by customers, regulators, and investors. This finding reiterates the conclusions of Van de Ven and Garud (1993) that the adoption of technological innovations appears to be less based on technical and performance superiority, than on the entrepreneur's ability to create an accommodation with existing cultural schema and institutional logics and structures.

Following Aldrich and Fiol's work (1993), Zimmerman and Zeitz (2002) also developed a process model incorporating different types of *legitimacy* (i.e. regulative, normative, cognitive and industry legitimacy) as crucial for new ventures seeking resources, and the *strategies* that can be used to augment legitimacy, by either conformance, selection, manipulation, or creation. Besides these strategies, the incremental accumulation of human, financial, and intellectual resources also augments the legitimacy of the venture. More recently, Zott and Huy (2007) conducted one of the few empirical studies into the symbolic actions (*i.e.,* strategies) of entrepreneurs seeking legitimacy and resources. Based on a two-year inductive field study of 26 British ventures they identified four categories of symbolic actions that improved resource acquisition: conveying the entrepreneur's personal credibility, professional organizing, organizational achievement, and the quality of stakeholder relationships. The effects of these actions on the build up of legitimacy and acquisition of resources are moderated by the structural similarity between the resource holder and resource seeker, by the intrinsic quality of the new ventures (the more advanced its state of development), and by the amount of uncertainty in the marketplace about the value of the new venture's offering. Their study is one of the few detailed and empirical investigations into the symbolic actions as facilitators of legitimacy and enablers of resource acquisition.

It is important to note that the research on institutional theory, legitimacy and legitimation, and new venture creation and innovation within institutions as reviewed above, is still in development. Most papers are theoretical by nature and aim at refinement of theory and the classification and definition of relevant concepts and processes. Until now, relatively few empirical studies have been conducted that specifically address the relationships between innovation and new venture creation, legitimation and institutionalization.

*Institutional theory and innovation within established companies*

In the rest of this section we will review several studies that have directly investigated the institutional aspects of innovation within established companies. Before we review studies that have specifically applied an institutional perspective, we note that there are a number of studies that investigated similar phenomena with related theoretical approaches, but which will not be extensively treated in this review. For instance, Dougherty (1992) investigated the interpretative barriers stemming from departmental thought worlds and organizational routines, which endanger successful product innovation within companies. Garud & Rappa (1994)

developed a socio-cognitive model of technology evolution within industries and companies. Their model explains how the reciprocal interaction between researchers' beliefs, technical artifacts and institutionalized evaluation routines shapes technological evolution. Dougherty & Hardy (1996) focused particularly on the systems of power within organizations that constrain innovators to solve innovation-to-organization problems. Kaplan (2003) studied the cognitive framing contests that occur between groups within established companies, during the sensemaking of technological change. And Regnér (2005) adopted a social practice perspective and focused on a variety of mechanisms that induce strategic lock-ins and inertia, ranging from escalation of commitments, to learning myopia and institutional forces. Although these studies bear similarities with the institutional explanations followed here, they will be left out of a further detailed review for reasons of conciseness and focus.

Dougherty & Heller (1994) specifically investigated the importance of legitimacy and legitimation for innovation *within* established companies using inductive analysis of interviews with 134 different 'product innovators.' The effects of institutional practices and logics on 40 different product innovations in 15 large and established firms, ranging from more incremental innovations (an existing product for a new market segment) to more radical innovations (new product technology, new market segments, new manufacturing, new applications). Dougherty & Heller argue that three types of necessary linking activities in the case of product innovation (*i.e.,* linking technological opportunities to market needs; linking and collaboration on activities across departments; and linking the product to firm strategies and structures) are often illegitimate within large old firms and consequently hamper a successful innovation process. They also identified three different *a priori* defined strategies to overcome and solve these illegitimacies. The first strategy involved the conformation to usual and established practices in order to legitimize the linking activities (termed 'usual approaches'). The second strategy was to associate the innovation and linking activities with established and legitimate practices, but continue to behave in the old way (termed 'ceremonial approaches'). And the third strategy involved the use of legitimate practices to reframe the innovation so people could understand how to carry them out (termed 'reframing approaches'). Product innovations that were in the end successfully launched in the market, showed a high percentage of illegitimacy problems solved. Illegitimacies were most often solved by either 'usual' or 'reframed' approaches. However, product innovations that were cancelled during development also showed a relatively high number of reframed approaches to overcome illegitimacies. This suggests that there are other forces and institutional factors at play that interact with the strategies followed to determine eventual product innovation success.

A recent study by Vermeulen, *et al.* (2007) adopts a micro-institutional perspective to investigate why established firms in the financial services industry struggle with their complex incremental product innovation efforts. Building upon the work of Scott (2001) they investigate different micro-institutional forces (i.e.

organizational pressures) at the business unit level that either enable or inhibit incremental product innovation processes. Three types of micro-institutional forces are distinguished: 1) *regulative* forces, involving the directive influence on actors' behaviors stemming from established organizational structures, rules and procedures, and organizational systems; 2) *normative* forces, involving existing social obligations, values, norms and binding expectations; and 3) *cultural-cognitive* forces, involving shared meaning systems, dominant identities and existing frames. Based on the inductive analysis and comparison of 24 successful and unsuccessful complex product innovations at distinct business units of 12 incumbent firms, Vermeulen, *et al.* (2007) identified two distinct institutional templates (consisting of regulative, normative and cultural-cognitive forces) that are associated with unsuccessful or with successful innovation projects. The unsuccessful projects were all dominated by a 'business as usual' template. These innovation projects were all managed in strict conformation to prevailing rules and procedures, risk avoidance was highly valued, and dominant groups within the organization supported this taken-for-granted way of dealing with incremental innovation. By contrast, successful projects displayed an 'innovation' template, in which standard rules and procedures were discarded, innovative projects were isolated from the organization, the risks were treated as being part of the innovation game, and the projects were framed similar to more radical innovations (Vermeulen, *et al.,* 2007; *cf.* Jelinek, 2003). The identification of these two distinct templates shows amongst others, that regulative, normative and cultural-cognitive institutional forces can simultaneously exert pressures on organizations and actors, and are strongly intertwined, mutually reinforcing their impact on actors' within institutions. Another important finding of this study is that within the same company, distinct institutional 'templates' (or institutional systems) can exist at the level of business units. Micro-institutional forces can arise *within* organizational groups, and may differ *between* groups within the same organization. These differences between micro-institutional forces and templates stems from the segmentation of organizational groups, based on their professional discipline, task specialization, and idiosyncratic experiences. The study of Vermeulen, *et al.* (2007) provides a deeper understanding the distinct institutional templates and associated institutional forces that enable or inhibit innovation, but did not investigate actor's responses and strategies to deal with institutional forces.

Both Dougherty and Heller (1994) and Vermeulen, *et al.* (2007) used an institutional perspective to investigate the problems of innovation within established companies to offer a more fundamental explanation of the difficulties of innovation by showing how innovation lacks legitimacy and thus how they experience institutional pressures for conformity within established structures, rules, norms, values and meaning systems . The lack of legitimacy limits access to necessary resources, support, knowledge, people and groups, which inhibits successful innovation processes. Both papers argue that innovation within established companies is not improved by implementing rational and instrumental approaches that only change organizational procedures and structures (management instruments, best practices, etc.). The institutional logics,

structures and templates that hinder innovation involve aspects beyond procedures and structures, and also consist of mutually reinforcing rules, norms, values and meaning systems that must be addressed to become truly innovative.

The literature reviewed in this section has provided a good insight into the state of the art in institutional theory and its applications in the field of (radical) innovation. Institutional theory offers a more comprehensive and fundamental perspective for understanding the illegitimacies of radical innovation within established companies, and also explains how innovating actors are able to overcome the lack of legitimacy to initiate change at the institutional level. Although much is known, recent research also has some important limitations. In the next section we will pinpoint these limitations and formulate the objective and research questions of this thesis accordingly.

### 1.3 Research objective

The aim of this thesis is to apply an institutional perspective on radical innovation within established high-tech companies. Our review of institutional research on innovation demonstrates its relevance for understanding the complexities of realizing radical innovation within established companies, and how innovators may influence established institutional logics and structures to accommodate radical innovation. An institutional perspective acknowledges rational (and regulative) structures and procedures, but also institutionalized interests, norms, values, and shared meaning systems, which can severely limit radical innovation initiatives by obstructing innovators' efforts

Although others have already attempted to develop an institutional perspective on innovation within institutions and established companies, their studies focused either on macro-levels involving legitimacy problems of new ventures or companies and their strategies for legitimation (e.g., Aldrich & Fiol, 1994; Hargadon & Yellowless, 2001; Lounsbury & Glynn, 2001; Zimmerman & Zeitz, 2002; Zott & Huy, 2007); or they focused on product innovation in general (Dougherty & Heller, 1994); or on incremental innovation within established companies (Vermeulen, *et al.* 2007). No specific accounts directly address radical technological innovation within established high-tech companies (that might have a track record in incremental innovation)[1]. Moreover, most of the recent studies have been primarily theoretical in nature and lack empirical substantiation. In addition, most studies pay limited attention to the active role of agency within institutions or the possibility of institutional change and transformation, even though these notions seem important to understand how established companies and their innovators are able to realize radical innovations despite their illegitimacies and complexities. We consequently formulate the objective of this thesis as follows:

[1] Leifer *et al.,* (2000) have investigated in detail how mature companies are able to realize radical innovation, but do not adopt an institutional perspective, nor focus on legitimacy and legitimation.

> The *objective* of this thesis is to develop an empirically grounded micro-institutional perspective on radical innovation within established high-tech companies that explains both the difficulty and possibility of radical innovation within established companies, by examining both the constraining and the enabling effects of institutional logics and structures on the actions of radical innovators.

As such, this research can be characterized as a theory development effort responding to persistent calls to investigate more closely the micro-level processes and micro-foundations related to institutions, agency, innovation and change (Aldrich & Fiol, 1994; Dougherty & Heller, 1994; Suchman, 1995; Johnson, *et al.* 2000; Lounsbury & Glynn, 2001; Zimmerman & Zeitz, 2002; Suddaby & Greenwood, 2005; George, *et al.* 2006; Reay, *et al.* 2006). Moreover, this theory development effort must contribute to a more comprehensive understanding of the difficulties and possibilities of radical innovation within established high-tech companies. To achieve these goals, research questions will be formulated that address specific limitations of the previous literature on institutional theory and radical innovation within established companies.

*Legitimacy*

Past institutional research has pointed out that the concept of legitimacy is highly relevant for understanding the difficulties associated with innovation within organizations and institutions (Aldrich & Fiol, 1994; Dougherty & Heller, 1994; Suchman, 1995; Lounsbury & Glynn, 2001; Zimmerman & Zeitz, 2002). Suchman (1995) defined legitimacy as: "... a generalized perception or assumption that the actions of an entity are desirable, proper, or appropriate within some socially constructed system of norms, values, beliefs, and definitions..." (Suchman, 1995, pp. 574). These authors argue that achieving legitimacy is a crucial element in the survival of innovations within institutional systems. Innovations' lack of legitimacy versus established institutional logics and structures reduces innovators' access to necessary resources, knowledge and social networks, and limits support from key constituencies. Although past research has shed light on the lack of legitimacy of new ventures and product innovation (*e.g.* Dougherty & Heller, 1994; Zimmerman & Zeitz, 2002), little insight exists of the intricacies surrounding the legitimacy of *radical innovation* within established high-tech companies. Because radical innovation involves the development and acquisition of novel technological competencies, which are used to develop novel technological products, for existing or novel markets, we argue that it will evoke different and more complex illegitimacies than (incremental) product innovations, even within established innovative high-tech companies.

In order to develop a micro-institutional perspective on radical innovation within established high-tech companies we thus have to answer the following research question:

1. What types of legitimacy crises do innovators encounter during their pursuit of radical innovation activities within established high-tech companies?

*Strategies favoring legitimation*

Past institutional research has identified different strategic responses of actors (and organizations) to deal with a lack of legitimacy and the institutional pressures they must overcome to realize successful innovations (Oliver, 1991; Dougherty & Heller, 1994; Suchman, 1995; Greenwood & Hinings, 1996; Lounsbury & Glynn, 2001; Zimmerman & Zeitz, 2002; Seo & Creed, 2002). Most empirical studies have focused on either (processes of) conformation or transformation of established institutional logics and structures. The theoretical frameworks of Oliver (1991) and Suchman (1995) suggest that there might exist a wider variety of strategies to respond to institutional pressures and legitimacy crises, although these have not been empirically investigated. Moreover, past research has defined these different strategies primarily at more macro-levels of analysis (*i.e.,* the organization within its institutional environment). Consequently, in order to develop a micro-institutional perspective on radical innovation within established high-tech companies, we choose to investigate with more detail and at micro- and actor levels of analysis what kind of strategic responses innovative actors use to augment the legitimacy of radical innovation. This leads to the following research question:

2. What strategies do innovators use to address legitimacy crises, potentially augmenting the legitimacy of their radical innovation activities within established high-tech companies?

*Institutional circumstances and opportunities*

Research on agency within institutions and institutional entrepreneurship acknowledge that although institutions direct and constrain the behavior of individual actors, actors have several degrees of freedom in response, among them to initiate transformation of established institutions. Through processes of reflexivity, awareness and participation in multiple institutional spheres, actors are able to criticize, reframe and renegotiate established institutional fabrics (*e.g.* Giddens, 1984; DiMaggio, 1988; Greenwood & Hinings, 1996; Scott, 2001; Seo & Creed, 2002; Dorado, 2005; Greenwood & Suddaby, 2006). These authors have tried to understand how specific characteristics of the institutional logic and structure enable actors to initiate institutional change (*e.g.,* institutional contradictions), and how some actors are better positioned within the institutional network to do so (*e.g.* their embeddedness). These extensions to traditional institutional theory are highly relevant to understand not only the constraining

and stabilizing effects of institutions, but also to understand the ways in which institutions are changed and recreated.

Although past institutional research on innovation within established companies (*e.g.,* Dougherty & Heller, 1994; Vermeulen, *et al.* 2007) has acknowledged actors' agency and freedom to respond in different ways to particular illegitimacies and institutional pressures, the institutional circumstances and opportunities that enable actors to do this remain unexplored. Recent research on institutional entrepreneurship and agency within institutions at least suggests that not all actors are equally well positioned and skilled to follow particular strategies of legitimation, and that specific institutional circumstances offer opportunities that enable particular legitimation strategies while constraining others (DiMaggio, 1988; Greenwood & Hinings, 1996; Fligstein, 1997; Scott, 2001; Seo & Creed, 2002; Dorado, 2005; Battilana, 2006; Greenwood & Suddaby, 2006). In order to develop a micro-institutional perspective on radical innovation within established high-tech companies, it is thus necessary to investigate in more detail and at micro-levels of analysis which institutional circumstances enable innovative actors to initiate particular strategies to augment the legitimacy of radical innovation activities. This leads to the following research question:

3. What institutional circumstances enable or constrain innovating actors seeking to pursue particular strategies to augment the legitimacy of their radical innovation activities within established high-tech companies?

The answers to these three research questions will enable us to develop a more comprehensive micro-institutional perspective on radical innovation within established companies, helping to explain the difficulties and possibilities of radical innovation within these contexts. This micro-institutional perspective will address both the constraining and enabling effects of dominant institutional logics and structures of established companies on radical innovation, and will consequently be able to account for the stability and change of these institutional logics and structures. In the next section we will present a short outline of the rest of this thesis.

### 1.4 Outline of the thesis

In chapter 2 we will discuss the theoretical building blocks and initial outline of the micro-institutional perspective that will be used as starting point for this research. We will also elaborate in more detail on the ontological assumptions of institutional and structuration theory that have guided our inquiry over time. Although this thesis can be characterized as a theory development effort, this does not mean we will not use any *a priori* theory at all. As our review of past research shows, several relevant theoretical concepts offer a starting point for our inquiry and invite extension during the theory development process. This secures the grounding of our theory development effort in past research, but allows us also to

develop novel insights, concepts, and relationships. Chapter 3 will explain the research methodology followed in this thesis and elaborate on the case selection criteria, data collection methods, and most importantly the inductive and qualitative data analysis and theory development methods. In chapter 4 we present the longitudinal case descriptions of five different radical innovations within two different established high-tech companies. In chapter 4 we will also analyze the cases in terms of different types of legitimacy crises and different strategies used by innovators to overcome these crises. Chapter 4 thus presents the answers to research question 1 and 2. In chapter 5 we continue the analysis of the cases and identify the different institutional circumstances that offered opportunities favoring particular legitimation strategies. This chapter consequently answers research question 3. In chapter 5 we will also synthesize the answers to research question 2 and 3, and develop an integrated model that explains how innovators make use of particular institutional opportunities to pursue the different strategies identified. This model is part of the micro-institutional perspective developed, and is one of the major contributions of this thesis. Chapter 6 will summarize the micro-institutional perspective and theory development effort and discuss its theoretical relevance for institutional research on innovation. Several future research questions will be identified. In this chapter we will also elaborate on the limitations, reliability and validity of the research findings. The final section of chapter 6 ultimately summarizes the main conclusions of this thesis.

# Chapter 2 Theory

## 2.1 Introduction

In the next sections the initial outline of the micro-institutional perspective is defined that forms the starting point of this thesis. Because the aim of this thesis is to develop and extend theory, this initial outline allows for extension with novel concepts and relationships based on our empirical investigation and the answers to the research questions. However, because there is a relevant body of knowledge on institutions, legitimacy and innovation, it is necessary to build upon and link the micro-institutional perspective to previous research as well. Therefore, the initial outline of the micro-institutional perspective will build upon past institutional and legitimacy theory and will particularly integrate several concepts and ideas of the theoretical framework of Suchman (1995). The latter framework is based on an extensive review of past research on legitimacy and legitimation from both strategic and institutional perspectives. Suchman (1995) has identified different types of legitimacy and different types of legitimation strategies that can be used to augment the legitimacy of actions of an entity vis-à-vis dominant institutional logics and structures. The framework of Suchman (1995) will be elaborated and translated to the context of radical technological innovation within established high-tech companies in the next sections. Before we go deeper into the different types of legitimacy and legitimation strategies as identified by Suchman (1995), we will first elaborate on the (micro-)institutional and structuration view of organizations and related ontological assumptions that guide this inquiry.

## 2.2 Organizations as micro-institutions

*Organizations as micro-institutions*

Central idea of this thesis is to use an institutional perspective to explain the difficulty and possibility of radical technological innovation within established high-tech companies. The idea to view companies as institutions is not new, although usually organizations like hospitals, banking services, schools, universities, or government agencies are viewed and treated more easily as being an institution. However, Selznick (1957) already identified some institutional characteristics of companies that transcend the primarily rational notions of organizational structures and procedures. He states that organizations, consisting of expendable structures and techniques (*i.e.* means) to achieve designated ends, become infused with value over time and acquire a distinctive identity of their own, and consequently evolve into institutions:

> "...Institutionalization is a process. It is something that happens to an organization over time, reflecting the organization's own distinctive history, the people who have been in it, the groups it embodies and the

> vested interests they have created, and the way it has adapted to its environment..." (Selznick, 1957: 16).
>
> "...The transformation of expendable technical organizations into institutions is marked by a concern for self-maintenance. A living association blends technical aims and procedures with personal desires and group interests. As a result, various elements in the association have a stake in its continued existence... As an organization acquires a self, a distinctive identity, it becomes an institution. This involves the taking on of values, ways of acting and believing that are deemed important for their own sake. From then on self-maintenance becomes more than bare organizational survival; it becomes a struggle to preserve the uniqueness of the group in the face of new problems and altered circumstances" (Selznick, 1957: 21).

Organizations can be viewed as institutions, not only consisting of formal structures and procedures to enhance efficiency in order to achieve organizational goals, but also infused with values and vested interests and contain shared understandings of social reality, organizational purpose and identity that are reproduced by the organizational members (Selznick, 1957; Dougherty & Heller, 1994; Ocasio, 1997; Scott, 2001; Vermeulen *et al*., 2007). As such, organizations as institutions are enduring systems of belief and behavior that constrain and enable the conduct of individuals. We experience them as having an external reality, as something objectively real that exists outside our individual thoughts (Dougherty & Heller, 1994). Human conduct within organizations thus does not occur in a social vacuum, but is governed, enabled and constrained by socially shared regulative, normative and cognitive-cultural conventions (Scott, 2001). These conventions are embodied within the institutional structure and logic and acquire a high degree of resilience to change, thus providing stability and meaning to the social and economic life of organizational members. It is easy to identify institutional characteristics of long established companies when strong views of organizational identity have developed, and when organizational members adhere to and maintain distinctive and socially shared values and norms of for instance, professionalism, innovativeness, trustworthiness, or social responsibility.

Organizations as institutions are self-maintaining, stable and resilient to change. This means that vested interests, organizational identities, and shared values (*i.e.* the institutional logics and structures) remain stable over longer periods of time and are not changed easily by any of the organizational members. This is explained by:

> (1) the pre-selection among potential new organizational members (job applicants) when organizational identity and values are strongly communicated to the outside world. In that case, only job seekers will apply that feel affiliated with the organizational identity, and which share the institutionalized values and aspirations. This pre-selection reinforces the already existing institutional logic of the organization.

> (2) institutions also consist of institutional mechanisms that direct and align the actions and behaviors of organizational members with institutional logics and structures (*i.e.,* institutional pressures for conformity; Scott, 2001). The organization as institution embodies many regulative and formal procedures and structures to align the actions of its members with dominant institutional logics, such as for instance: resource allocation mechanisms, distributions of decision making authority, management control systems, contracts, HRM practices, codes of conduct, job training, function descriptions, reward and penalty mechanisms, and so on.

Besides regulative and formal procedures, various social mechanisms enhance homogeneity and stability within institutions and align individual behavior with dominant institutional logics as well, such as peer and group pressures, social imitation, mutual adaptation, and principles of reciprocity and homophily (*e.g.* 'birds of a feather flock together'). Both these formal, regulative and social mechanisms maintain the institutional logic, defend the *status quo* and increase stability.

*Structure and agency*

The above mentioned view implies that organizations are self-maintaining institutional systems that embody vested interests, shared values, and shared views of organizational reality and identity (*i.e.* the institutional logic), which also consist of institutional and social mechanisms that align the behavior of organizational actors accordingly (*i.e.* institutional structures). This suggests that there is very little room for actors to make deliberate choices, do 'something different' or initiate change. This view of organizations as institutions tends to become overly deterministic and neglects the voluntaristic dimension of managerial and organizational life. However, as suggested and discussed in chapter 1, an institutional view of organizations will allow for agency when we incorporate several ontological assumptions of structuration theory (Giddens, 1984) into our approach, similar to other institutional theorists as Barley and Tolbert (1997), Hardy and Phillips (1999), Ocasio (1999), or Scott (2001). Two ontological assumptions of structuration theory are relevant to our view of organizations as micro-institutions. First of all, Giddens (1984) introduced a *duality* of structure and action to overcome dichotomist thinking in terms of either voluntarism or determinism, where respectively agency or structure preclude the other. Secondly, Giddens (1984) assumes the competence and *reflexivity* of social agents within social systems that allows for deliberate choice and agency. We will elaborate on both assumptions in more detail.

In terms of Giddens's structuration theory (1984), structure (*i.e.* institutional logics and structures) and action (*i.e.* choice and actions of actors) are closely related and are representing a duality. Social life might be best understood as

comprising an iteration of structure and action in which each interacts with, and informs, the other. Social structure is recursively implicated in the process of social action, and not just 'constrains' action, but makes it also possible through processes of sensemaking, legitimation, and empowerment (de Rond, 2003). As such, social structure is both the precondition (or medium for) *and* consequence of action and agency, whereas the actions of human agents are inseparable from structure in being 'structured' and enabled by it. As De Rond (2003) states:

> "... [structure and action] are different but clearly related – structure is to action what language is to speech. As language enables conversation, so does conversation help the evolution of language by introducing new word configurations and new vocabulary or by retiring 'old-fashioned' words and expressions... Emerging from this duality is an intellectual lens that explains the production and reproduction of social systems as a function of human interaction, but informed by underlying social structures" (de Rond, 2003: 140).

As such, structure (*i.e.* institutional systems comprising of institutional logics and structures) consists of institutionalized features of a social system that have stabilized across time and space. These features both constrain actors in their choices and actions (by structuring them), but also enable actors to actually make sense of their choices and actions, legitimate them, and empower them by allocating resources to them. Consequently, also the notion of agency is redefined by Giddens (1984) in his view of the duality of structure. Although individuals necessarily draw upon existing structures to act and make sense of the world, and their practices are possible only because of these pre-existing structures, their 'agency' resides in their ability to 'act otherwise', 'say no' and have an effect on the social world, altering structures, or the rules and distribution of resources: "... to be able to 'act otherwise' means being able to intervene in the world, or to refrain from such intervention, with the effect of influencing a specific process or state of affairs" (Giddens, 1984: 14). Thus, although structures limit action, the agency of actors enables them also to draw upon pre-existing structures to direct actions in a different way, or 'say no' to them altogether (Giddens, 1984; Scott, 2001; de Rond, 2003). For innovating actors within established companies, this means that although particular institutional logics and structures may limit and constrain their pursuit of innovative activities, they are able to make use of other elements of the institutional logic and structure within the same institutional system to initiate change and legitimate innovation.

Besides the duality of structure, another important ontological assumption from Giddens's structuration theory that enables agency within institutions, is the competence and reflexivity of social agents. Giddens argues that individuals are reflexive and interpreting beings that continually monitor their actions while reflecting on their consequences (Giddens, 1984; de Rond, 2003). This knowledge is then incorporated in future behavior and by drawing upon existing rules and resources (*i.e.* structures) can become institutionalized and transform established

institutional logics and structures. Reflexivity is a precondition for agency, as it enables the framing of alternative choices and actions within institutions. As such, reflexivity and agency reside in "the interpretative processes whereby choices are imagined, evaluated, and contingently reconstructed by actors in ongoing dialogue with unfolding situations..." (Emirbayer & Mische, 1998: 966). Through processes of reflexivity, awareness and participation in multiple institutional spheres, actors are able to criticize, reframe and renegotiate established institutional fabrics and exercise their agency, even though pressures for conformity are present.

Incorporating the ontological assumptions of the duality of structure and the reflexivity of social agents into our view of organizations as institutions, relaxes the deterministic notions of traditional institutional theory. Institutional logics and structures do not only limit and constrain the actions and agency of actors *(i.e.* pressures for conformation), but also enable them to act and can be drawn upon to initiate change and transformation. And the reflexivity of social agents indeed allows them to interpret and be aware of the different choices they can make, the actions they can follow, and the (unintended) consequences those have, within the institutions they reproduce (or even reconfigure). These notions will be used to investigate the institutional circumstances that enable or constrain innovating actors in their actions to solve or overcome legitimacy crises.

**2.3 Legitimacy**

In this thesis we are interested in the typical legitimacy crises experienced by actors pursuing radical innovation within established high-tech companies. Therefore it is relevant to define more precisely what we mean by legitimacy and relate it to recent work on institutions and innovation. Although institutional researchers have defined and used the concept of legitimacy in similar ways, they also often address different but related dimensions or aspects of legitimacy in their work (*e.g.,* Elsbach & Sutton, 1992; Aldrich & Fiol, 1994; Dougherty & Heller, 1994; Suchman, 1995; Ruef & Scott, 1998; Human & Provan, 2000; Scott, 2001; Lounsbury & Glynn, 2002; Zimmerman & Zeitz, 2002; Suddaby & Greenwood, 2005; Reay, *et al.,* 2006; Tyler, 2006). Suchman (1995), in his extensive review of past research on legitimacy, provides a comprehensive definition of this central concept:

> "...*legitimacy* is a generalized perception or assumption that the actions of an entity are desirable, proper, or appropriate within some socially constructed system of norms, values, beliefs, and definitions" (Suchman, 1995: 574).

With the 'socially constructed system of norms, values, beliefs, and definitions', Suchman denotes the established institutional logic and structure. Consequently, actions of an entity are considered legitimate when these actions are perceived to conform or correspond with elements of the institutional system. The perceived correspondence with elements and aspects of the institutional systems grants the

actions of an entity legitimacy. In this thesis we will adopt the definition of Suchman (1995) and translate it to the phenomena of radical technological innovation within established companies. There are two important aspects of this definition that need elaboration. We will first focus on the notion of legitimacy as a perception or assumption, as well as its evaluative nature. Secondly, we will address the different institutional sources (and thus the different dimensions) that grant actions of an entity legitimacy.

The definition of Suchman (1995) states that legitimacy is a perception or assumption of some group of observers observing the acting entity. It represents a reaction of the observers to the acting entity as they see it. It furthermore states that actions of an entity are legitimate with respect to some socially constructed system of norms, values, beliefs and definitions. This means that actions of an entity are congruent with shared norms and beliefs of some social (and institutionalized) group, and thus dependent on a collective audience, and not on a particular, independent observer and its personal opinion. In other words, legitimacy is an evaluation of (proposed) action along institutionalized 'criteria'. This also means it is a reflexive process; actors reflect upon the consistency between their own and others' actions and that of socially shared interests, norms and beliefs. This implies that every aspect of radical innovation (actions) can become the subject of an evaluation of legitimacy. It also means that even the specific actions to change or build the legitimacy of an idea, can become its subject. In the evaluation of (proposed) actions of an actor by others as (il)legitimate, the institutional logic and structure are reproduced and enacted by the involved actors (Giddens, 1984; Barley & Tolbert, 1997 ; Scott, 2001)

As argued, legitimacy entails an evaluation of the correspondence of the actions of an entity with respect to institutionalized norms, values, beliefs and definitions. Actions are legitimate when they are *desirable*, *proper* and *appropriate* vis-à-vis institutional logics and structures (Suchman, 1995). These three different aspects (or dimensions) of legitimacy are based on different behavioral logics and stem from different institutional sources. Suchman (1995) identified three different types of legitimacy that stem from three different sets of elements of the institutional system, termed *pragmatic*, *normative* and *cognitive* legitimacy, respectively.

*Pragmatic legitimacy*

Pragmatic legitimacy is based on interest satisfaction of institutionalized stakeholder groups (Suchman, 1995). The proposed actions of an entity (and its related goals) can be responsive and beneficial to the interests of specific groups within institutional systems. Actions of an entity are evaluated based on the expected value of these actions for involved groups. At the level of groups within an organization, pragmatic legitimacy boils down to some kind of exchange legitimacy (Suchman, 1995) – the support for a particular course of innovative action is based on the expected value of that course of action and its consequences

to particular institutional stakeholders. Pragmatic legitimacy in the context of, for instance, decision making about the exploration of radical technological innovations then centers on the evaluation whether the innovation is *beneficial* to (or satisfies) the established interests of institutional actors and groups.

*Normative legitimacy*

Normative legitimacy[2] is based on a positive normative evaluation of the entity, its actions and their consequences (Suchman, 1995). Observers of the acting entity evaluate its actions and consequences along the observer's socially constructed value system. These evaluations (or judgments) reflect the observer's beliefs about whether the actions and consequences of the entity 'are the right or *good* thing to do'. At the societal level, normative legitimacy rests not on judgments about whether actions and consequences are beneficial to the observers, but rests on judgments about whether actions and consequences contribute to societal welfare and the general 'good'. At the level of established companies, actors of course internalize and carry these socially shared norms and values that extend the boundaries of the organization. But particularly at older companies, we suggest that company-specific norms, values and codes of conduct for doing business and carrying out work and innovation processes may also be part of these shared norms and values. Norms and values can be embedded within rules and procedures defined at the organizational level to regulate the behavior of actors working on radical innovation. For instance: one should not waste scarce resources on risky projects, one should oblige to established agreements, one should not make mistakes, etcetera. The evaluation of normative legitimacy within established companies thus considers the perceived correspondence of the (proposed) actions with institutionalized norms, values, rules and procedures that define how organizational actors 'ought to behave' and what is considered *proper* and appropriate behavior.

*Cognitive legitimacy*

The cognitive legitimacy of the actions of an entity rests on the *comprehensibility* of these actions according to an observing audience (Suchman, 1995). Cognitive legitimacy stems from the availability of established cognitive schema, beliefs and meaning structures that enable plausible explanations of the entity and its actions – these cognitive schema and beliefs make it meaningful and predictable. Although institutionalists traditionally focus more on cultural-cognitive models that provide meaning, cognitive legitimacy within organizations is strongly related to sense making, framing and learning processes within organizations (Weick, 1979, 1995; Weick *et al.*, 2005; Levinthal & March, 1993; Kaplan, 2005). Established companies more likely will have learned and institutionalized specific views of reality as well as

[2] Suchman (1995) uses the term 'moral legitimacy' instead of 'normative legitimacy' and focuses more on aspects of morality and ethics at the societal level. At the level of established companies, we translate this to 'normative legitimacy', and focus instead on more local institutionalized norms, values, rules and procedures that define what is 'proper' behavior of actors within the organization.

their role and function within their environment. Established companies can have strongly institutionalized views of organizational identity and consequently strong opinions on which (innovative) actions do or do not belong to them. Also specific schema in use to make sense of the organization's strategy can become institutionalized and can rule out alternative views and strategic options. For instance, if a company sees itself as strongly market and customer focused, driven by an outside-in view of strategy (*e.g.* Porter) where external (market) trends and changes in competitor's positions define organizational strategy, pursuing technology push innovations with unclear market potential does not really make sense. By contrast, companies that focus on their competencies and unique capabilities, and are driven by an inside-out strategy (*e.g.* Prahalad & Hamel) in which core competencies are stretched and leveraged into novel markets and domains, pursuing such a technology push innovation is highly sensible and legitimate (see Vos, 2002). As argued, the cognitive legitimacy of (proposed) actions thus stems from the correspondence of the framing of these actions with institutionalized cognitive schema and distinctions in use that amongst others define organizational reality, strategies and identities.

These three different types of legitimacy will be used in this research to identify legitimacy crises during radical technological innovation within established high-tech companies. When radical innovation ideas and actions are perceived as not beneficial to institutional actors, not proper with respect to institutional norms and rules, or incomprehensible with respect to established views of organizational reality, then we can characterize this as either a pragmatic, normative or cognitive legitimacy crisis, respectively. In general, pragmatic legitimacy centers on the alignment of actions with institutionalized interests; normative legitimacy centers on the correspondence of actions with institutional norms and rules; and cognitive legitimacy centers on the equivalence of the framing of the actions with institutionalized beliefs and cognitive schema. The exact operationalization and related coding categories and procedures for these different types of legitimacy will be discussed in the next chapter on methodology.

We adopt the typology of legitimacy of Suchman (1995) because it integrates and encompasses the different illegitimacies identified by Dougherty & Heller (1994), but structures them based on different theoretical dimensions and behavioral logics. The typology of Suchman (1995) is also closely related to the three pillars of institutions as defined by Scott (2001), although Scott focuses also (and more) on the different institutional *mechanisms* that govern behavior and enforce compliance with institutional interests, norms and beliefs (*i.e.,* pragmatic, normative and cognitive aspects of the institutional system). Scott (2001) argues that institutions consist of both regulative, normative and cultural-cognitive systems that govern the actions of actors within institutions and account for the stability of these institutions. The regulative pillar refers to the institutional systems that constrain and regulate behavior through rules and coercive mechanisms in order to guard institutionalized interests. The underlying logic of this pillar is a logic of instrumentality which primarily governs the economic actions and self-interested

behavior of actors within institutions. In terms of Suchman (1995) the compliance of the actions of an entity with the regulative system accounts for pragmatic legitimacy (although Suchman focuses more on institutionalized interests than on mechanisms of regulation and laws). The normative pillar of institutions as defined by Scott (2001) refers to the normative rules that introduce a prescriptive and obligatory dimension into social life. Underlying the normative system of institutions is a logic of appropriateness (March & Olsen, 1989) where the actions of actors are evaluated against shared normative expectations and rules regarding their role and related behavior within the institution. In terms of Suchman (1995) conformation to these binding normative expectations and rules grants the actions of an entity normative legitimacy. The cultural-cognitive pillar of institutions defined by Scott stresses the importance of "... the shared conceptions that constitute the nature of social reality and the frames through which meaning is made" (Scott, 2001: 57). Common beliefs and shared logics of action direct how meaning is created and reality is enacted by actors within institutions. The legitimacy of actions with respect to the cultural-cognitive system depends on the adoption and reproduction of these common beliefs and shared logics by actors and is denoted by Suchman (1995) as cognitive legitimacy.

Although the three types of legitimacy are analytically distinct, most authors stress the fact that the three types are strongly interwoven and that the related institutional mechanisms mutually reinforce each other in their influence on the actions of actors within institutions (Suchman, 1995; Scott, 2001; Wicks, 2001; Vermeulen, *et al.*, 2007). For instance, an organizational procedure that describes a formal decision making process to align innovation activities with a designated strategy (*i.e.,* interest alignment) is reinforced by normative expectations that employees should agree with formal decisions from a higher authority. Moreover, during the execution of the procedure, established frames and shared beliefs of what 'decision making', 'innovation' and 'strategy' is, are enacted and reproduced in the realm of action. As such, legitimacy can best be viewed as a *multi-dimensional* concept, consisting of strongly interwoven pragmatic, normative and cognitive evaluations, which are analytically distinct but appear in empirical reality as different sides of the same coin, where one side may be stronger emphasized than the others. In this thesis we will use the term 'institutional logic and institutional structure' to denote the self-reinforcing fabric of pragmatic, normative and cognitive institutional elements and mechanisms. The legitimacy typology of Suchman (1995) will be used as a starting point to investigate the different legitimacy crises that occur during radical innovation processes within established high-tech companies and will be grounded empirically.

## 2.4 Strategies of legitimation

Besides our interest in the different types of legitimacy crises that can occur during radical innovation processes within established high-tech companies, we are also interested in the different strategies of innovating actors to overcome these crises and augment the legitimacy of radical innovation. The framework of Suchman

(1995) also offers promising starting points for the investigation of different strategies of legitimation. Suchman (1995) in his extensive review of empirical and theoretical work on legitimacy and legitimation identifies different legitimation strategies that either focus on gaining, maintaining or repairing legitimacy. As this research specifically focuses on radical technological innovations and explorations that lack legitimacy (with respect to pragmatic, normative and cognitive institutional elements), we will concentrate on legitimation strategies that *'build'* legitimacy. The focus on strategies that build legitimacy assumes a rather proactive behavior of innovating actors in assessing needs for legitimation and actively influencing (internal) stakeholders to achieve this (*cf.* Frooman, 1999; Howell & Higins, 1990; Friedman & Miles, 2002). In his review, Suchman (1995) has identified different legitimation strategies that build pragmatic, normative and cognitive legitimacy. We will translate these strategies to the context of radical innovation *within* established high-tech companies. These legitimation strategies fall into three broad clusters: (a) efforts to *conform* to institutional interests, norms and beliefs of established institutional groups within the organization (*i.e.* micro-institution), (b) efforts to *select* among multiple institutional groups within the organization that will support the course of action, (c) efforts to *transform* established institutional logics and structures, and create novel and better legitimating interests, norms and beliefs, with respect to the radical innovation. These strategies clearly fall along a range from relative passive conformity, to more active and resistant transformation (Oliver, 1991). It is important to note that Suchman (1995) has based this typology upon processes and strategies of legitimation that can be identified in the context of an organization and its institutional environment. In this research, however, we focus on radical technological innovation within the context of an established company. This means that legitimation strategies are directed at institutionalized organizational groups and institutional actors within organizations that determine what is legitimate and what is not. In the next sections we will more closely define the different strategies of legitimation in the micro-institutional context of radical innovation within established companies.

*Conformation strategies*

Conformation strategies consist of efforts to match the course of action and goals associated with the exploration of radical technological innovations with established interests, norms and beliefs of preexisting institutional groups within the organization. Conformation means that the proposed course of action and the associated goals are adapted to incorporate or include established interests, norms and beliefs of relevant institutional groups. It means that the ideas for radical innovation are adapted to be consistent with established practices and expectations and to fit in established structures. However, the ideas for radical technological innovation are only malleable to a limited extent – adapting the proposed course of action and its goals too far might in the end make it 'legitimate', but also nonsensical or irrelevant; it can lead to goal displacement and deradicalization and not lead to 'exploration' as proposed by the innovating actors,

who consequently can lose their interest, enthusiasm and commitment for the innovation ideas (Suchman 1995).

The nature of conformation will be somewhat different for achieving pragmatic, normative or cognitive legitimacy. For building pragmatic legitimacy conformation rests on conforming to demands and needs of established groups – incorporating their needs, interests or goals in the proposed course of action and intentions. For building normative legitimacy the proposed course of action and outcomes should conform to the apparent norms, rules and values of established groups within the organization. This can be done for instance by associating the proposed course of action with established norms of professionalism – using existing scientific techniques, established methodologies and following institutionalized procedures (Dougherty & Heller, 1994). For building cognitive legitimacy, conformation means that the established cognitive schema and beliefs (*e.g.* labels, distinctions in use and shared cognitive models of reality) of institutional groups are used to frame, talk about and justify the exploration of radical technological innovation. In chapter 3 on methodology, the definition and coding procedures for this strategy are operationalized in more detail.

*Selection strategies*

Instead of adapting the proposed course of action to conform to the interests, norms and beliefs of institutional groups and actors within the organization, *selection strategies* consist of selecting a different institutional group within the organization, with different established interests, norms, and beliefs that legitimate the innovation ideas in a better way. This means efforts are made to find alternative institutional groups or actors for which the radical technological innovation is more legitimate, and hence where relatively small, if any, changes are demanded (Suchman, 1995). Thus, rather than conforming to the demands of a specific setting, proponents of radical technological innovation may attempt to locate a more friendly 'environment' in which otherwise illegitimate activities appear more beneficial, good and comprehensible. This means that innovating actors pursuing a selection strategy attempt to break out of the established structures and institutional logics of their specific setting, and get access to other established groups or actors within their organization that are more willing to support the exploration of radical technological innovation. Selection strategies are possible in organizations that consist of multiple institutional groups that have diverse, and partially idiosyncratic institutionalized interests, norms and beliefs.

*Transformation strategies*

When it is not possible or desirable to select a more friendly micro-institutional environment or align the ideas for radical technological innovation with established interests, norms and beliefs, innovating actors can attempt to

*transform*[3] existing institutional logics, and shape and institutionalize novel interests, norms, rules and cognitive schema that grant the radical innovation legitimacy (Suchman, 1995; Dougherty & Heller, 1994). Shaping and stimulating new interests, norms and beliefs and mobilizing actors and institutional groups around them is a complex and difficult task. New interests can be shaped by promoting and demonstrating the radical technological innovation to relevant institutional actors and groups, and show new emerging trends (or strategic problems) in the environment of the organization that become important and are linked to the radical innovation (Suchman, 1995). Also displaying dramatic future strategic visions for the organization, which require change and radical innovation, contribute in stimulating new interests and a sense of urgency. These can also help to demonstrate that old established practices do no longer suffice, and new organizational structures, routines and cognitive models are needed to enable radical technological innovation. Transformation strategies aim to mobilize a substantive coalition of believers around these novel interests, norms and beliefs that can influence decisions to allocate resources to the exploration of radical technological innovation.

The three identified types of strategies to build legitimacy of Suchman (1995) also encompass (and partially abstract) different typologies of responses and legitimation strategies as developed by other authors. For instance, the typology of strategic responses to institutional pressures as developed by Oliver (1991) can be translated (and mapped) onto Suchman's typology. The legitimation approaches as identified by Dougherty & Heller (1994) can also be captured under the more general typology of Suchman (1995). The typology of Suchman seems to be both general and accurate enough to identify relevant legitimation actions. Consequently, this typology of legitimation strategies will be used in this thesis as a valid starting point for the investigation of the strategic responses of innovating actors to overcome legitimacy crises during radical innovation processes within established high-tech companies. In the next chapter on methodology, the definitions of the legitimation strategies (*i.e.* strategic responses) will be operationalized in more detail and related coding procedures will be grounded in empirical reality.

[3] Suchman (1995) uses the term 'manipulation' instead of 'transformation' to denote the creation, stimulation, and shaping of novel interests, norms and beliefs and the mobilization of coalitions of supporters around them. We prefer the use of the term 'transformation' over 'manipulation' because it has no negative connotation. Besides, transformation is a better description for the process of introducing and linking novel elements (interests, norms, beliefs) to existing institutional logics and structures and change it in something new. Moreover, other relevant authors use the term 'transformation' in a similar vein to denote processes of institutional change and transformation (*e.g.* Greenwood & Suddaby, 2006)

## 2.5 Outline of a micro-institutional perspective

Based on the view of organizations as institutions and the initial typologies of legitimacy crises and legitimation strategies, we can now develop the initial outline of the micro-institutional perspective that helps us to investigate the research questions. First of all, we are interested in the different types of legitimacy crises that occur in the context of radical innovation within established high-tech companies (*research question 1*). The legitimacy of proposed radical innovation activities consists of the evaluation of proposed actions along institutionalized pragmatic, normative and cognitive dimensions of the institutional logic and structures. Therefore, we are interested in characteristics of the radical innovation activities and characteristics of the dominant institutional logic and structure and its relationship with the occurrence of legitimacy crises (see Figure 2-1). Secondly, we are interested in the different types of legitimation strategies and strategic responses of actors within established high-tech companies to overcome these legitimacy crises and augment the legitimacy of proposed innovation activities (*research question 2*). These strategic responses will follow the occurrence of typical legitimacy crises (see Figure 2-1).

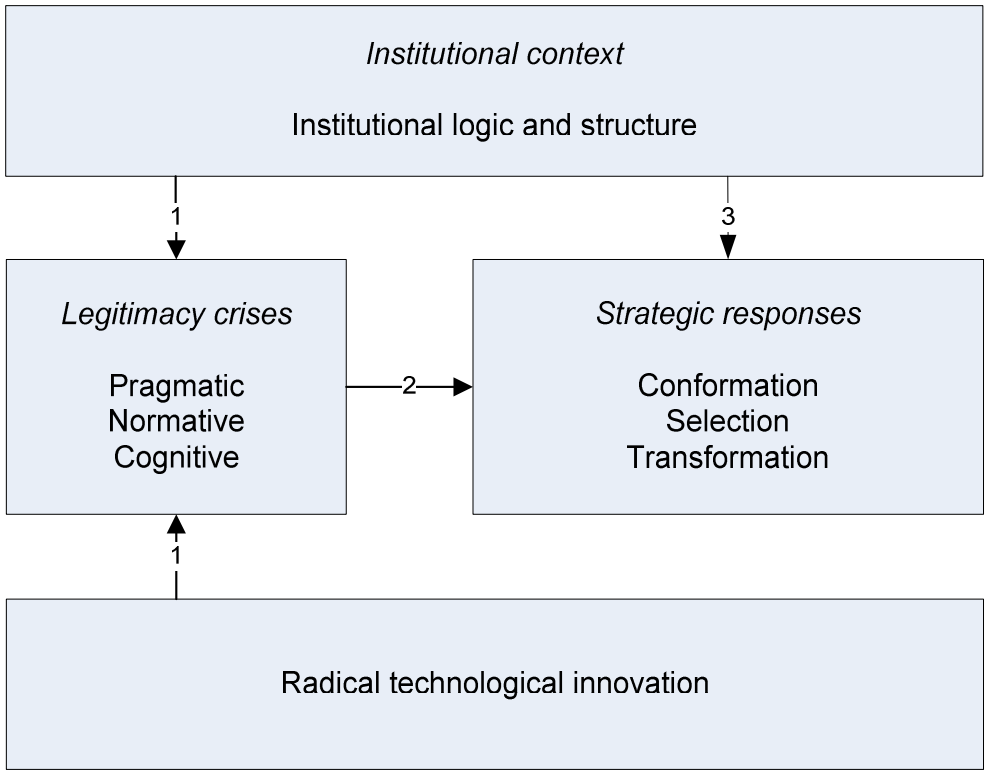


**Figure 2-1 Initial outline of the micro-institutional perspective**

Thirdly, as these strategic responses are enacted and pursued within an established institutional system, we are also interested in the characteristics of the institutional logic and structure that either constrain innovative actors in their choice for particular responses, or that instead enable (and offer institutional

opportunities to) innovative actors to choose alternative strategic responses (*research question 3*). We are thus interested in the enabling and constraining characteristics of the established institutional logic and structures on the strategic responses of innovating actors to overcome legitimacy crises during radical technological innovation within established high-tech companies (see Figure 2-1).

The initial outline of the micro-institutional perspective as developed in this chapter, is left rather abstract and non-conclusive to allow for translation to the context of radical technological innovation within established high-tech companies, and to allow for extension with novel types, characteristics, concepts and relationship to accommodate novel empirical findings. As such, this initial outline (or model) will be operationalized, empirically grounded and extended during this thesis, in order to develop a micro-institutional perspective on radical innovation within established high-tech companies that explains both the difficulty and possibility of radical innovation within established companies, by examining both the constraining and the enabling effects of institutional logics and structures on the actions of radical innovators.

# Chapter 3 Methodology

## 3.1 Introduction

The aim of this thesis is to develop a micro-institutional perspective on radical technological innovation within established high-tech companies, which characterizes this thesis as a theory development effort. In this chapter we will outline the methodology and related methods and techniques for data analysis that allow us to translate, extend and develop theory, while building upon and incorporating theoretical ideas from past research. The methodology used in this thesis is an adapted form of case study research (Yin, 2003; Swanborn, 2003; Eisenhardt, 1989) and grounded theory development (Glaser & Strauss, 1967; Strauss & Corbin, 1998). It uses qualitative data analysis techniques (Miles & Huberman, 1994; Strauss & Corbin, 1998) to extend theory and discover novel concepts, relationships and mechanisms, and ground it in empirical observations. In the next sections we will carefully outline the methodology, data analysis and theory development techniques, and related validity and reliability issues.

## 3.2 Case study research

*Case studies*

Case studies allow for close and intimate investigation of the phenomena of interest and are specifically suitable for extending and developing theory (Yin, 2003; Eisenhardt, 1989). Instead of testing hypothesis and measuring variables across a large number of subjects (or cases) randomly selected from a population, case studies focus on the selection and investigation of a small number of cases for reasons of in-depth theoretical exploration and advancement. By focusing on a small number of exemplary cases, selected for theoretical reasons, the researcher is able to investigate in close detail multiple characteristics of the interpretations of involved actors, their actions, and the (historical and institutional) context in which certain social activities occur. The aim of this research is to develop a micro-institutional perspective on radical innovation within established companies. The emergence of legitimacy crises (which are evaluative and reflexive by nature), the strategies of involved actors to solve these legitimacy crises (which are partially symbolic, involve sensemaking, and are strongly based on communication) and the enacted characteristics of the institutional context are of central interest to this perspective. Acquiring insight in these concepts and relationships requires close interaction with involved actors and detailed investigation of a limited number of insightful cases, which also allows for cross-case comparison to discover patterns across the cases and increase the robustness of our findings. As such, doing case studies is highly suitable for the objective of this thesis.

*Case selection*

The selection of cases is based on a theoretical sampling logic (Yin, 2003; Eisenhardt, 1989), and is determined by the aim of this thesis and the phenomenon of interest. As stated in chapter 1, we want to develop a micro-institutional perspective (theory) on radical technological innovation within established high-tech companies that explains both the difficulty and possibility of radical innovation within established companies, by examining both the constraining and the enabling effects of institutional logics and structures on the actions of radical innovators. As argued in chapter 1, we are specifically interested in radical innovation within established companies that do have a track record in innovation and are competent in incremental innovations and exploitation, but who experience difficulties with realizing radical innovation nevertheless. This implies that we selected companies that are operating within a high-tech industry, are long established and are competent (incremental) innovators. The two European companies selected for this investigation (PhemCo and OmegaCom/AlphaSys[4]) are operating in the advanced electronics industry and in the advanced chemicals industry, and exist both for more than 100 years[5]. Both companies have also successfully realized many incremental innovations over the years, and even introduced a number of radical technological innovations, although these were characterized by a complex and difficult innovation process (see chapter 4 for an overview of the histories of both companies).

Moreover, as stated in chapter 1, we focus on radical technological innovations (and their development process) that embody novel technologies or technological principles, address familiar or novel application areas, and focus on familiar or novel market segments (customer base). Within the OmegaCom/AlphaSys company, three different radical technological innovations have been selected that involve developing novel technologies and related competencies for the company (i.e. DaXo, Zapim and Icon). Both the DaXo and Zapim innovation also address novel application areas of the technology for the company (i.e. the company is not familiar with the specific application area of this technology, and thus also has to build up knowledge about it). The Icon innovation uses novel technology to address a familiar application area, for which AlphaSys already has existing technological solutions/products. Zapim and Icon are innovations that target existing and familiar customer groups of AlphaSys, while DaXo targets a novel customer group (see Table 3-1). At the PhemCo company, two different radical technological innovations were selected (Treemax and Reflactone). Both these radical innovations are novel to the company on all three dimensions. They embody novel technological principles, address novel application areas, and target

[4] For reasons of confidentiality and non-disclosure, the names of the companies (and interviewed actors) are made anonymous.

[5] As far as we know, there exists no clear age limit that defines when a company is established or not. To be on the safe side, we selected two companies that are relatively old (> 100 years) and have a long history in technology and science intensive industries and products.

novel customer groups and market segments, with respect to PhemCo (see Table 3-1).

| Innovations | Radicalness |
|---|---|
| **AlphaSys** | |
| DaXo | Novel technological competencies<br>Novel application areas<br>Novel customer base |
| Zapim | Novel technological competencies<br>Novel application areas<br>Familiar customer base |
| Icon | Novel technological competencies<br>Familiar application area<br>Familiar customer base |
| **Phemco** | |
| Treemax | Novel technological competencies<br>Novel application areas<br>Novel customer base |
| Reflactone | Novel technological competencies<br>Novel application areas<br>Novel customer base |

**Table 3-1 Radical technological innovation characteristics**

Moreover, we are specifically interested in how innovators were able to realize radical innovations despite the initial lack of legitimacy. We are interested in what types of legitimacy crises emerged and how they were solved or overcome by the innovators to enable innovation. We thus selected those cases where innovators were indeed able to realize radical technological innovations (*i.e.* 'successful' in terms of realization, not in terms of market success) even though legitimacy crises occurred within the context of the established high-tech company. This means, that we selected radical innovations that experienced severe legitimacy crises[6] during development and where the innovating actors have been able to overcome these crises and augment the legitimacy of the innovative ideas. Consequently, we

[6] After consultation with representatives (CTO Office members) of both companies, radical innovation projects (and processes) were selected that suffered from a lack of organizational support, or severe debates/conflicts over strategic relevance, intra-organizational collaboration, resource allocations, and go/no-go decisions.

did *not* select radical innovations that were discontinued and abandoned during the innovation process before a product was realized, or that did not suffer from any legitimacy crises.

For data collection and reliability reasons, *recent* radical innovations (mostly consisting of several related projects) were selected in consultation with members of the CTO Office (either with the CTO or Research Director himself, or CTO staff members). The selected five radical innovations were reaching the end of the research and development process at the stage of advanced prototype development or market introduction and industrial manufacturing. The initial ideas for the radical innovations were developed around 2000 for four of the five innovations (Icon, Zapim, DaXo and Reflactone). The initial ideas for Treemax emerged around 1994. We collected data about the legitimacy crises, strategies and institutional contexts that occurred in between the beginning of the innovation processes and 2006. Moreover, only radical innovations were selected for which the key stakeholders (scientists, developers, managers, marketeers, etc.) were still employed by the company and easily accessible.

As argued, for each of the five radical technological innovations that were developed by the two established companies, we are interested in the different legitimacy crises that emerged during the innovation process, the different strategies used by the innovating actors to overcome these crises, and the characteristics of the institutional context that enabled or constrained them to do so. This means that the actual unit of analysis (and thus the actual case) is the legitimacy crisis and the strategy to overcome it, within a particular institutional setting (*cf.* the initial outline of the micro-institutional perspective of chapter 2). We consequently investigate and compare multiple cases of crisis/strategy/context, which differ with respect to the radical innovation context and the company context in order to reduce innovation and company/industry specific findings and increase robustness and validity. As will be demonstrated in chapter 4, a total of 23 different cases of crisis/strategy/context are identified across the five radical innovation processes at the two companies. These 23 cases form a broad dataset for cross-case comparison and data analysis and will allow for the development of theory with sufficient complexity (*cf.* Eisenhardt, 1989).

### 3.3 Data collection

In order to study how legitimacy is evaluated and what legitimacy crises arise, what legitimation strategies are used, and how innovating actors are able to enact and use institutionalized logics and structures to augment the legitimacy of radical innovation, it is necessary to focus on the reflections, interpretations and actions of both innovating actors and those actors that reproduce (and represent) the existing institutional order (*i.e.* institutional actors). One of the most suitable ways of collecting data about interpretations and actions of the involved actors, would be participant-observation during the whole innovation process. However, because radical innovation processes usually take a long time (the innovation processes

studied in this thesis took between 5 to 12 years from idea generation to prototype development or initial commercialization) and because a single researcher cannot observe multiple individuals at different places at the same time, it was decided to do 'historical' case studies and collect data primarily through extensive interviews with key stakeholders of the radical innovation process. This resulted in a large amount of qualitative data that reveals the opinions, interpretations, and actions of both innovating and institutional actors with respect to legitimacy, legitimation and enacted institutional logics and structures. In the following part of this section, the procedures for data collection are elaborated to give insight in the reliability of the data.

*Selecting key stakeholders*

Usually, the number of people involved in the radical innovation process was relatively small (consisting of 4 to 8 people). This is explained by the fact that most of the research and development force of established companies is dedicated to incremental innovation, and smaller budgets and resources are available for radical innovation. Moreover, especially in the initial stages of research and development, adding large numbers of personnel to a project does not reduce lead-time or improve efficiency, as research and invention is highly unpredictable and dependent on serendipitous discoveries. However, for data collection and doing interviews this was beneficial. Only a small number of individuals had to be interviewed to get a reliable insight in the evolution of the innovation process and the legitimacy crises and legitimation strategies followed. For each of the radical innovations at least three to five involved stakeholders were extensively interviewed to get insight in the different perceptions of legitimacy and enacted institutional logics and structures and corroboration of the findings. We chose at least one person that was involved from a research and development discipline (scientists, engineers), one person that was involved from a marketing/business development discipline (marketeers, new business developers, sales managers), and one person that was involved from senior and upper management perspective and had decision making authority (research department directors, technology strategy directors, corporate venturing and new business development directors). Usually, we interviewed the project manager responsible for the innovation first, and when new names of relevant stakeholders where mentioned, we tried to interview those as well (see Table 3-2).

*Conducting interviews*

We conducted interviews with the above mentioned individuals in 2005 and 2006. On average each of the interviews took about 1,5 to 2 hours and all interviews were recorded and transcribed. The resulting transcriptions were send back to the interviewees for corrections or additions. If issues emerged that remained unclear or ambiguous we asked for clarifications through email, telephone or during a follow-up interview. The transcribed interviews resulted in about 600 pages of interview texts.

| Innovation | Period | Key actors interviewed |
|---|---|---|
| **AlphaSys** | | |
| DaXo | 2000 - 2006 | Senior scientist<br>Research group manager<br>Business developer DaXo<br>2 Technology strategy directors |
| Zapim | 2001 - 2006 | Senior scientist<br>2 Research department directors<br>2 Technology strategy directors |
| Icon | 2001 - 2006 | Design director<br>Marketing manager<br>Project manager internal supplier<br>2 Technology strategy directors |
| **Phemco** | | |
| Treemax | 1994 - 2006 | Senior scientist<br>General manager Treemax<br>Sales manager Treemax<br>Director of NBD group |
| Reflactone | 2001 - 2006 | Senior scientist<br>Business developer Reflactix<br>Director of NBD group |

**Table 3-2 Radical innovations, period of investigation and interviewed actors.**

The interviews were of a semi-structured nature and consisted of three main parts. In the first part of the interview, we asked for a short summary of the main events, critical decisions and conflicts that occurred during the whole innovation process to get a grasp of its history and main crises of legitimacy. During the second part, we focused our questions on those issues during the innovation process that signified a lack of organizational support for the innovation, resistance from organizational groups, conflicts over resource allocations or debates over go/no-go decisions as indicators of potential legitimacy crises. We asked in more detail about the reasons for this resistance, lack of support, conflicts or debates concerning the innovation ideas to get better insight in the potential legitimacy crises that underlie these observations. We also asked who the involved stakeholders or groups were, and what they did to solve these issues in order to continue with the innovation. We inquired about the results of these actions in

terms of changes to the innovation ideas, or changes in the views/perceptions of resisting organizational groups and actors, to get a better insight in the effects of these strategic responses to overcome legitimacy crises. And, we asked about the reasons why particular actions were chosen and why they were allowed to do so, to get insight in the contextual and institutional characteristics that enable or constrain particular strategic responses (*i.e.* legitimation strategies). In the third and final part of the interview, (legitimacy) issues were addressed that had been identified and brought up by other stakeholders previously interviewed, to cross check and validate these issues. The semi-structured nature of the interviews and the open questions asked (what, why, when, who, how), helped to prevent imposing interpretations of the researcher/interviewer onto the interviewed subject.

*Member checks*

As said, all interviews were recorded and transcribed by the researcher. The transcriptions were send back to the interviewees for additions or corrections. After all interviews had been finalized, we developed a description of the history of the radical innovation process, including the main events and critical issues that emerged during the process, based on all interviews about a particular innovation. This integrated description did not contain any theoretical interpretations. The case description of the history of the innovation was then submitted to all interviewed persons for another member check, and subsequently corrections or additions were incorporated. The member checks of the data, and corroboration of the observations of a single interviewee by the others, enhanced the reliability of the data and reduced retrospective bias of individuals (Yin, 2003; Huber & Power, 1985).

*Data triangulation*

In addition to the detailed interviews with key stakeholders, secondary data were collected to triangulate the factual data of the interviews and enhance the reliability of the set of empirical data. Secondary data consisted of project proposals, patents, and presentations, articles and other public publications about the innovation and (innovation) strategies of both companies, totaling around 250 pages (Jick, 1979, Yin, 2003).

*Confidentiality and non-disclosure*

It is important to note that the collection of data about strategically relevant radical innovations and about organizational 'conflicts' or resistance against these innovations, is surrounded by issues of sensitivity and confidentiality. Both companies were concerned about the sensitivity of this data and did not want it to be published or distributed without their explicit agreement. Also the interviewed persons were concerned that confidential information about the technology and business plans would leak out via the researcher. In response to these concerns and

to allow the interviewees to speak freely, the researcher signed a secrecy agreement, and agreed to make names of persons, technologies, and organizations anonymous in any publications and omit or disguise technical or economic details not relevant to the subject of investigation. These agreements served to get access to all relevant internal stakeholders and enabled free discussion. The secrecy agreements did not have any effect on the investigation of the social phenomena of legitimacy crises, legitimation strategies and institutional contexts. Representatives of both companies did not demand any adaptations to the writings about these observations and the developed micro-institutional perspective and related models. The secrecy agreements concerned specifically the confidentiality of technological information, economic figures and numbers, and names of strategic partners, insofar these were not already publicly known. Besides, the research project of the researcher was not financially supported by any of the companies, which allowed him to follow his own interests and limited sponsorship influence or bias on the scientific results.

### 3.4 Qualitative data analysis and theory development principles

In this section the principles and techniques for analyzing the data and refining and extending the theory are outlined. The data analysis procedures are based upon the qualitative data analysis techniques of Miles and Huberman (1994) and Strauss and Corbin (1998). The approach followed here departs from traditional grounded theory development (Glaser & Strauss, 1967; Strauss & Corbin, 1998) by using the initial outline of the micro-institutional perspective of chapter 2, and the related concepts and relationships, as intellectual lens and initial coding categories to analyze and organize the data (following a similar approach as *e.g.,* Suddaby & Greenwood, 2005; Reay *et al.,* 2006; Vermeulen *et al*., 2007). Strictly speaking, grounded theory development starts with as little as possible theory to allow for discovery and novel theory construction from the empirical data[7]. Although our data analysis and theory development approach will purposively start from relevant previous theories and already incorporates theoretical concepts and relationships, the procedures from grounded theory methodology and qualitative data analysis techniques do enable the translation and refinement of these concepts to the context of interest, and help to extend the initial outline of the micro-institutional perspective with novel concepts and relationships that emerge from the data. Furthermore, these procedures help the researcher to make sense of large amounts of qualitative data in a structured and reliable way. Several central principles of grounded theory development (Glaser & Strauss, 1967; Suddaby, 2006) have been used to refine and develop theory in this thesis. These principles consist of: constant comparison, theoretical sampling, inter-coder reliability checks, and theoretical saturation. We will shortly elaborate on all of these principles.

[7] According to Suddaby (2006) this *strict* interpretation of grounded theory is based on a common misperception that grounded theory requires a researchers to enter the field without any knowledge of prior research. According to him this seems not to be possible, but also defies logic and forms a misreading of the work of Glaser & Strauss (1967).

*Constant comparison*

The principle of constant comparison (Glaser & Strauss, 1967; Strauss & Corbin, 1998) refers to the collection and analysis of data simultaneously, and the systematic comparison of emerging themes, categories and concepts across all interviews and cases. Constant comparison consists of several steps to go from a wide variety of initially developed codes to describe themes in the qualitative data, to further refinement, categorization and abstraction of themes into categories, concepts and relationships that form the building blocks of the to be developed theory (*i.e.,* open coding, axial coding, selective coding). During open coding, the interview texts are coded *descriptively* to identify relevant themes, issues, actions and contexts and their properties (which in this study, signify potential legitimacy crises and strategies). During axial coding, these descriptive codes are compared across all cases and interviews to identify commonalities and similar patterns, which enables reduction of this large variety of codes into more general categories, sub-categories and their relationships. In this thesis' methodology, the theoretical concepts and relationships, as defined in the initial micro-institutional model, will be introduced during the axial coding stage to categorize and organize the descriptive codes and themes. This serves on the one hand to link descriptive codes (and the related data) to previously identified theoretical concepts. On the other hand it also enables further refinement of the theoretical concepts or extension with novel categories when the descriptive codes (and related data) cannot be appropriately categorized along the *a priori* defined concepts and theoretical model (see chapter 2). During the final stage of selective coding, the categories and relationships are finalized and specific coding rules and definitions are developed. Coding and data analysis in this stage is focused on validating the identified relationships between categories based on all data, and finalizing the theoretical model.

As such the process of constant comparison can be characterized as an interpretative process, not a logico-deductive one. The researcher is an active element of the research process, and the act of research has a creative component that cannot be reduced to a strict set of procedures. Creativity depends on the researcher's analytic ability, theoretical sensitivity, and sensitivity to the subtleties of action/interaction in the phenomena of interest (Suddaby, 2006). Constant comparison is a process of *'analytic induction'* (Glaser & Strauss, 1967) where a researcher moves between induction (category development from the data) and deduction (apply and compare categories across cases to determine its validity). The qualitative data analysis software package NVivo version 2.0 is used to organize all data in a central database and help coding and categorizing the texts (Richards, 1999).

*Theoretical sampling*

Theoretical sampling refers to the principle that the decisions about which data should be collected next are determined by the theory that is to be constructed. So

based on constant comparison of data and the emerging categories and theory new data is collected that sheds light on these constructed categories and relationships and furthers understanding. As already said, this means that during follow-up interviews (data collection) the researchers needs to focus more and more on questions that provide insight in the developed concepts and relationships (similar to the ideas of theoretical sampling and replication of case study research; Yin, 2003).

*Inter-coder checks*

During the process of open, axial and selective coding, coding procedures and category definitions have to be developed that are reliable and replicable by other researchers to prevent confirmation bias[8] or ambiguity. After each separate step of coding, the developed coding rules and definitions were also used by another researcher[9] to code parts of the data to identify differences of interpretation and coding. The differences identified were discussed and resolved, leading to further refinement and clarification of categories and relationships.

*Theoretical saturation*

The principles of constant comparison and theoretical sampling stimulate a researcher to continue collecting data to refine categories, relationships and theory as far as possible. This calls for the question what the criterion is to end data collection and stop the process of constant comparison and theory refinement. According to Glaser & Strauss (1967), the moment to stop data collection and theory refinement is dependent on *theoretical saturation*. Saturation is a practical outcome of the researcher's assessment of the quality and rigor of an emerging theoretical model: "The criteria for determining saturation... are a combination of the empirical limits of the data, the integration and density of the theory and the analyst's theoretical sensitivity" (1967: 62). The signals of saturation include the repetition of information and conformation of existing conceptual categories and relationships. Saturation is reached as further data collection and comparison do not lead to novel insights, but instead conform already identified categories and relationships. As such, it represents the stabilization of shared meaning and interpretation of the researcher and its peers. Saturation is also inherently pragmatic and depends upon the time and resources available to the researcher to do his research and the research objective he aims to fulfill (Suddaby, 2006). In this study, saturation was reached when the theory and related categories and relationships were of sufficient complexity to explain and describe the case observations, and when including alternative relationships or categories did not add any extra explanatory value to the developed theory so far.

[8] Confirmation bias: seeking confirmatory information for what you think is true and neglecting a search for disconfirmatory evidence (Van de Ven, 2007).

[9] In this thesis, coding rules and category definitions were cross-checked by members of the research team that were familiar with the ideas of legitimacy, legitimation and institutional theory.

## 3.5 Steps in the data analysis and category definitions

In this section the final category definitions and coding rules will be presented that are the result of the qualitative data analysis procedures and principles as defined in the previous section. These definitions and rules form the *result* of an elaborative coding process that consisted of three main phases of analysis. First, we concentrated on the identification, categorization and finalization of the different types of *legitimacy crises*. During this phase a total of 23 different legitimacy crises have been identified within the 5 radical innovation processes. These 23 legitimacy crises (and associated strategies and institutional contexts) form the basic unit of analysis during the next phases of the data analysis process. The *a priori* defined legitimacy types of the initial micro-institutional model have been refined based on the data during this first phase. The second phase of analysis, consisted of the identification, categorization and finalization of the different types of *strategic responses* to overcome legitimacy crises. Based on the empirical data the initial typology of 'legitimation strategies' is refined and extended with two new strategy types. During the third phase of analysis, the characteristics of the *institutional context* that enable or constrain innovating actors in their choice for particular strategic responses have been identified, categorized and finalized for each of the 23 identified legitimacy crisis/strategy cases. This resulted in a novel and empirically grounded typology of institutional characteristics that enable or constrain actors in their actions to overcome legitimacy crises.

For each central concept (legitimacy crises, legitimation strategies/responses, institutional context) the final definitions and coding rules will be described in a concise way in the next sections. This presentation is purely illuminating the coding process and the final operationalization of the concepts and relationships. Chapter 4 and 5 will elaborate extensively on the cases and data analysis to show why extensions and refinements were made to the initial micro-institutional model. Furthermore, in those chapters the relationships between the concepts are analyzed, integrated and elaborated in much more detail.

*Legitimacy crises*

The open coding step of the constant comparison method consisted of the descriptive coding of the interviews to *identify* a wide variety of possible legitimacy crises categories. Excerpts of the interviews texts were coded and labeled that described a *lack of organizational support* for the radical innovation plans and related actions, which inhibited the innovating actors to continue with their ideas at a certain moment in time. Texts were coded that described *evaluations* of the radical innovation plans and actions and the reasons for why support lacked. In these evaluations *'institutional criteria'* are mentioned to evaluate the legitimacy of the radical innovation.

In order to be selected as an *evaluation of the legitimacy* of innovation (vis-à-vis the established organization), these 'criteria' should:

1. Represent *established* interests, norms, beliefs, definitions, procedures, rules or practices, etcetera, which are attributed to 'the organization' or 'organizational groups' in the here and now.
2. Be *socially shared* between different members of the organization; they cannot be personal opinions or preferences.
3. Be perceived as *obligatory* by individual members of the organization; individual members should feel *obliged to* or *responsible for* these institutionalized 'criteria'.

After open coding, the axial coding step involved comparing the inductively defined preliminary legitimacy crises categories to improve the descriptive fit across all interviews and entire data set. Furthermore, this reduced set of initial legitimacy crises categories was sorted along the different types of legitimacy crises as defined *a priori* in the initial micro-institutional model (pragmatic, normative and cognitive). During this step, the appropriateness of the legitimacy crises typology of the initial micro-institutional model was assessed. If not all inductively defined legitimacy crises categories can be sorted along the *a priori* defined typology, this typology requires extension or refinement. In the case of the *a priori* legitimacy crises typology this was not deemed necessary as all inductive findings could be categorized into either pragmatic, normative or cognitive legitimacy crises types.

During the selective coding step, the legitimacy crises typology was finalized and coding rules were defined to distinguish between the different types. The entire data set was analyzed again with this final and more comprehensive legitimacy crises typology and a total of 23 different legitimacy crises cases were identified (see Table 3-3 for the final typology, coding rules and examples).

**Table 3-3 Final typology and examples of legitimacy crises.**

<table>
<tr><td colspan="3">"How do we identify a legitimacy crisis?"<br><br>A legitimacy crisis occurs when innovating actors experience a lack of legitimacy of their radical innovation plans and activities, which limits or obstructs the innovating actors in their pursuit of the radical innovation (no organizational support, no access to necessary resources, knowledge and networks). The lack of legitimacy is a negative evaluation of the radical innovation and related activities along 'institutionalized criteria' that represent established interests, norms, and beliefs attributed to the organization or organizational groups.</td></tr>
<tr><td colspan="3">"What type of legitimacy crisis is it?"</td></tr>
<tr><td>Pragmatic<br><br>It lacks legitimacy with respect to established interests and needs of the organization or organizational groups.</td><td>Normative<br><br>It lacks legitimacy with respect to established norms and rules of the organization or organizational groups</td><td>Cognitive<br><br>It lacks legitimacy with respect to established frames of reference and views of identity of the organization or organizational groups.</td></tr>
<tr><td>Lack of fit with:<br><br>- strategic goals<br>- business targets<br>- strategic priorities<br>- responsibilities</td><td>Lack of fit with:<br><br>- performance norms<br>- standard work procedures<br>- standard decision making procedures<br><br>of the organization or organizational groups</td><td>Lack of fit with:<br><br>- organizational identity<br>- technological paradigms<br>- strategy and business models/logic</td></tr>
<tr><td colspan="3">Example of a pragmatic legitimacy crisis:<br><br>"… I mean the [strategic business units] are responsible for their own innovation pipeline. But Zapim is not considered 'my' innovation pipeline to any of them. So it is then up to the chief technology office basically to take ownership for this. But also their funds are limited, because AlphaSys as a whole has promised to the outside world to reach a certain profitability. AlphaSys as a whole is expected … to deliver a certain amount of profit. And then priorities are adjusted accordingly…" (Zapim case; see chapter 4).</td></tr>
</table>

Example of a *normative* legitimacy crisis:

"… If you do not come up with positive results after a couple of months, you then start to feel the pressure to switch to another promising topic… If it had been sponsored by the business unit, we probably would have stopped it after a couple of months. Because of course the results were negative during the first months, and you cannot justify [to the business unit] to work on something for such a long time when its results are negative…" (Treemax case; see chapter 4).

Example of a *cognitive* legitimacy crisis:

"…the director at that time said, guys, what are you doing with that dental care business? That does not belong to PhemCo… It just didn't fit into his frame of reference. During his whole life he hadn't seen such a thing at PhemCo, that such a thing was possible. So he had very big doubts about whether we could do it … he didn't believe we could pull it off… that was what he believed… instead just sell [tons of the stuff] to the paper chemicals boys, that's much easier…" (Treemax case: see chapter 4).

*Strategic responses*

During the open coding stage, the actions pursued by the innovating actors to solve or overcome the identified legitimacy crises, were descriptively coded to identify a wide variety of potential strategic responses to overcome or augment the legitimacy of the innovation. Excerpts of text were coded that described the various actions initiated by innovating actors to create a better 'fit' in some way, between their radical innovation ideas and established interests, norms and beliefs of the organization or organizational groups. It is important to note that we *only* coded pieces of text that described actions that indeed had an effect on legitimacy and (or) that enabled the innovating actors to continue with the innovation. 'Failed' actions, in the sense that they had no effect on legitimacy or didn't enable them to continue, were not selected and coded. During the axial coding stage, the set of descriptive codes (and identified actions) were compared across all interviews to identify similarities and were categorized along the *a priori* defined types of strategic responses of the initial micro-institutional model (conformation, selection and transformation). The grouping of the descriptive codes (identified actions) along the *a priori* strategy types revealed that not all codes fitted the type definitions. Consequently, for the codes that could not be sorted, two novel strategy types were defined (toleration, and non-conformation[10]), as an important theoretical extension of the initial micro-institutional model.

[10] As will be demonstrated in chapter 4, both non-conformation and toleration are necessary and relevant additions to the *a priori* defined legitimation strategy/strategic response typology. It is important to note however, that the non-conformation and toleration strategy do not augment legitimacy in anyway. These can thus not be characterized as typical 'legitimation strategies',

During the selective coding step, the strategic response typology (incorporating the *a priori* defined legitimation strategy types) was finalized and coding rules were defined to distinguish between the different types. The entire data set was analyzed again with this final and more comprehensive typology and the related operationalization, to strengthen its validity. See Table 3-4 for the final typology, coding rules and definitions. We have excluded the examples in this table for reasons of conciseness; all instances of the different strategies are extensively discussed in chapter 4.

**Table 3-4 Final typology of legitimation strategies/strategic responses.**

| |
|---|
| "How do we identify a strategic response to overcome a legitimacy crises?"<br><br>A strategic response is a set of related actions used by innovating actors to either (1) augment the legitimacy of their radical innovation ideas and related activities and create a better 'fit' between the radical innovation ideas and established interests, norms and beliefs of the organization or organizational groups (cf. legitimation strategy definition); or (2) a set of related actions that enables innovating actors to overcome or ignore the legitimacy crises and continue with the radical innovation nevertheless. |
| "What type of legitimation strategy/strategic response is it?"<br><br>*A. Conformation*<br><br>It is a conformation strategy when the radical innovation ideas and its related proposed course of action is adapted to be consistent with established interests, norms and beliefs as used in the evaluation of the legitimacy of radical innovation.<br><br>- compliance with established performance norms<br>- compliance with established decision making/work procedures<br>- incorporating business/market scope and goals into innovation plans<br>- postponing proposed actions to comply with established interests<br>- cancelling elements/aspects of the radical innovation ideas<br>- to match established interests and business/market scope definitions |

although they do enable innovating actors to overcome the legitimacy crisis. For that reason, we choose to speak of 'strategic responses' to legitimacy crises to denote both the three legitimation strategies and toleration and non-conformation (in chapter 4 and 5).

*B. Selection*

It is a selection strategy when the innovating actors search for and select another established organizational group within the organization for which the radical innovation and related proposed course of action is more legitimate, based on an alternative (partly idiosyncratic) established set of interests, norms and beliefs.

- searching for alternative sponsors within the organization
- negotiation with alternative supporters within the organization
- broadening the scope and impact of the innovation ideas to enable search

*C. Transformation*

It is a transformation strategy when the innovating actors introduce novel interests, norms and beliefs that better legitimate the radical innovation and proposed course of action, which are incorporated and merged with, or replace established interests, norms and beliefs of the organization or organizational groups. As such, these actions adapt established sets of interests, norms and beliefs.

- adapting established work procedures
- propagating novel labels/frames to denote technology
- popularizing novel industry models
- popularizing novel business models
- popularizing new visions for the company
- reframing organizational identity

*D. Toleration*

It is a toleration strategy when the innovating actors appeal to the apparent tolerance of institutional actors for which the radical innovation lacks legitimacy. The institutional actors deliberately allow the radical innovation to continue, even though it is not completely legitimate to them. No adaptations are made to either the radical innovations ideas and proposed course of action, or the established set of interests, norms and beliefs of the organization or organizational groups.

- allowing innovation to continue, even though short term interests and performance norms are not met
- allowing innovation to continue, even though innovation lacks strategic fit and doesn't fit with organizational identity

*E. Non-conformation*

It is a non-conformation strategy when the innovating actors deliberately ignore the existing legitimacy crises and do not initiate any actions to augment the legitimacy of their ideas and proposed course of action. The institutional actors do not support or allow the radical innovation to continue. No adaptations are made to either the radical innovations ideas and proposed course of action, or the established set of interests, norms and beliefs of the organization or organizational groups.

- pushing actions forward against the will of organizational groups

*Institutional circumstances*

With respect to the identification of typical characteristics of the institutional context that enable (or constrain) innovating actors to pursue particular strategic responses to overcome the legitimacy crises, the coding and categorization procedures follow the traditional logic of constant comparison and will not incorporate *a priori* theory. With respect to the categorization of these characteristics we cannot fall back on *a priori* defined concepts and relationships because the framework of Suchman (1995) (as incorporated in the initial outline of the micro-institutional perspective of chapter 2) does not include any propositions about relevant concepts and relationships concerning the opportunities and constraints offered by the institutional context to initiate particular legitimation strategies or other strategic responses. Consequently, we will follow the open coding, axial coding, and selective coding procedures of grounded theory development, without using *a priori* defined typologies.

The open coding stage consisted of identifying statements within the interview texts that described properties or elements of established (institutional) systems, structures, procedures, role positions, role definitions, and established sets of interests, norms and beliefs of the organization or organizational group, that either enabled or constrained innovating actors to pursue a particular type of legitimation strategy. Focus is on what people said were the reasons for choosing a strategy, and how they interpreted the institutional circumstances. A wide variety of potential categories describing characteristics of these institutional circumstances were identified and coded accordingly. During axial coding, the preliminary set of categories describing institutional characteristics was compared along all interviews and along the different instances of the legitimacy crises types and strategic response types as identified earlier. This enabled us to identify similarities across the crises/strategy cases, and to group, generalize and sort the categories of potential institutional characteristics and the relationships they had with each of the strategy types, accordingly. This resulted in the identification of several distinctive categories that enabled or constrained innovating actors in initiating particular strategy types. So for each strategic response type several

institutional characteristics were identified and categorized that enabled/-constrained this strategy type. During selective coding the categorization of the institutional characteristics was finalized and definitions and coding rules were developed. All coded interview texts and cases were rechecked according to these final definitions and rules. In Table 3-5 we summarize the final concepts, definitions and coding rules. In chapter 5 all the different institutional characteristics are elaborated in much more detail and the relationships with the different strategies are extensively discussed.

**Table 3-5 Final typology of the institutional circumstances.**

| "What institutional characteristics enable or constrain the initiation of particular strategic responses?" |
|---|
| *A. Characteristics of the institutional logic and structure*<br><br>1. *Regulatory regime*<br>The regulatory regime refers to the formal means of institutional actors to influence and control the actions of innovating actors; these means involve formal decision authority and formal resource control (as embodied in the institutional structure).<br><br>2. *Heterogeneity*<br>The heterogeneity of the institutional context is defined as the existence of multiple institutional constituents (*i.e.* established organizational groups) within the organization that reproduce differentiated sets of established interests, norms and beliefs.<br><br>3. *Multiplicity*<br>The multiplicity of institutional interests, norms and beliefs refers to the co-existence of multiple alternative interests, norms and beliefs within the same institutional logic.<br><br>4. *Ambiguity*<br>The ambiguity of institutionalized interests, norms and beliefs refers to a situation where different interpretations of particular institutional interests, norms and beliefs co-exist or conflict; or when the meaning of institutional interests, norms and beliefs is vague or inconsistent. |

*B. Characteristics of the institutional position of innovating actors*

1. *Expert outsiders*
   Organizational members that have much experience with respect to a particular discipline or field of knowledge and are thus perceived to have an expert status. Moreover, they are organizational members that also have extensive experience outside of the particular organizational/institutional system, which makes them more aware of alternative institutional logics and structures.

2. *Boundary spanners*
   Organizational members that have a boundary spanning position, which is characterized by a central position in-between different (more coherent) social networks within the established organization, due to their formal role or informal social relations.

*C. Characteristics of the radical innovation*

1. *Resource impact*
   The impact of the radical innovation idea and related course of action on the availability of resources controlled by institutional actors.

As said, the final typologies as presented in the different tables (legitimacy crises, legitimation strategies, institutional characteristics) form the *result* of an elaborate qualitative coding and categorization process conform the constant comparison method. As such, these final typologies form an important part of the micro-institutional perspective and related models as being developed in this thesis. The presentation of these final typologies in this chapter is for reasons of comprehensiveness and readability and does consequently not suggest that these have been defined entirely *a priori* the data collection and analysis stage, as is normal in theory testing research approaches (*cf.* Suddaby, 2006).

## 3.6 Validity and reliability

The outline of the research methodology and the used data collection and data analysis techniques in this chapter aims to clarify the reliability and validity of final findings of this thesis. The evaluation of the validity and reliability of knowledge claims based on qualitative and interpretative research is of a different nature than within a positivistic research tradition of testing hypothesis based on the co-occurrence of certain events (Yin, 2003; Swanborn, 2003; Strauss & Corbin, 1998). Reliability is essentially about the replicability and reproducibility of the final results, which means that the outcome of a particular study will occur again if the study is replicated by another investigator. With respect to the collection of data, reliability is thus improved by the triangulation of data by collecting

different sources of data (interviews, memo's, public publications etcetera) and by interviewing different organizational members about the same events (Jick, 1979; Huber & Power, 1985). Also the member checks of the interview transcriptions and historical case descriptions improve the reliability of the collected data. With respect to the reliability of the data analysis and development of typologies and categories this is a slightly different story. Because the constant comparison method is an interpretative act, and not a logico-deductive one, and consequently is dependent on the researcher's theoretical and empirical sensitivity, the identified typologies and categories could be different if another investigator would go through the same process. However, if another investigator would use the final typologies and their operationalization and coding rules to analyze the same data set, he or she would likely find the same empirical results and evidence. The inter-coder checks and structured and empirically grounded development of the final typologies and categories improve the reliability of these findings.

With respect to the validity of the final results (typologies, categories and theoretical models) based on the qualitative analysis of the data, we essentially are interested in the generalization of the findings to situations different from the particularities of the cases. The knowledge claims of this thesis refer to the developed micro-institutional *theory* (concepts, relationships and models) that *explain* why particular events happen and what the underlying social mechanisms are (informed by institutional and structuration theory). These theoretical claims thus go a step further than only describing the co-occurrence (or correlation) between events in a particular case. Consequently, the theoretical claims of this thesis can be generalized to situations of legitimacy crises of radical innovation within established organizations in general, and even to situations where 'proposed courses of action are illegitimate with respect to institutional logics and structures and need legitimation'; based on the developed theory (and identification of the underlying social mechanisms) we would expect to see the same legitimation dynamics and mechanisms at work (Tsoukas, 1989; Hedstrom & Swedberg, 1998, Van de Ven, 2007). As such, the validity of this thesis' findings refers to the validity of the developed theory, which has been enhanced by systematic abstraction and theoretical generalization, uncovering 'deeper' structures, and by defining and extending previously identified social mechanisms of legitimation and institutionalization.

In this chapter we have explained the research methodology in great detail to give insight in the reliability of the data collection and analysis methods and discuss the validity of the findings. In the next chapter we will describe the cases in more detail and analyze both legitimacy crises and legitimation strategies.

# Chapter 4 Radical innovation and legitimacy crises

## 4.1 Introduction

In this chapter we present the first part of the empirical findings of this research project. We will first introduce the two established high-tech companies and the five nested case studies of radical innovation that have been investigated. Secondly we will present and categorize in detail the pragmatic, normative and cognitive legitimacy crises that occurred in each of the cases and identify the strategies that have been used by the involved actors to overcome these legitimacy crises. Finally, we will summarize the results and discuss two novel strategic responses that we have identified based on the empirical findings, which extend the initial micro-institutional model as presented in chapter two. As such, this chapter provides the answers to research question 1: What types of legitimacy crises occur during radical innovation in established high-tech companies? And to research question 2: What types of strategies are used to deal with legitimacy crises in established high-tech companies?

## 4.2 The case companies

### *4.2.1 OmegaCom, Omega Research and AlphaSys*

*OmegaCom Electronics*

OmegaCom Electronics is one of the largest European electronics companies, with more than 150,000 employees in over 50 countries and sales in 2005 of more than Euro 25 billion. OmegaCom is active in over 60 different businesses, and has more than 100,000 registered patents. The foundations for OmegaCom were laid in Northern Europe around the end of the 19th century. OmegaCom began by making carbon-filament lamps and, by the turn of the century, was one of the largest producers in Europe. As developments in new lighting technologies fueled a steady program of expansion, in 1914 it established a research laboratory to study physical and chemical phenomena and stimulate product innovation. In 1918, it introduced a medical X-ray tube. This marked the beginning of the diversification of its product range and the moment when it began to protect its innovations with patents in areas stretching from X-ray radiation to radio reception. In 1925, OmegaCom became involved in the first experiments in television in 1925 and, in 1927, began producing radios; by 1932, it had sold one million of them. A year later, it produced its 100-millionth radio valve and started production of medical X-ray equipment in the United States. Science and technology underwent tremendous development in the 1940s and 1950s, with Omega Research laying down the basis for later ground-breaking work in transistors and integrated circuits. The company also made major contributions to the development of the recording, transmission and reproduction of television

pictures. In 1963, it introduced a novel audio recording format and media device. In 1965, it produced its first integrated circuits.

The flow of new products and ideas continued throughout the 1970s. Research in lighting contributed to the new energy-saving lamps, while Omega Research made key breakthroughs in the processing, storage and transmission of images, sound and data. These led to the inventions of important media and audio storage devices and optical telecommunication systems. During the '70's it grounded and acquired several companies in the television and audio industry to strengthen its portfolio. Then, in 1983, came a technological landmark: the launch of a completely novel audio storage system that had a major impact on the industry.

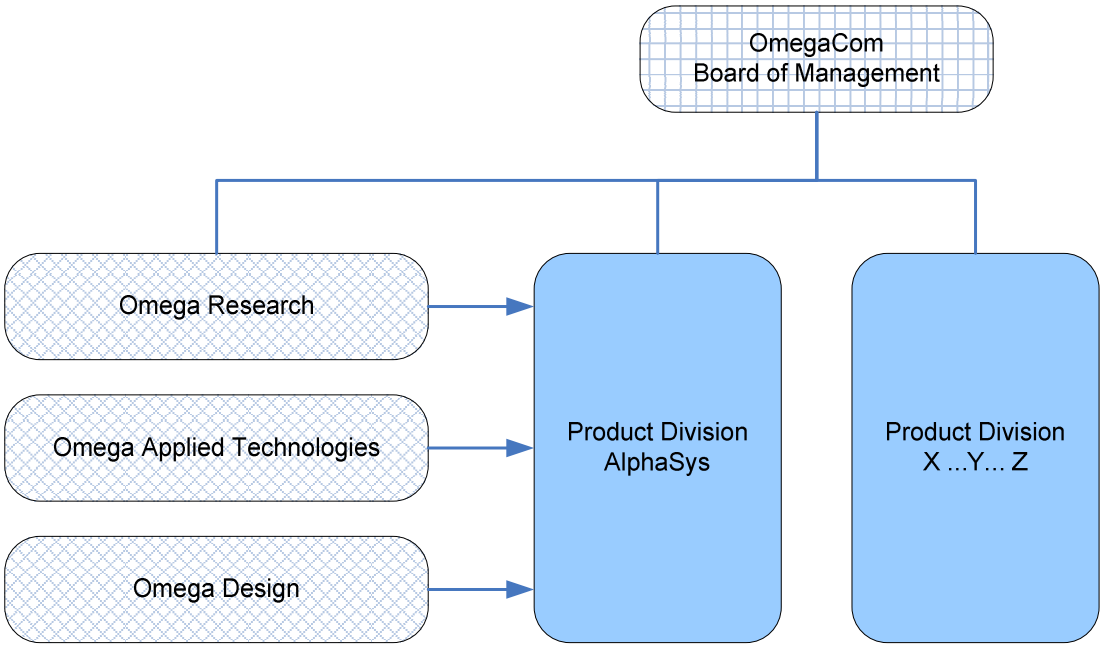


**Figure 4-1 Part of the organizational structure of OmegaCom Electronics (2000 – 2006)**

The 1990s was a decade of significant change for OmegaCom. The company carried out a major restructuring program to return it to a healthy footing, simplifying its structure and reducing the number of business areas. In 1997, in cooperation with several other companies - and building on the success of its audio and data storage technology - it released a novel data storage device what proved to be the fastest growing home electronics product in history. In the first years of the 21st century the major corporate restructuring program was completed, reducing the number of employees to about 80 percent. It also sold some of its businesses and a large product division to simplify its portfolio on strengthen synergy between its businesses.

*Omega Research*

The OmegaCom company started in the end final decade of the 19th century. The technical development of its sole product, the incandescent lamp, was done 'alongside' the factory. In the rest of the world, the concept of a separate industrial research laboratory was only just emerging. In the beginning of the 20th century, the decision was taken to open a physics laboratory. During the following years the Omega Research organization developed into a major centre of technical competence and innovation. Broadly speaking, three periods of Omega Research can be distinguished. These are closely related to the historical development of the OmegaCom company and the general economic and political situation in the world at the time.

From 1914 to 1945 was the period of growth and diversification. Apart from improvements to the incandescent lamp, research was carried out into gas discharge lamps as a more efficient way to generate light. At the same time, the 'bulb technology' opened up the way to new products such as the X-ray tube and the radio valve. The invention of the pentode gave OmegaCom a basic patent in the radio field. In 1923, OmegaCom decided to become a 'systems supplier' instead of a 'components company'. This was a decision which was to have far-reaching consequences. The research organization broadened its scope into work on radio receiving and transmission. Early work was also done into the development of television.

The second period (1945-1970), which started after World War II, was the period of expansion. The research philosophy was characterized by the belief that research always pays off, and that research automatically leads to products. There was room for every invention, and the sky was the limit. In this period television became a mass-produced consumer good and the research work initiated in the 1930s became a major program. This was also the era of 'solid state'. The invention of the transistor by Bell Labs changed the world of electronics forever. OmegaCom had access to the transistor patents through a cross-license agreement between OmegaCom and AT&T. OmegaCom' strength was based, among other things, on its strong patent position in magnetic materials. In the field of semiconductor devices, Omega Research contributed a new germanium transistor based on an alloying method and later, in the Integrated-Circuit (IC) field, the LOCOS process (LOCal Oxidation of Silicon) used in every modern Metal-Oxide-Semiconductor (MOS) IC and the Integrated Injection Logic used in the majority of the present bipolar-IC devices, were developed. In this period research laboratories in England, France, Germany and the USA were founded. The present international research set-up began to take shape.

In the third period from 1970 to the present time, industrial research has been tied much more closely to industrial activities. The emphasis has been shifted to research on systems; the research into integrated-circuit design and technology has played a very important role. The watchword was, and is, 'expressing your ideas on

silicon'. Information processing, storage, transmission and display were and are the main subjects of research. In this period, the field of optical recording was opened up by Omega Research giving rise to well-known products in the area of video, audio and data storage and recording. Omega Research was, by this time, also heavily involved in medical systems such as magnetic-resonance imaging and ultrasound. In mobile telephony -where the smaller bandwidth and the required error correction ask for more economic speech coders than normal telephony- an important Omega Research contribution, the full-rate GSM speech coder, found its way into all GSM base stations and handsets in the nineties. The same holds true for television system research, with emphasis on digital standards and digital processing. Systems are made up of components and software. Research into components has brought a great deal of success. World-class semiconductor lasers from infrared to red, yellow and green are good examples of this. New dedicated multi-million-transistor ICs are designed for digital video coding and decoding. Programmable processors make it attractive to realize increasingly more functions in software. Finding the right balance between dedicated and programmable solutions ('co-design') is one more example of the many activities in which Omega Research is involved today.

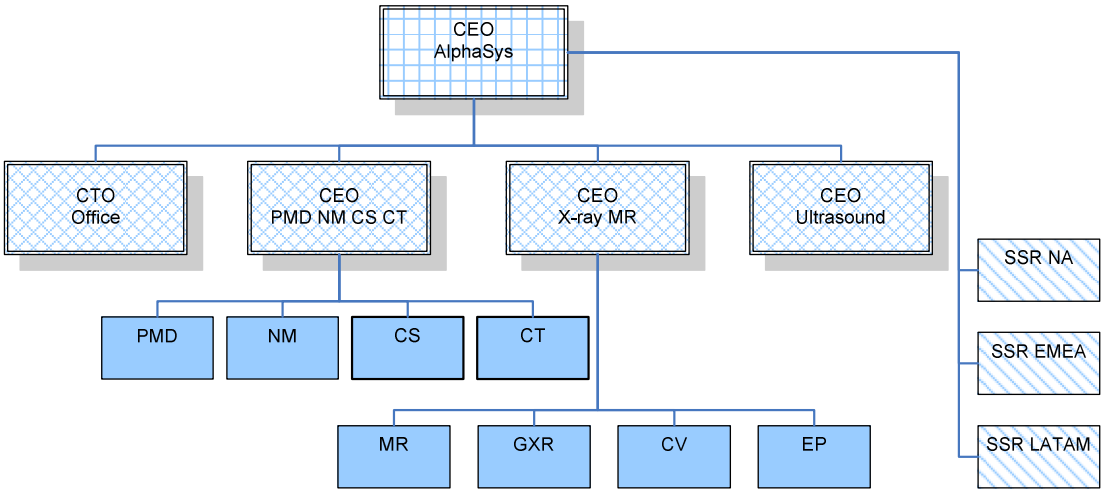


**Figure 4-2 Part of the organizational structure of the product division AlphaSys (2000 – 2006)**

*AlphaSys*

The OmegCom product division AlphaSys has long provided the equipment and technologies that are on the cutting-edge of the healthcare market. Founded in the last decade of the 19th century when OmegaCom manufactured the first x-ray tubes for medical applications to 1998 when OmegaCom launched a Healthcare Services group dedicated to the advancement of healthcare technology that meets the specialized needs of clinicians as well as patients. After launching the Healthcare Services group in 1998, OmegaCom invested heavily in its medical business segment in order to further enhance its product portfolio. Since 1998, OmegaCom acquired various companies in digital ultrasound systems, nuclear

medicine, diagnostic cardiology, patient monitoring, leading multi-slice CT systems as well as advanced applications in cardiology, oncology and PET/CT imaging, automated external defibrillators, point of care diagnostic systems, related supplies, and professional services and support.

### *4.2.2 PhemCo*

PhemCo is a large European chemicals company and realized annual sales of over EUR 8 billion and employs some 20,000 people worldwide in 2006. PhemCo ranks among the global leaders in many of its fields. The company is headquartered in the Northern Europe, with locations in Europe, Asia, Africa and the Americas.

In the beginning of the 20th century the government of a European country grounded PhemCo as national coal mining company. When mining activities increased and PhemCo extended its processing activities, it also started producing ammonia (from a by-product of its mining activities). Ammonia is a basic ingredient for the production of nitrogen fertilizer products. This first step into diversification helped PhemCo to survive the closure of the coal mines. After the second world war the demand for synthetic materials increased and PhemCo started the production of industrial chemicals and raw materials for synthetic fibers and seized these new opportunities. Shortly hereafter, the need for coal decreased sharply. After the rise of mineral oil and natural gas the last coal mine was closed in 1975. PhemCo changed its business focus in a high tempo. In 1970, industrial chemicals and fertilizer products amounted to two-third of total turnover. In twelve years time, petrochemistry became the most important activity for PhemCo and the turnover of raw materials for synthetic materials increased tenfold. During that period PhemCo had to fight its way into a business that was dominated by large established foreign companies. During the 1970s and 1980s PhemCo implemented large restructuring programs to achieve economies of scale and better guarantees for market demand. Moreover, it diversified into advanced synthetic materials and fine chemistry. After 1985, it implemented ambitious innovation strategies. These resulted in specialty products such as polyethylene fibers, one of the world's strongest fiber. In 1989 the government privatized PhemCo and PhemCo got a stock exchange quotation. During the 1990s PhemCo focused on a better match between its research activities and value creation. It focused on the development of processes and products with high added value, in particular products for the pharmaceutical and food industry, and advanced synthetic materials for the automotive and electronics industry.

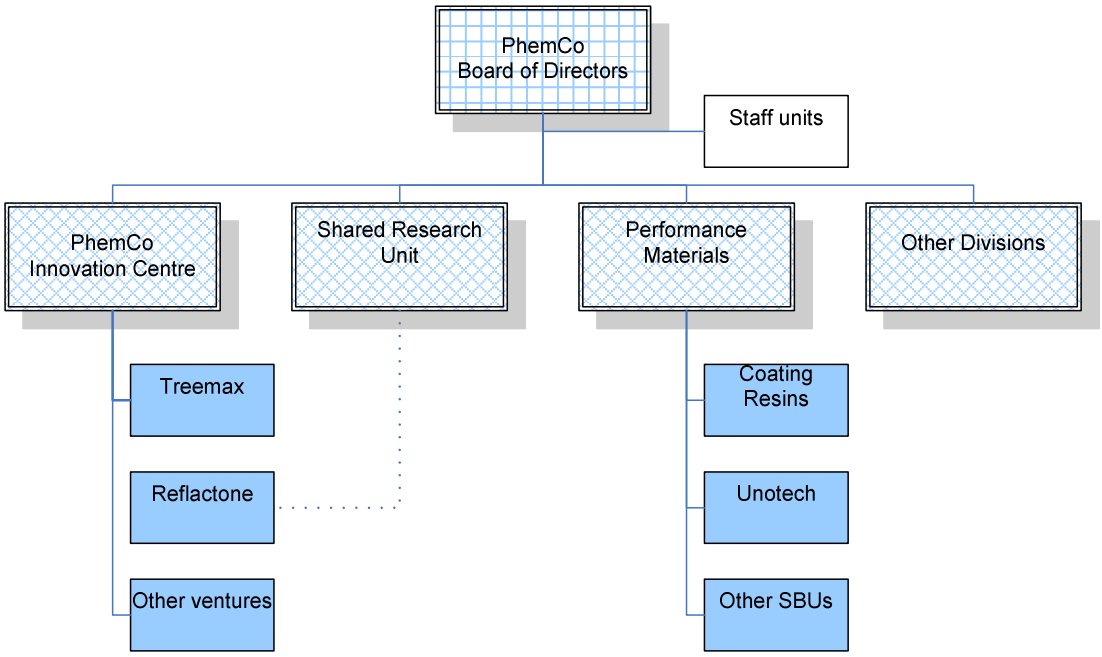


**Figure 4-3 Part of the organizational structure of PhemCo**

So far, growth had been largely organic. From the mid of the 1990's on PhemCo pursued rapid growth in life science products through acquisitions and joint ventures, and selective growth in sophisticated performance materials. From 1996 PhemCo added the chemical activities of several other companies to its stable. PhemCo's fine chemicals activities now generated over a quarter of total turnover, and the company was able to offer all relevant technologies in-house: organic chemistry, enzyme technology, fermentation and physical separation. This strategy was continued during the beginning of the 21st century. Life science products and high performance materials were to form the core activities, while, for long as necessary, petrochemicals would generate funds to finance expansion in those directions. PhemCo was now becoming a truly global company, and this globalization was set to continue. In 2000, PhemCo enlarged its presence in North America by acquiring the pharmaceutical activities of a US firm, raising the proportion of the company's turnover from life science products to over 30% and making pharmaceuticals PhemCo's biggest end-use market. In 2002, an even more substantial acquisition followed: the vitamins and fine chemicals division of another European company, making PhemCo the world's leading supplier to the life science industry and a powerful research force. Some months before in 2002, PhemCo completed its exit from the cyclical petrochemicals business, selling all its activities in that field to an external partner. With more than 1,300 R&D staff worldwide, organized in a range of competences, PhemCo currently benefits from an extensive knowledge and skills base. The total R&D expenditure of PhemCo in 2005 amounted to more than EUR 250m.

### 4.3 The radical innovation cases

We selected and investigated three radical innovation cases at AlphaSys and two cases at Phemco. All of the radical innovations involve the build up of novel technological competencies for the two established high-tech companies. For four of the five cases it also involved building up knowledge about novel application areas of the technology, based on a new set of customer requirements for the respective application area. One of the radical innovation cases (i.e. Zapim) would also result in the development of a completely new type of product with novel functionalities that does not already exist in the marketplace. The other four radical innovation cases result in substitution products and offer major functionality and performance improvements with respect to existing products of competitors.

Furthermore, to be able to interview the key actors involved and develop an historically accurate description of legitimacy crises and strategies, we selected radical innovation cases that only recently finished or were still active in doing research and development activities (< 2 years ago). Of the five cases, only Icon and Treemax had entered the manufacturing and commercialization stage during the period of 2004-2006. For each of the cases we interviewed key actors that were involved in the execution of research and development activities, marketing activities and project management, and the upper management that was involved in decision making and sponsoring of the innovations. In Table 4-6 we give a short overview of the characteristics of the cases, the period of the innovation process that is analyzed, the number of departments that were involved and the key actors that were interviewed.

| Case | Radicalness | Period | Depts. | Key actors |
|---|---|---|---|---|
| AlphaSys | | | | |
| DaXo | Novel technological competencies<br>Novel application areas<br>Novel product<br>Novel customer base<br>Improved functionalities (cust.) | 2000 - 2006 | 4 | Senior scientist<br>Research head<br>Business developer DaXo<br>2 Technology strategy directors |
| Zapim | Novel technological competencies<br>Novel application areas<br>Novel / extended product<br>Existing customer base<br>Novel functionalities (cust.) | 2001 - 2006 | 3 | Senior scientist<br>2 Research directors<br>2 Technology strategy directors |

| Case | Radicalness | Period | Depts. | Key actors |
|---|---|---|---|---|
| **AlphaSys** | | | | |
| Icon | Novel technological competencies<br>Established application area<br>Extended product<br>Existing customer base<br>Improved functionalities (cust.) | 2001 - 2006 | 6 | Design director<br>Marketing manager SBU<br>Project manager internal supplier<br>2 Technology strategy directors |
| **Phemco** | | | | |
| Treemax | Novel technological competencies<br>Novel application areas<br>Novel product<br>Novel customer base<br>Improved functionalities (cust.) | 1994 - 2006 | 4 | Senior scientist<br>General manager Treemax<br>Sales manager Treemax<br>Director of NBD group |
| Reflactone | Novel technological competencies<br>Novel application areas<br>Novel product<br>Novel customer base<br>Improved functionalities (cust.) | 2001 - 2006 | 3 | Senior scientist<br>Business developer Reflactix<br>Director of NBD group |

**Table 4-6 Overview of the case characteristics**

## 4.3 Case 1: AlphaSys - DaXo

### *4.3.1 Case background*

The basic ideas for the molecular diagnostics solution (DaXo) were researched and developed around 2003 at the Omega Research group responsible for research into molecular and biomolecular engineering. The case description describes the major research and development activities, decisions and issues that occurred during the period from 2000 to 2006. It also includes the description of certain up-front research activities and explorations in 2000-2002 that eventually led to the development of the actual DaXo solution in 2003. It describes the innovation process from the invention of the DaXo solution to the development of fully working prototypes that are used for clinical testing.

For this case interviews were held with: Dr. Hank Abbot (senior scientist and the current DaXo research project leader), Prof. Dr. Jasper Burton (the department head of molecular and biomolecular engineering at Omega Research), and Dr. Andy Newman (the DaXo program manager from the New Business Development group of AlphaSys). The case description was validated by the interviewees and by Dr. Ed Greenland (senior director technology strategy at the Technology Office of AlphaSys) and Mr. Vince Petrakis (senior director software technology at the Technology Office of AlphaSys).

### *4.3.2 Case description*

**Exploring novel medical technologies at the molecular level**

Around 2000 the Board of Management of OmegaCom Electronics decided that their Healthcare division was of primary importance to the long term survival and growth of the OmegaCom company. Although OmegaCom had leading market positions in Lighting and Consumer Electronics, profit margins in those areas were eroding and market size growth was constricted. Their medical division instead offered many new growth opportunities and the profit margins were much higher in that business. The Board of Management decided that in order to grow and become leading in healthcare they had to invest more in research and development. One of the promising areas and big trends in healthcare was the emerging discipline of 'Molecular Medicine'. Recent major discoveries in genomics and proteomics (i.e. the human genome project, understanding gene and protein activity patterns, systems biology) opened up new ways to diagnose and treat diseases at the molecular level (e.g. identifying gene and protein activity patterns responsible for cancer, infectious diseases, or cardio-vascular diseases; gene therapy). Although traditional imaging technologies could also be used to enable molecular medicine, those technologies had several limitations and did not address all molecular medicine applications. There remained many blank spots in the space of technological solutions for molecular medicine, waiting to be discovered. To the Board of Management it seemed a promising although

uncertain business area for which AlphaSys could potentially realize innovative technological solutions. They decided to start a relatively small research program at Omega Research to learn and understand the developments in Molecular Medicine and explore the opportunities for OmegaCom to develop new solutions based on their existing technological competencies. This research program was sponsored by Corporate Research and the researchers were allowed to explore various interesting ideas. To guide their explorations, the researchers interacted frequently with people from the CTO office of the AlphaSys Division.

**LC 1.1 Biology is a new way of thinking and working**

Several small research projects were started between 2000 and 2002 to investigate the possibilities to identify and characterize molecules with advanced sensor and detection technologies that built upon the OmegaCom competencies in amongst others micro-electronics, semiconductors, and laser and printing technology. The researchers were allowed to work freely on several interesting topics in this area. No large issues of legitimacy regarding these projects occurred in this period. The only issue that emerged concerned the different way of thinking and working when dealing with (molecular) biology in a context dominated by the disciplines of electronics, physics and engineering.

*Legitimacy crisis*

During several of the small research projects scientists noticed that integrating knowledge from molecular biology with knowledge from micro-electronics, physics and engineering was not as straightforward as expected. The molecular biologist that worked in the teams had a different way of working and thinking and had a different approach in doing experiments. Dr. Hank Abbot, one of the senior scientists noticed:

> '...Biology is a different way of working. If you work with people from Applied Technologies, such as CAD/CAM programmers or engineers... they can do a lot of things on the computer, if you change something you can immediately see what the impact is. For thermo-dynamics you have great models to see where the heat goes into, or how much power you need to do something. You can all calculate that. Also electronics, that is all designable... Biology is different. Of course you also have designables, but that's usually driven by hypotheses. You think that something must work, and then it only works for 80 percent. And then you have 20 different parameters that you could manipulate to get it working. But you can't say it is this parameter and I will calculate what will happen. You have to do it... and that also means a completely different timeline than with mechanics...'

> '... You really have to take that into account; that they [the biologists] think in a different way and are more focused on experiments. Calculating doesn't mean much to them. You have to try things, and then it usually is

> different from what you expected. A physicist would just calculate it. And if an experiment failed, then the experiment wasn't carried out in the right way. That [the way physicist work] is just the other way around ...'
>
> '... for example, we worked for sometime on a project in which we tried to bind relatively large molecules (a 'label' molecule) to a relatively small molecule... And naturally we calculated how fast this process would go, because we have all kinds of models to do so. And the physicist calculated that it would be possible... But the biologists said, compare it with a cat catching a mouse. That cat is very good at that. But now you give this cat a large backpack, then it will no longer catch the mouse that easy... as a physicist you can put a number on it, but usually that number is not correct. It is just an assumption. And the biologist would say that you never should attach such a large molecule to a much smaller one, and expect that such a small binding would occur, that's against nature...but we had project leaders and physicists that didn't understand that line of reasoning and just pushed forward. And then the biologists had to solve consequent problems...'

This confrontation between a *new way of thinking* (biology) and the dominant logic of physics, electronics and engineering can be characterized partly as a *cognitive* legitimacy crisis. The biologists working on the initial research projects experienced that their way of reasoning was not always accepted by and legitimate to the dominant group of physicists and engineers as it resulted in different solutions and suggestions. Moreover, their focus on doing experiments instead of calculations and simulations implied a different research approach, research process and related timeline, which conflicted with the established and institutionalized *norms and procedures for working* at the research lab. Usually, researchers at Omega Research worked on relatively strict plans and deadlines, which was enabled by the reduction of uncertainty through calculations and simulations. The biologists were less able to reduce uncertainty and as a consequence needed more flexibility in the project plans. Besides, the biologists needed more time for experimentation, instead of time for simulation and calculation. This latter aspect of the issue can be characterized as the *normative* dimension of the legitimacy crisis.

*Strategy*

After doing several research projects on the link between OmegaCom' technologies and molecular biology and molecular medicine, the understanding of the established physicists and engineers of the complexities of biology grew. Some of the project leaders and scientists realized they had to change their approach to these multidisciplinary research projects and leave room for the biologists to experiment. They recognized that they should not make issues more complex than they already are for the biologists. Instead they would have to use their

technological competencies to make the life of the biologists more easy, and develop technological solutions around the biological solutions. Hank Abbot said:

> '... I have changed in that respect. I would say, don't make it too difficult for the biologists. Because that is already so complex and we still know so little about it. So there you need the freedom. And that is what we can do as OmegaCom. We have the capabilities to do just that... Don't say, we have developed some great technological solution and now the biologists have to work their way around and develop something else that matches. Because then you transfer the problem to a different area, an area over which we have less control. That is a much more delicate process. Biologists normally use all kinds of standard operating procedures... If you then change a step, then it is no longer reproducible. And that is not what we want. So that is the way I think about it, and also AlphaSys thinks about it in that way... so now the power lies a bit more with the biologists...'

We can characterize this response as a *transformation* process. The new way of working and thinking of (molecular) biology is slowly accepted and more legitimate to the dominant group of scientists and project leaders. The established way of working is adapted to incorporate the biologists way of working. Besides, the dominant group changed its way of dealing with bio-molecular phenomena and now see the benefits of using their technological competencies to *enable* and support biological solutions, because this gives the best results.

**Exploring new market opportunities at AlphaSys**

During the period that a small group of scientists at Omega Research worked on the exploration of Molecular Medicine solutions, the AlphaSys division acquired Virotin Technologies' Healthcare Solutions Group (around 2001). The purchase of Virotin's former healthcare business extended and complemented the AlphaSys product portfolio in several important ways. Key products included diagnostic cardiology, ultrasound imaging, patient monitoring, automated external defibrillators, point of care diagnostic systems, related supplies, and professional services and support. After integrating the Virotin group into the AlphaSys organization, the relatively small former New Business Development group of Virotin got the assignment to explore new market opportunities in the area of point of care diagnostics and molecular diagnostics, around 2003. At that time this assignment was completely unrelated to the work been done at the Omega Research lab.

The Business Development team headed by Dr. Andy Newman identified some clear unmet needs in the area of point of care diagnostics and developed some general product ideas on how to meet those needs. One of those ideas involved the use of molecular diagnostics principles to diagnose cardio-vascular diseases and infections diseases in a very fast way, in an intensive care setting. Fast diagnosis of different types of heart attacks (cardio-vascular) could help to select the right

therapy, and save lives. Fast diagnosis of different types of infectious diseases helps to identify the best treatment and antibiotics. Especially postoperative people or people that have had chemotherapy, have a reduced functioning of the auto-immune system and consequently a high chance of getting bacterial infections that can cause so called *sepsis* or *severe sepsis*. Severe sepsis results from the body's systemic over-response to infection. This over-response disrupts homeostasis through an uncontrolled cascade of inflammation, coagulation, and impaired fibrinolysis. Deranged microcirculatory function leads to global tissue hypoxia and direct tissue damage. This ultimately results in organ failure, and often, death. Several medical studies have demonstrated that for every hour delay in the administration of appropriate antibiotic therapy there is an associated 7% rise in mortality. Fast diagnosis of sepsis and the bacterial infection that is causing it, is thus important. Currently however, diagnosis is taking relatively much time; to identify the specific type of bacteria, a sample has to be cultivated by using methods of microbiology that take a couple of days. The NBD team of Dr. Newman envisioned a product that would be very easy to use and would speed up the diagnostics process considerably by using molecular diagnostics principles.

After the investigation of unmet customer needs and envisioning a novel product for (in the first place) fast bacterial infection (and thus sepsis) diagnosis, the NBD team of Newman started talking with scientists from the Omega Research lab to see what would be possible. At that time the research efforts at the Research lab and the investigations by Newman' team were still unrelated. After several interactions Newman' team understood that the Omega Research team on Molecular Medicine could research and develop some very promising technological solutions. It seemed that they could integrate the bio-molecular technologies (analyzing gene expression with gene chips, so called micro arrays, and protein activity patterns with mass spectrometry) with already developed technologies of OmegaCom and their advanced knowledge of semiconductors, micro-systems and systems integration. Consequently, the NBD team defined a business proposal for a Molecular Diagnostics device for sepsis management (called DaXo for sepsis) and defined related research and development projects for Omega Research that had to be initiated (in the form of contract research for AlphaSys). It was aimed to be a platform technology, which in later stage could be extended into other medical application areas such as cardio-vascular, oncology and neurodegenerative diseases.

To AlphaSys and OmegaCom it was a *radical* innovation in three ways: it focused on a market segment and customer group that they had previously not addressed, it would be a medical device solution they had not produced and delivered before, and it would built upon technological principles (molecular biology, biochemistry, fluid dynamics) that were relatively novel to AlphaSys and Omega Research. The business proposal and business case as developed by the NBD team by Newman seemed very promising, but the CEO and CTO of AlphaSys and its Board of Directors, and also the Research and Program management of Corporate Research had to be convinced before investments could be made and research projects could

start. Three important issues emerged during the evaluation of the DaXo business proposal and research proposals as will be described in the next sections.

**LC 1.2 Developing a competency in molecular biology and biochemistry**

*Legitimacy crisis*

To develop the DaXo solution for sepsis, Omega Research (and AlphaSys) had to build a competency in molecular biology and biochemistry. They had to learn and understand at least the basics of these new disciplines to research and develop the DaXo solution. This would imply amongst others investing in biological labs, hiring experts in molecular biology and educating some of the existing research personnel. This was not an easy decision. Many discussions arose between the NBD team of Newman, the CTO office of AlphaSys, and Department heads of Omega Research. Prof. Dr. Jasper Burton, at that time department head of 'Molecular and Biomolecular Engineering' at Omega Research, said about this:

> '... We had lots of discussions about that [developing a competency in biochemistry and molecular biology]... whether we should develop it ourselves or source it from the outside. Most important factor is then of course how fast you can build up such a competency. If you want to do everything yourselves it takes too much time. So we made a compromise and decided to do some things with others, but also develop a competency internally... But we also talked about whether such a competency actually belonged to OmegaCom... we are of after all an electronics company. And that made the discussion a bit more complicated... that was much more subjective and had an emotional component...'

As it seems the involved actors had difficulties with deciding about building up a competency in 'biology'. It didn't fit with their established view of what kind of company OmegaCom is, and what kind of research they do; they are an electronics company and not a pharmaceutical or a biochemistry company offering diagnostic lab tests. To build up a competency in molecular biology and biochemistry didn't seem to make *sense* with respect to the established and institutionalized view of their corporate *identity*. As such we characterize this issue as a *cognitive* legitimacy crisis.

*Strategy*

The people supporting the business proposal for DaXo, notably Newman' team, scientists working on molecular medicine such as Abbot, and also Burton as department head, did their outmost best to convince upper management and legitimize their ideas. Dr. Abbot, one of the senior scientists said:

> '...Well, we did lobby a lot, at least the people from Newman' team and also people from Research. It really is an area we should not miss, and that is

about the whole area of molecular medicine. So much is happening, with very large margins, and it is closer to OmegaCom technology than most people think. Of course you have to demonstrate that that is really true. So we brought in people from the field, external experts with their stories. Of course, the usual reports and market analysis... And you also have to show that you really can do it. By putting the right people to work and to demonstrate, based on deliverables, that we can do it. We made prototypes. We had a clinical trial... and until now so far, so good... and that's really unbelievable actually...'

'... And we give a lot of presentations about the role OmegaCom can play in this field... [Burton] has also done a lot of those things. He is from outside OmegaCom and has a history [in bio-molecular technology], and he sees those opportunities also. But I must say, we bluff our way through sometimes. We just say we can do it, and most of the time we indeed can do it. Sometimes it takes a month longer, but if it takes a couple of years, then of course it is a problem. And that risk is still existing...'

'...now our CTO also says that we see some kind of merging between biotech companies and hardware, medical systems companies. Companies such as AlphaSys. But also our competitors; GE bought Amersion. Samsung is doing things in diagnostics. Hitachi also. Siemens. We are absolutely not the only one...

Dr. Andy Newman from the NBD team gave a more rationalized interpretation of how they convinced upper management:

'... It is simple. If you would like to stay in the medical business, then you have to. This is a trend... this is a change ... there is a paradigm shift. You saw it as well at our competitors, like for example GE, they acquired Amersion...'

'...Look at all those kind of exhibitions as the medical conferences. What the people are talking about and what is going on in research... And it is really a conscious decision at the management level, do you like to be in that business: yes or no, as there are certain trends. And than if you say A you have to say B. You have to talk about the consequences as well...'

'... If there is a business proposition... if there is a value we can create here for the company, then you have to look at potential consequences. And this is a conscious decision where you look at the value chain, where you can make the gap analysis and based on the gap analysis you clearly see there is a gap. If there is a gap and if you clearly decide to move in that direction, then it is a very simple consequence...'

So the actors in favor of the DaXo project proposal lobbied a lot to demonstrate that building a competency in molecular biology and biochemistry is necessary to stay in the business of molecular medicine and that big benefits can be made. As such they tried to stimulate and *shape new interests* and *needs* at upper management level. They also showed that it is an important trend in the medical field and that competitors similar to OmegaCom (hardware oriented companies) are also investing in this competency. It is presented as a *paradigm shift* in the industry, namely that of merging technologies between biotech and medical systems hardware. As such, they tried to popularize *a new model* or cognitive frame that linked novel bio-molecular competencies with the established view of what a medical systems hardware company is. This is characterized as part of the *transformation* strategy to overcome the illegitimacy of developing competencies in molecular biology and biochemistry.

Moreover, the scientists try to demonstrate that these new competencies are more related to the established technologies of OmegaCom than most people *think*, and that they indeed can do it and develop this competency (showing results and deliverables, using a bit of bluff). These actions are also characterized as being part of the *transformation* strategy.

**LC 1.3 We don't want to get wet**

*Legitimacy crisis*

A similar issue as mentioned above emerged with respect to a competency in fluid dynamics. The management and CEO of AlphaSys did not want to work with (and integrate) fluids in their medical systems products. Senior scientist Abbot said:

> '... OmegaCom is good in the total integration of systems. Such a system integrates electronics, optics, all kinds of magnetic and mechanical components, heating... and fluids. However, we're not yet that good in the integration of fluids... The managers of AlphaSys and its CEO have been here often, and said "we don't want to get wet'. So, we don't want to go into fluids. Because they think we can't do it. And we are a hardware company. We don't do stuff like that. There are other companies much better in it...'

Working with and integrating principles of fluids (dynamics) in medical systems seemed not legitimate to the management and CEO of AlphaSys. The idea to work with *fluids* conflicted with the commonly held *perception* of what a *hardware* company *is* and *does*. In their view, working with fluids doesn't really make *sense* with respect to the *identity* of a 'hardware' company. As such, this aspect of the issue can be characterized as a *cognitive* legitimacy crisis. In addition, the management and CEO of AlphaSys also think that OmegaCom is not able to integrate fluids in medical systems. They think that OmegaCom might fail, or at least that there are other companies much better in it and thus have an advantage.

As such, trying to integrate fluids in their products poses a high technological risk, which conflicts with their *interests* to realize a successful product. We characterize this aspect of the legitimacy crisis as *pragmatic*.

*Strategy*

To legitimize the idea to start working with and integrating fluids in their hardware medical systems products, scientists of Omega Research and the NBD team of Newman appealed to the benefits of doing so, and stated that it was the consequence of wanting to build up a business in molecular diagnostics. Moreover, they tried to show that working with fluids was a challenge they could meet, because OmegaCom had also competencies in working with LCD's in which they also integrated fluids. Scientist Abbot remarked about this discussion:

> '...As a response we say "you better get wet". That is inevitable. If you want this [molecular diagnostics] than you have to do something with it. And you have to show them that we can do it, by giving presentations, discussing with people. And be honest... Moreover, a LCD display also contains fluids. That are also very small amounts of fluids and we are pretty good in that. So we think we can handle this integration project...'

> '... But the integration of hardware with fluids, that is something new. Nobody is really good at that, actually. And then you also have to say that there is value in the total. And we want to capture the largest part as possible of that value. You definitely need a partner. But together you can come to really innovative products... and there are also biotech companies that really want something like that...So those are really interesting combinations...'

To overcome the legitimacy crisis of working with and integrating fluids in hardware solutions, proponents of the DaXo proposal tried to demonstrate that it is really in the *interest* of OmegaCom and AlphaSys to continue with it. They stimulate *new* interests within the established order by appealing to the *value* of the integrated solution and the *benefits* that could be realized. This response to the legitimacy crisis can be characterized as a *transformation* strategy. Moreover, to solve the apparent cognitive dissonance of a hardware company working with fluids, they partly *reframed* the established view of what OmegaCom is and does; they are not only a hardware company, but they had also worked with fluids in LCD displays for many years. So integrating fluids in medical systems is not at all that *strange* for them and should pose no high risks. The reframing of OmegaCom as a hardware company that is also experienced in fluids, is also part of the *transformation* strategy to legitimize working with fluids.

**LC 1.4 What is the link with traditional imaging?**

*Legitimacy crisis*

Another issue that emerged during the evaluation of the ideas to develop the DaXo solution concerned the link of the DaXo solution with the traditional product portfolio of AlphaSys. AlphaSys had a strong position in developing and delivering large medical imaging equipment and the management of AlphaSys stated often that the molecular diagnostics solutions have to be linked (in someway) to medical imaging. However, the proposed DaXo solution did not do so at all; the technological principles used were different, the medical application area (*i.e.* sepsis management) was different, and the business model behind it (the DaXo system used special disposable units to do the diagnosis – so revenue streams came from selling the system and selling disposable units) was different from the traditional imaging systems (like x-ray, mri, pet, ct and spect scanners). Senior scientist Hank Abbot said:

> '... they said often that we had to link as much as possible to the imaging equipment. Being AlphaSys, we are a real imaging company. And in principle, that is big equipment, costing a couple of million, and making images. And we do not go inside the human body... Of course this [DaXo solution] is still outside the body, but it is a different way of thinking. And it is a small system. How does that fit into our traditional business? And that link was not at all obvious...'

The ideas for the DaXo solution did not easily match with the existing *view* of what AlphaSys is and does, namely delivering medical imaging equipment. The management of AlphaSys expressed the presumption that innovations in the field of molecular diagnostics should naturally link to and build upon their established imaging equipment. However, the DaXo solution was completely different from that and the management of AlphaSys had a difficulty in *understanding* how this solution consequently fitted to their company. When the idea for DaXo is evaluated from the *perspective* of AlphaSys as 'a medical imaging company', it seemed not very legitimate. As such, this issue is characterized as a *cognitive* legitimacy crisis.

*Strategy*

Proponents of the DaXo proposal, amongst others Newman and his team, but also some people from the CTO Office of AlphaSys that were already convinced of this project, initiated efforts to overcome the confusion about how DaXo links to the established business of AlphaSys. At that time, there had been extensive discussions on new ways of defining and framing the business portfolio of AlphaSys within the CTO Office of AlphaSys. These discussions were initiated by the recent acquisition of Virotin, which had a strong position in patient monitoring systems, also a *non*-imaging product line. Of course, AlphaSys had

acquired Virotin deliberately to strengthen its position in non-imaging businesses, but the discussions on how they should organize the company along this new business portfolio, how they should communicate it to customers, and how it could drive innovation roadmaps, was still going. One of the concepts floating around in those discussions that integrated the different product lines of AlphaSys in a nice way, was the 'total care cycle'. The total care cycle describes the different stages of activities a patient undergoes when he or she needs medical care. The different stages of the total care cycle are: diagnostics, treatment and follow-up. In each of these stages different imaging, monitoring and other diagnostics needs exist as part of the medical care process of the patient. The idea is then that AlphaSys should provide solutions that address the needs at all of the different stages, at least where it concerns imaging, diagnostics and monitoring (*i.e.* medical systems solutions). The care cycle concept could be used to communicate in a better way to customers what AlphaSys is and does, and it could be used to identify gaps and opportunities in the business and drive innovation programs. However, the concept was at that time not yet used as such; it had not yet been commonly accepted as the new business definition. The proponents of the DaXo solution however, found it a very useful concept and model to improve the understanding of how DaXo linked to the traditional medical imaging business. Scientist Abbot noted:

> '... I still think the things we do [with DaXo] are not directly linked to imaging. But they do fit into a patient monitoring portfolio. You could think of some kind of workflow, or total care cycle... Look, imaging is expensive and the equipment is usually in constant use, so you don't want to put everybody in a scanner. You want to focus that, especially when it concerns screening. Maybe you can do a simple test in advance that determines which people you should and which you should not send to the scanner. That is what we call the 'total care cycle', in which we offer molecular diagnostics, and based on the results of DaXo you can do this, or something else. Actually, we want to direct the whole care cycle of a patient, and develop appropriate technologies to support that. It is a concept just recently developed internally at AlphaSys...Technically speaking there is no relation between DaXo and imaging. It's just too different. But in the care cycle and in a certain workflow it is indeed a good concept. There it does fit...'

The introduction and use of this new model of the business and product offerings of AlphaSys helped to position the DaXo solution in a better way. By using this *new model*, the link of the DaXo solution with the AlphaSys business made more *sense*. This new model (or frame) was popularized by members of the CTO office also in favor of the DaXo solution. They made serious efforts to get this new model of 'what AlphaSys is and does' established, and use it to drive the innovation programs. In other ways, they tried to establish a *new* set of criteria and models to evaluate the innovation proposals. As such, this response to the initial lack of legitimacy of the DaXo proposal, is characterized as a *transformation* strategy.

**Starting R&D projects for the DaXo solution**

After convincing upper management of AlphaSys (CEO and CTO Office) of the importance of DaXo, the NBD team of Newman was allowed to set the wheels in motion. For 2003 and 2004 they received the necessary R&D budget approvals and started several R&D projects at Omega Research to develop the DaXo solution. To develop a successful solution, several other internal and external partners were involved in the process to provide complementary competencies and resources. During these initial years of researching and developing a prototype of the DaXo solution, no major issues or crises of legitimacy occurred. Most of the technological problems were solved, and initial responses from lead customers and experts in the field were positive.

**LC 1.5 Budget and hiring processes don't match required flexibility**

During the research and development process of 2004 and 2005 a new round of budget approvals was required. The team of Newman experienced that the approval process however took a too long time with respect to their own process momentum. The same applied for the hiring process of new personnel for the R&D and NBD process. The budget approval and hiring procedures at AlphaSys were primarily designed for incremental innovation projects, which did not require the same amount of flexibility and momentum as for the radical DaXo innovation project. The team of Newman however wanted to go faster and needed much more flexibility. Newman mentioned:

> '... On one hand I cannot complain in terms of the amount of money provided to us. On the other hand I have to complain in terms of the process, how long it takes. So it took us more than a quarter last year to get a final feedback on the amount of money we can spend in 2005. That is you know for innovation, new ventures, in which we have a approach to attack the market, than this is important. You have to go fast, you have to make decisions. You have to have the people empowered ... there is a far too long chain of command and this applies as well for the hiring. So even if your annual budget is approved... the money is approved and available, then it is a question of getting the approval for hiring. So there are too many approval processes we have to follow through. Which again are certain slowdowns. You cannot keep the momentum ... you can not keep the space you would like to. So fast decision making and empowerment, that's important to innovation... Sometimes people came up and said you are punished because you are being innovative...'

> '... I got my budget for 2005 approved in the March-April time frame. So it was not clear in January, February, March, if you will. So right now I am in the situation where I got only approved a certain amount of money, for a certain period of time. But I cannot go for a long term commitment with externals... I am only pointing out that innovation, and this kind of

> innovative activities require a different style. You cannot manage those ones as you manage well established product lines, where they build every day a thousand of units. Which is well established in the market, has a well established value chain... where you know everything and everything is well established... this is a different type of business... you know there are certain needs, certain requirements and those have to be fulfilled to be effective... You know you could go for them, but this has certain consequences. And if you would like to be efficient... if you think you have to meet certain criteria in terms of getting to the market, with these kinds of opportunities, then you need those kinds of processes...'

The need of Newman' team for fast decision making and action to realize a radical innovation conflicted with the relatively slow established budget approval and hiring processes designated for more incremental innovations at AlphaSys. The team of Newman was not allowed to act on its own in these decisions, but had to follow established procedures that did not fit their needs for flexibility. If Newman' team could have it their way, they would act and decide in a very fast way and hire the right people to be able to attack the market. However, in the institutional context of AlphaSys that was not *legitimate,* instead they had to follow the formal and established procedures. In other words, the required flexibility and speed of deciding and acting conflicted with the well established procedures and norms of doing things at AlphaSys, concerning innovation. As such, this issue is characterized as a *normative* legitimacy crisis.

*Strategy*

As already evident in the above mentioned quotes from Newman, the NBD team followed the established procedures and processes for budget approval and hiring personnel, although these didn't match their need for flexibility. They did not try to look elsewhere for budgets or resources and also did not try to change the established procedures and ways of doing. Instead, the complied with the normal procedures and processes. As such, this response to the legitimacy crisis is characterized as a *conformation* strategy.

**LC 1.6 Golden standard in sepsis diagnosis**

*Legitimacy crisis*

During 2005 and 2006 the NBD team of Newman and scientists working on the R&D projects encountered an important issue when talking to lead customers and experts in the field. The DaXo solution implied a radical departure from the 'golden standard' at hospitals for diagnosing sepsis and its causing bacteria. Physicians and clinicians in the hospital were used to work with traditional methods of microbiology (cultivating bacteria colonies) to determine the bacterial infection causing sepsis. In general, the medical care setting is characterized by strong formalization of procedures and ways of working and the DaXo solution

entailed a radical break with the standard procedures of microbiology. The Omega Research scientists and Newman' team wondered whether their solution would be easily accepted by their customers or not. Senior scientist Abbot said:

> '... what you encounter, is that they [medical experts in hospitals] are used to cultivate bacteria. And what we do is using a totally different method... What they typically do is that they take some blood from the patient and put it into small bottles. Then, they put those in an incubator at 37 degrees Celsius and measure whether any CO2 is produced. That would be evidence for something living in it. That already takes one day. Then they use the positives to cultivate bacteria colonies. That also takes a day. When there is a bacteria colony they will use their knowledge and experience to determine the type of bacteria. After that, it takes another day to determine the resistance of the bacteria to various antibiotics, also by using traditional methods of microbiology... And what we are doing is using a totally different method [namely, measuring gene and protein activity patterns] One of the arguments against our method is that with the traditional method of bacteria cultivation, you only look at the living bacteria. In our solution, you also look at the dead bacteria that don't need any treatment. Of course, usually this means that there are also a lot of living bacteria in that case, otherwise the patient wouldn't be that ill. But it still is different and you go against the golden standard...'

The DaXo solution is a rather radical departure from the established 'golden standard' in the medical care setting. The team from OmegaCom wonders whether their novel solution will be accepted by the medical experts, because it deviates considerably from the norms and standard way of working. The (potential) conflict between their solution and the established way of working in terms of norms and standards is characterized as a *normative* legitimacy crisis.

*Strategy*

To overcome the issue the DaXo team of Omega Research and the NBD team of Newman initiated several actions to demonstrate the advantages of the DaXo solution. Abbot said:

> '... So we have to prove that the solution we provide, gives at least the same results as the standard approach of microbiology. Of course one can say that it is the golden standard, but also with microbiology things are missed. And if we don't miss them with our solution, that is great. And that is why we do several clinical trials in which we make the comparison between our technology and traditional microbiology... We also asked questions to the clinicians, whether they would have changed their treatment if they could have used our test [the DaXo solution]... and I think that in 50 percent of the 800 cases that was a yes...'

In addition Newman mentioned about their actions to overcome the initial lack of legitimacy of the DaXo solution versus the golden standard:

> '... First of all the DaXo solution is much more convenient... because it reduces labor, it's reducing cost, it's faster. So there are lots of requirements met that for example a physician or clinician has. Nevertheless you have to provide the proof that it is better or at least
> equivalent to the existent methods. And this is the challenging part here. So our plan is here to go trough opinion leaders and lead-users, and if they proof that the system is good and put their name on it, then you can go for it in the market... and that is a known approach...'

> '...Second, we are thinking about trying to establish new guidelines that this kind of detection has to be used in certain situations and so forth. When there are guidelines available and supporting this kind of technology or this kind of approach, then you are in good shape... Third to name is that the big company Roche has another product which has the same technology or with the similar basic technology. But not as automated as ours so that is a huge difference in terms of performance. And in terms of handling. But if this one makes it to the market that is perfect for us. So this helps to break the ground, it helps to cross the barriers. And they already are introducing that product. So people are to some extend known to all the basic technologies used...'

The DaXo team initiated several actions to overcome (potential) legitimacy problems at their customers; clinicians and physicians at hospitals. They try to stimulate the needs of customers by demonstrating the relative advantages of the DaXo approach with respect to the golden standard. Moreover, they collect and provide scientific evidence that the DaXo method is at least as good, but hopefully even better than the golden standard for the detection of bacteria causing sepsis. They approach leading experts in the field that are allowed to work with the DaXo solution and prove that it is really a good solution and the new norm for detection and sepsis treatment. In addition, the DaXo team is aiming to (potentially) establish new detection and treatment guidelines for sepsis that support their own solution. As such, they try to establish novel norms and criteria that support the DaXo solution instead of the traditional golden standard. All these actions, can be characterized as being part of a *transformation* strategy to shape new norms, criteria and needs that legitimize the DaXo solution in a much better way.

**Filing the patent for the DaXo system solution**

In 2006 the prototype of the DaXo solution is finished and the related patents are officially filed. Currently, several clinical tests have still to be executed and the FDA has to approve the solution. Market introduction of the first DaXo solution for sepsis is expected in 2008 or 2009. The management of AlphaSys and Omega Research are still convinced of the opportunities for molecular diagnostics and the

OmegaCom scientists are already working on ideas for the extension of the DaXo platform technology into other application areas.

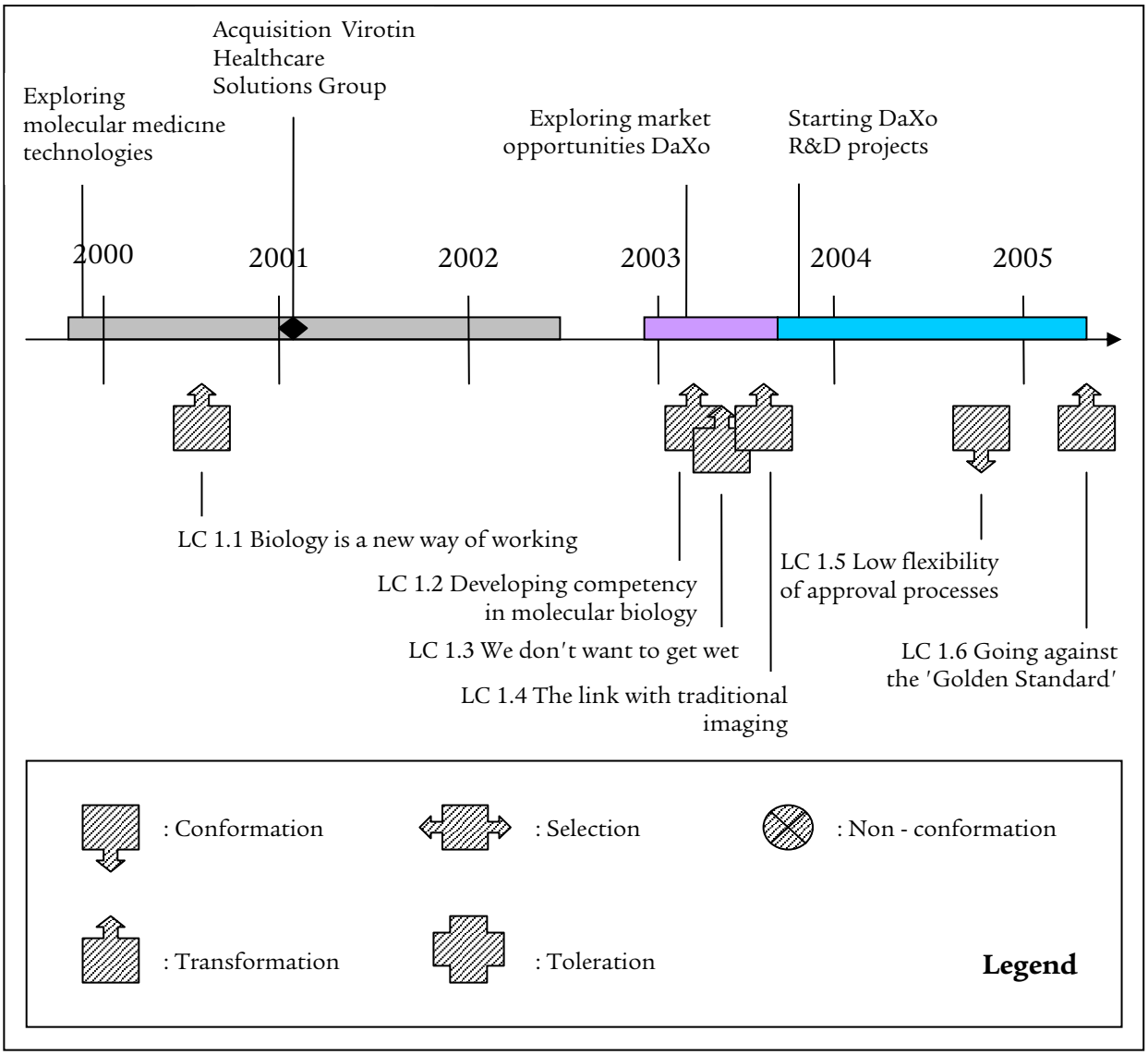


**Figure 4-4 Timeline of the DaXo case.**

## 4.4 Case 2: AlphaSys - Zapim

### *4.4.1 Case background*

The magnetic particle imaging principle (Zapim) was invented around 2001 at the Omega Research group responsible for research into advanced medical imaging systems, and more particular by researchers from the group working on the established Magnetic Resonance Imaging technology (MRI). The case description describes the major research and development activities, decisions and issues that occurred during the period from 2001 to 2006. It describes the innovation process from the discovery of the technology principle to the development of a pre-clinical scanner prototype. For this case interviews were held with: Dr. Jake Berkovich (senior scientist and the current Zapim project leader), Dr. Fred Boisson (the current program director responsible for the medical imaging research program (RPIS) at Omega Research), and Mr. Frank Popper (the former program director of RPIS (until 2004) and currently vice president technology strategy at the Technology Office of AlphaSys). The case description was validated by the interviewees and by Dr. Ed Greenland (senior director technology strategy at the Technology Office of AlphaSys) and Mr. Vince Petrakis (senior director software technology at the Technology Office of AlphaSys).

### *4.4.2 Case description*

**Inventing a new imaging principle**

In 2001, Peter Wright, a young researcher at Omega Research that worked on various research projects for the established magnetic resonance imaging (MRI) technology, comes up with the idea for a radically new imaging principle. This so called Magnetic Particle Imaging (Zapim) principle combined knowledge about physical principles as already deployed in the MRI solutions, but in a completely novel way. The Zapim principle centered on the idea to directly measure (and locate) small magnetic particles within a three-dimensional magnetic field. They expected that this new imaging principle has major benefits over the established technologies because it has a much higher imaging sensitivity and can be manufactured against lower costs. Peter Wright and his fellow researcher John Stanton worked in their spare time on small simulations of their ideas and did experiments to demonstrate the theoretical feasibility of the new principle. Jake Berkovich, the current project leader for Zapim, said about this period:

> '... Peter Wright and John Stanton are the two inventors of this new technology. They come from the MRI part of our group. And before this project, they spend a lot of their work on the generation of magnetic fields, magnetic core systems and such, so it just came natural to them to think in directions like that. And I think the really initial idea came from Peter, he just invented it. I think that is one of his abilities, to come up with these new ideas. He is really an inventor ... in the literal sense of the word...'

The simulations and experiments were successful and showed initial feasibility of the Zapim principle and of course the researchers felt very excited. They applied for a formal research project to develop an experimental Zapim system with which tests could be done to demonstrate also the technical feasibility of the concept. The project did not require much resources and the management team of the Research Program Imaging Systems (RPIS) agreed to support the project in 2002. The project was sponsored out of the Corporate Research budget, which the RPIS management team could spend on promising, but early stage inventions that still needed a lot of research work. This budget was largely independent of the interests and needs of the Medical Systems product division and the Management team of RPIS was free to make its own decisions about it. Frank Popper, the former Director of the RPIS, said:

> "... It was a rather nice invention of Peter Wright. Many ingenious inventions have the property that they are very simple. That is also the case for this one. So we encouraged Peter for a follow-up, to see if it is really feasible, and step by step he showed that it was feasible. So I tried to nurture the project as much as I could, when I was responsible for it...'
>
> '... [In the beginning] it was small. There was never a problem to nurture it. So it was like 1 person, 2 persons... At the time, Peter and John said: the basics we can work out. It is not that if you give us 10 people we can be faster. But I always pushed to say: well let the speed not be determined by the number of people. Let the speed be determined by other things...'

**Early research collaborations**

In the year 2003, Frank Popper, the director of RPIS, initiated the idea to start a collaboration with University X from the United States to speed up the research on Zapim and determine the most promising clinical application areas. The Research Department had a competency in researching and developing MRI-like systems (the hardware side), but lacked specific knowledge on the magnetic nano-particles or so called 'contrast agents' that went into the human body. These nanoparticles are measured with the Zapim system to construct the images of particular clinical anomalies. At that time University X was setting up a completely new biomedical engineering lab and was looking for promising research topics and director Frank Popper thought that research on Zapim could fulfill their need. For the management team of RPIS it was important to get access to the researchers and clinicians of this University to determine the most promising clinical applications, and thus the most promising markets. Based on the resulting priorities, research and development efforts could be dedicated more effectively. In addition, the RPIS management team expected that the University would supply the manpower for free, because Zapim was such a promising idea to work on.

However, the negotiations about the collaboration with the University did not result in a deal. A conflict of interest arose between the University and Omega Research about which party would own the intellectual property rights on the developed 'contrast agents' (i.e. important complementary technologies). University X wanted to own all intellectual property rights concerning these complementary technologies. This was unacceptable to the RPIS management team, because this would severely limit their revenue stream from the complementary 'contrast agents' business when Zapim was established. Frank Popper, the former director of RPIS said:

> '... So what we did in 2003, very early on... we approached University [X]. This university has one of the top-ranking medical schools, but was ranking only 13 in biomedical engineering. In the USA that is a bad position... So what University [X] did is they created a completely new biomedical engineering lab, for 26 million, a brand new building, rooms, people, but no content. So we went there and said we have content for you. We will allow you to work on this idea, if you can give the manpower for free. The key thing then was that as a first step, because you are also a medical school, we want access to your clinicians. Because at the very early stage - that would have been 3 years ago - we wanted to come up with the priority of which application is the most promising. Which market is the most promising. So that we can dedicate our efforts, and you can dedicate your efforts in your lab to make this system. And then you will be the first to develop this kind of system. And we thought that was really a win-win situation. It turned out that in University [X] there is also a professor who is a big shot in Molecular Imaging, he turned around and said: I want all IPR on the agent, which was completely unacceptable to us. Since we wanted to stay on friendly terms with this professor because of other important initiatives, we just kept the thing silent. Which blew this opportunity...'

One year later, during 2004, RPIS management and the research team working on Zapim were able to find another partner for the research on the magnetic nano-particles, or 'contrast agent'. This new partner was a commercial company called MaterialTech, which already had several 'contrast agent' products on the market and had much knowledge on the clinical application areas of these contrast agents. One of the existing contrast agents of MaterialTech seemed to be the best one currently available on the market for the purposes of the Zapim research team. This contrast agent could already be used together with the Zapim system and provided satisfying performance. MaterialTech also saw the potential of Zapim and was willing to improve their existing contrast agent to improve the performance of the Zapim system even more. The big advantage of using an existing contrast agent was that it already had been approved by the FDA. A completely new contrast agent would need to get formal FDA approval, which is a process that takes several years. By using the contrast agent of MaterialTech the research team could thus reduce development time considerably. MaterialTech also agreed to share (or co-own) the intellectual property rights for newly

developed contrast agents. Jake Berkovich the current project leader, noted about this period:

> '...In the first place we just called companies, providers of contrast agents, and asked them if they could send us samples, and just try those samples. OmegaCom had another project going on with MaterialTech, and through that project the link was established for our project. It also showed that their contrast agents is the best. They have the best you can get your hands on...'

> '... I think one point that we underestimated is that this early availability of a dedicated collaboration partner, in our case MaterialTech... I mean it is extra work, you must make sure that you have your approval, not only from your organization but also from their organization. So the effort of aligning your activities is higher, but the outcome is also higher than without such a partner. As I said, the contrast agent has to be improved, it has to be worked on, and I cannot see anyone inside OmegaCom who can do that in the way MaterialTech can...'

The partnership with MaterialTech did not came out of the blue completely. AlphaSys (AlphaSys) had announced a formal collaboration with MaterialTech on other technologies and imaging modalities a couple of months before. Both AlphaSys and MaterialTech wanted to make the best of this collaboration so it was relatively easy to fit the research project on contrast agents for Zapim into their already existing joint research and development framework.

**LC 2.1 Distinguishing Zapim from established technologies**

*Legitimacy crisis*

Until the start of the small scale research collaboration with MaterialTech, little interest in Zapim had been demonstrated by the different business units of the product division AlphaSys or the Technology Office of AlphaSys. Initially, the research team on Zapim didn't think that this was an issue because the technology was still very experimental. However, the start up of the collaboration with MaterialTech in 2004 also focused on promising applications and their business potential, and thus questions emerged about how their technology would be commercialized eventually, and which party would be responsible for doing that. Normally, the product division AlphaSys would commercialize medical imaging technology and handle all commercial and business aspects, but Zapim was a radically new technology and for the Zapim team it was not evident how it would fit into the established product division organization. Jerry Hill, one of the technology strategy directors of the Technology Office of AlphaSys, who was partly responsible for the larger collaboration with MaterialTech, became interested in the Zapim technology and recognized the concerns of the Zapim team about the fit with the AlphaSys organization. He wanted to increase the awareness of Zapim

at the Technology Office and business units of AlphaSys and arranged presentations and discussions for the Zapim research team at AlphaSys. Around that time, the researchers working on Zapim thought that the Zapim technology could establish itself as a completely new imaging technology, complementing and partially substituting some of the established imaging technologies. In their view Zapim could become a new business for AlphaSys and thus eventually would also require its own business unit. However, when hearing the presentations about the Zapim technology, most people from the business units and Technology Office perceived the Zapim technology as something similar to the already existing MRI technology. Zapim was perceived as a variation of MRI, because it seemed to be based on similar physical principles, used contrast agents that were also used for MRI, and it had been developed by people formerly working on MRI innovations. Consequentially, they also linked the future development and commercial exploitation of Zapim to the MRI business unit and did not share the idea that Zapim could establish itself as an independent imaging technology and new business on its own. Jake Berkovich, the project leader for Zapim, said about this:

> '... For I think the last 6, 7, 8, months we had discussions... that we develop some kind of closer relationship between Research and AlphaSys, because this is not an evolutionary technology that improves part of an existing technology, or an existing scanner. But it is rather a new technology. It is a new imaging modality. And as such it has to find its place in AlphaSys in the future. And so you have to make sure in a very early phase of the project, that you develop some kind of link to AlphaSys with the project, because it doesn't exist naturally as is for other projects. As you do an improvement for an MRI-scanner, you naturally talk to the MRI guys. But there are no magnetic particle imaging guys in AlphaSys...'

> "...a lot of people come up with the idea that it is the same thing as MRI. You are using the same contrast agent as for MRI, so you are doing the same thing but then cheaper, better, faster ... but it is really different from MRI. I think the only link to MRI is that it is also using magnetic fields. But I think in principle we are doing different things. We are determining the local concentration as a number of this stuff inside the body. So we have to make sure in our so called strategic setting of the project, that we find a link in AlphaSys, but that we also prevent the people linking it to tightly to for example MRI, or just stuff it into the MRI business... but rather think about, or develop a new mindset and new business out of this...'

The ideas of the Zapim researchers to establish Zapim as an independent technology and new business is not legitimate to most involved actors from the Technology Office and the existing business units of AlphaSys. The established *models* and *frame of reference* of MRI are used to *make sense* of the novel Zapim technology as a 'variation' of MRI. Consequently, within this dominant frame of reference it doesn't make much sense to try to establish a completely new business for the technology. As such, this issue can be characterized as a *cognitive* legitimacy

crisis, in which the novel ideas for Zapim are not legitimate with respect to the established cognitive models and frames of reference in use.

*Strategy*

To change the perception amongst people from the business units and Technology Office and distinguish Zapim more clearly from the existing MRI technology, the Zapim researchers invented a new label to denote an important component of Zapim. Instead of calling the magnetic nanoparticles 'contrast agent', as is common within the MRI frame of reference, they started to call these nanoparticles 'imaging tracers'. Berkovich said:

> '... We call it 'imaging tracer', because we use it to directly image or determine the local concentration of the tracer material that can be injected into your bloodstream... but we use an already approved, and already established contrast agent from the MRI-business. But they don't use it for directly determining the concentration, but rather for enhancing certain contrasts in the body. So we tried to come up with a new name for these contrast agents to somehow... prevent the people linking it too tightly to MRI...'

The invention and popularization of *new labels* to make a clear distinction between the old and the new, can be characterized as a *transformation* strategy to change the mindset about Zapim. The use of these new labels helps to distinguish between the novel technology and the established MRI technology. As such it underlines the possibility that Zapim could indeed establish itself as a completely new business for AlphaSys, very distinct from MRI.

**LC 2.2 Publication and awakening the competition**

In the end of 2004, the Zapim research team and the management team of RPIS at Omega Research wanted to publish an article in one of the major international scientific journals to get the academic community interested and to establish the fact that OmegaCom was the inventor of this new technology. Besides, the management team of RPIS also felt obliged to the inventors Peter Wright and John Stanton to enable them to present their invention to the world and get recognition from the academic community for their work. But above all, the Zapim research team and their management felt that it was very important to stimulate the interest of the academic community in Zapim and in the end get the best academic partners involved. They compared the development process of Zapim with the history of the already existing MRI technology; initially, MRI had not been invented as a specific medical imaging technology, but through the adoption, involvement and efforts of many academic research groups, all kinds of new medical applications had been discovered which have contributed in a major way to its success and adoption by the medical sector. The Zapim researchers wanted this also to happen to their new Zapim technology. However, some of the

technology and strategy directors of the Technology Office from AlphaSys strongly disapproved of the plans to publish on the Zapim invention around this time. The Technology Office had not yet decided about what they would do with Zapim and whether AlphaSys would really develop it into a concrete product and business. They had not yet developed a clear strategy for Zapim and felt a bit rushed into an uncertain adventure. They certainly didn't want to wake the competition without having a plan and potentially loose their competitive advantage. Jake Berkovich, the research project leader said:

> '... We need publicity... because we need other academic partners joining in... if you think about MR, it was not invented as a medical procedure or application, it was just a technology. And then the academic community and other people took over ideas and developed certain aspects. And then there came big improvements in the technology by people looking into the way they reconstructed images for example, because that gave a big boost to it as a medical application. We foresee that the same thing has to happen to Zapim... we will show the first application, show the first scanner, we will present the first solution to technical problems, but to really make it a widely accepted technology, you have to have other academic partners, other companies joining, and therefore we have to get out and generate a little bit of publicity for this project from a research point of view...'

> '... I think there are always different opinions about how much publicity you need. And publishing in Nature is big publicity. It is the biggest publicity you can get in the technical based science business. And it was not always the case that all the people involved in this project, especially in AlphaSys, said that it was a good idea to publish as early as we did. I mean it is not early for us, because the things that we publish are two years old, to just keep us in advantage, and give us a head start in such new technologies. And they still thought maybe we should keep it to ourselves, just write enough to put it into the market. But that is clearly from the research point of view not a good idea...

The former director of RPIS from Omega Research, Frank Popper, also noted about this issue:

> '... There was a tremendous amount of discussion about whether we should publish this. Because it was clear that by the time we publish it, everybody will know. Everybody will get excited. People will wake up, that this is an opportunity they should invest in. All our competitors will wake up. On the other hand, when you patent something, the patent becomes published also. So would you assume that your competitors will not wake up when reading the patent publications? Well... we should not. We should assume that our competitors are professional people. So then there was a risk that the competitors would read the patent literature, and would reach some level of maturity, and then the world would know about Zapim through

> our competitors. And that was something we didn't want to do, we wanted to make clear that it is a OmegaCom invention. So then you are in a squeeze, you have to publish at some moment in time. And when you say don't publish, because we are not prepared for the consequences, strategically, that is never a good approach. But that was the response of some people of AlphaSys who tried to delay the publication at the last moment...'

The idea of the researchers to publish an article about the Zapim invention was not much supported by the people from the Technology Office of AlphaSys. The idea to publish about Zapim, and the *frame of reference* that the researchers used to legitimize this idea were not shared by the strategic directors from the Technology Office. The researchers were concerned with getting recognition for a great invention and getting access to interesting research partners that would stimulate all kinds of research and development activities around Zapim. The strategic directors of AlphaSys instead, *reasoned* from a typical 'strategic and competitive advantage' frame of reference. They were concerned that publication would wake up the competition and that they could lose their competitive advantage, which would limit commercial success. As such, these aspects of the issue can be characterized as a *cognitive* legitimacy crisis, in which the 'thought worlds' of researchers and business people clash and the proposed ideas don't make sense with respect to the dominant frame of reference at the Technology Office of AlphaSys.

Following from the dominant frame of reference at the Technology Office, the ideas to publish seemed also not in the interest of the decision makers of the Technology Office and AlphaSys. They felt rushed into an adventure with unknown outcomes for which they had not made any contingency plans yet. Because they had not decided yet about the strategy for Zapim and whether they would go ahead with it, the ideas to publish about Zapim did not yet match with their *interests* and *strategic goals*. As such, this aspect of the issue can be characterized as a *pragmatic* legitimacy crisis.

*Strategy*

The management team of RPIS and the Zapim research team nevertheless pushed forward, arguing that the patents had been filed and published publicly anyway. They ignored any further objections made by members of the Technology Office of AlphaSys and did not feel strongly obliged to comply to the concerns of AlphaSys. The research on Zapim had been completely sponsored out of the Corporate Research budget of Omega Research itself, so they felt free to do as they liked and not obliged to the AlphaSys product division. Berkovich said:

> '... they still thought maybe we should keep it to ourselves, just write enough to put it into the market. But that is clearly from the research point of view not a good idea. So we pushed forward to publish it...'

> '... So that was a bit of a procedure-less decision at that point of time...we now have the possibility to publish that, the editor says it is okay, and what does AlphaSys think of that, is it approved or not? And we had the impression that they just started thinking about it. And that was a bit vague... I think if we had an exchange about our strategy in terms of publication and their strategy of business earlier in time, that might have been circumvented. But otherwise no harm done...'

Also Frank Popper mentioned this reaction of the research team and RPIS management:

> '... But then again, Research said: AlphaSys thank you, but you are not in control, you have not paid a dime for it. So if you think it is so important, why didn't you pay a dime for it. And now it is ours, and we publish, because we owe this to the inventor...'

The reaction of the research team and the management team of RPIS was to push forward and not change their ideas to conform to the dominant group and established way of thinking at AlphaSys. They also didn't try to change the way of thinking and reasoning at AlphaSys, but instead just went ahead with their plans. As such, this response to the lack of legitimacy of their ideas can be characterized as a *non-conformation* strategy.

**LC 2.3 Finding a place within AlphaSys**

During 2004 and part of 2005 the research on Zapim was sponsored by Omega Research itself. In this period the technical feasibility of the Zapim principle and the first experimental Zapim scanner were demonstrated. At OmegaCom it was a rule that after technical feasibility had been demonstrated at the Research lab, a technology has to move out of 'corporate research' into 'contract research' funding. In the case of Zapim this means that a business unit from AlphaSys must be found that is willing to commercialize the technology and pay for its further research and development activities. The RPIS management team and the Zapim research team therefore thought it was necessary to start discussions with several business units to find a place for Zapim within AlphaSys. The timing seemed right as the publication about Zapim in one of the major scientific journals had stimulated the interests at AlphaSys. Besides, although the Zapim technology could be developed into an independent imaging scanner, for certain diagnostic imaging tasks and applications, Zapim potentially needed integration with existing imaging technologies. Zapim had certain limitations and could only image and visualize imaging tracers that bind with targeted biomolecules in the human body. However, the rest of the human tissue (and anatomy) surrounding these targeted biomolecules also have to be imaged and visualized for certain applications and Zapim is not able to do so. Potential imaging technologies that seemed very suitable to integrate with Zapim were MRI, but also CT. The RPIS

management team and the Zapim research team thus discussed their ideas for further research on Zapim and potential sponsorship by the product division with the MRI and CT business units.

*Legitimacy crisis*

The researchers and research management talked to the business unit MRI and CT about the potential opportunities of Zapim for their businesses. With Zapim the business units MRI and CT could potentially deliver interesting new customer benefits and functionalities within some of their established application areas and market segments. However, the MRI business unit stated that the Zapim technology was not part of their defined business, which was delivering MRI solutions. Moreover, the profitability targets set for the business unit MRI (and also CT) for the years 2005 and 2006 were very high, and investments in a new imaging technology with uncertain returns on investment for the next 5 years would not help in reaching these targets. As a consequence, the established business units declined the proposals to support the development of the Zapim technology and integrate it into their existing solutions and businesses. Frank Popper, the former research director of RPIS said:

> '... Now with Zapim - since it was a research initiative and I basically raised it - I paid for it out of company research, and AlphaSys always kept at a certain distance in order not to have to pay. And if you look at the decision making process, then of course the Business Unit MRI says: well it is nice, but we will not be the owner of it. Still ZAPIM has no owner, no business unit that says we want to have this, we want to produce this, we want to market this. Because as soon as they say that, they are expected to pay for it. So everybody was trying to work around that...'

> '... But [the MRI and CT business units] have more important things to worry about. They have targets from [our CEO], to be profitable, and they are struggling. So every dime they invest in something that turns out to be the blockbuster in ten years, does not help them to reach their target...'

> '... And in AlphaSys everybody is so busy with their own focus, in modalities and in the business units, that nobody takes ownership. And they all think it is a nice idea, and that it could be something, but even translating this idea into potential customer benefit, somebody should do that... but I think Research is now taking more of an entrepreneurial position, so they can also make their own case at board level. And hopefully that will then be the fast way...'

Thus on the basis of already established goals and responsibilities, as well as the investment impact required and its effect on performance targets, the proposed course of action to further develop Zapim technology and embed it within the MRI business unit was not legitimate to the MRI business unit managers. As such,

this issue can be characterized as a *pragmatic legitimacy* problem. It is concerned with the strict performance targets that had to be realized by the business units approached. As performance targets were set high, it was not in the *interest* of the business unit managers to invest in a immature technology with high technical and market uncertainties. According to them it did not help them in realizing challenging performance targets in the near future.

*Strategy*

At that time, the research team of Zapim and the RPIS management team didn't push forward with the MRI (and CT) business units. They couldn't change the minds and priorities of the business unit managers and left the ideas for an integration of Zapim with established imaging technologies for now. The researchers though still believed in these ideas, and wanted to try it again in the future, when more of the technical risks would be reduced and market potential could be better assessed, but for now they conformed to the immediate interests of the established business units. As such, this response can be characterized as a *conformation* strategy, in which the plans and ideas for aspects of the innovation are put on hold and the proponents wait for a seemingly better time with more favorable circumstances. This specific instance of a conformation strategy could also be framed more precisely as a postponement response, where innovative actors postpone or delay the pursuit of their ideas to a later stage. Throughout this case analysis we will categorize postponement actions[11] as being part of a conformation strategy.

**LC 2.4 Still too risky to invest by the product division**

As the business units were not prepared to fund research and development of the Zapim technology, the management team of RPIS and the research team also made a proposal and request for funding to the Technology Office of AlphaSys. The Technology Office is responsible for longer term technology development, and some people working there suggested during 2005 that they might pay for research and development of Zapim for the year 2006. The aim of the proposal was to further develop the Zapim technology (developing a more advanced system for scanning living animals) and to explore and research several applications. The Technology Office however, deprioritized the request for funding of Zapim for 2006. According to the Technology Office the Zapim technology was still too premature, it still involved high risks and had an unclear business potential, compared to other technological opportunities for which funding was requested.

[11] Postponement and withdrawal will be treated as specific instances of conformation throughout the analysis. In order to develop a clear and not too complex model we chose to introduce *no* new sub-category for postponement and withdrawal. The postponement/withdrawal response resembles the characteristics of the conformation category (adapting innovative ideas to incorporate and comply with established interests, norms and beliefs) and must be seen as conformation in its most definite and constraining form; adaptation means in this specific instance: postponing, delaying or cancelling the whole innovative idea or proposed action to comply with established institutional logics and structures.

The Technology Office had limited funds available for research, so priorities and choice were essential. AlphaSys as a whole had to realize specific financial targets, which meant that costs were being cut and the 'fat' of the organization as a whole was reduced, including funds for longer term research and development without a clear value proposition. Besides, the Zapim research team had also not yet made a real market projection and business case for Zapim, because no specific application area had been chosen. This made it also difficult for the Technology Office to evaluate the proposal. Fred Boisson, the current director of RPIS and responsible for all research on imaging systems, and also for Zapim, said about this:

> '...But the situation for this year, for 2006, has changed. It's a typical company internal story, because when we made all the strategic planning and so on for 2006, AlphaSys indicated this year they would pay for the project. Six people in the project in Berlin. But then after they had their internal budget rounds, they said: this is still too premature, we don't yet see what will be the return on our investment, so for 2006 we still not want to fund it...'

> '...AlphaSys is for more than three years in the process of increasing profitability. So they started at the level of 3%, roughly, and after three years they reached a profit margin of 14%, which was also promised to the analysts. So everybody was happy. Of course that does not come for free. It came on the expense of cutting costs everywhere, especially in development. And that meant that all, what you consider as 'fat' of the organization, but also a couple of projects, which not really related to your core business, they fell off the list. So it was the increase in profitability, combined with a focus on core business. And therefore since this is a new business, to some extent a new market even, which is not known today, it might be even cannibalizing their existing businesses to some extent... And we also had not made a real market projection, there was no full-grown business plan on the table, and they decided to not invest in it at this moment. Therefore what we are doing this year, is really preparing that case, so doing a full business-plan, doing the case numbers, the reimbursement, and what you need...'

Frank Popper, the former director of RPIS, who currently works as technology strategy vice president at the Technology Office of AlphaSys (as of 2004), also noted:

> '... And there was no party within AlphaSys, like the Technology Office - given all the other priorities and these other urgent improvement actions and other incremental innovations - that would have said: "we embark on this, we will do this". So it turned out that AlphaSys never paid anything for it. Therefore when it was clear that it is feasible, now for 2006, AlphaSys would have to pay. We didn't ... still AlphaSys did not pay, because there are so many other priorities, and we did not get as much funds from [our CEO]

> for research as we would have liked. So we said well we can't afford this, and even though we [AlphaSys] have negotiated this as part of the agreement with [MaterialTech], we ended up without control of the project. Who does not pay, has no control...'
>
> '... There is no focus on long-term opportunities, there are no extra funds, or extra mechanisms, unless we divert money from other projects, but that is up to the Technology Office. So it is all up to the Technology Office at this moment to make sure that these long-term things happen. And especially, I mean the modalities are responsible for their own innovation pipeline. But Zapim is not considered 'my' innovation pipeline to any of them. So it is then up to the chief technology office basically to take ownership for this. But also their funds are limited, because AlphaSys as a whole has promised to the outside world to reach a certain profitability. AlphaSys as a whole is expected by the OmegaCom Board of Management to deliver a certain amount of profit. And then priorities are adjusted accordingly. This is still in its infancy, we don't know whether we can make a system out of this, we have now seen images, we are preparing for animal images. And then of course, when we have animal images at the end of this year, that will lead to 100 more academic groups on it. So that will force you, if you want to stay in the lead, to invest more. But we don't have plans to do it at this time.

So the proposed course of action to further research and develop the Zapim technology was not supported and sponsored by the Technology Office of AlphaSys. This issue can be characterized as having primarily *pragmatic* and some minor *cognitive* legitimacy aspects to it. To start with the latter, the *cognitive* aspects concern the use of established *criteria and models* to evaluate a request for funding by the Technology Office, that focus specifically on the business potential and returns on investment, and as such adopt a *business logic*. However, the Zapim researchers did not use these models and criteria to present their proposal. They expected that with Zapim they could realize all kinds of interesting applications in the future, but did not develop 'hard' business cases to support this. For them it seemed evident that the Zapim technology is a highly promising topic to work on, at least from their *research* perspective.

The *pragmatic* aspects concern the established goals and responsibilities, and existing performance targets of the Technology Office. Just like the rest of AlphaSys, the Technology Office was also responsible for achieving strict performance targets and had received less resources to spend on longer term research. Its financial slack had been reduced and strategic priorities were set accordingly, with a stronger focus on core business. Consequently, it was not in the *interest* of the Technology Office to invest in a technology like Zapim which was still premature and inherently risky and did not have a direct link to their established core businesses and technologies.

*Strategy*

Because some members of the Technology Office of AlphaSys had indicated initially that they would support and finance further development of Zapim, the management of RPIS had not made any specific budget reservations for Zapim for the year 2006. This meant that another way of financing the research and development activities of Zapim had to be found. RPIS Management then decided to finance the Zapim project through a so called 'lab venture'. In a lab venture the Research Department itself takes some entrepreneurial risk by investing in research and development activities that have to generate some form of revenues (by selling prototypes or getting public funding) during the next couple of years. The difference with the normal 'corporate research' funding procedure is that the research team is responsible for creating (research) revenues to pay back the initial investments and hopefully even more. This means that RPIS Management and the Zapim research team are responsible for realizing these returns on investment, but also take the financial risk. The lab venture construction was a new way of financing and organizing technology development for the people involved with Zapim. But the big advantage was that it could be arranged relatively easy, because Fred Boisson, the director of RPIS, was partly responsible for granting projects the lab venture status. Boisson said about this issue:

> '... Then we were in a somewhat difficult situation. Actually then there were two options. The first option was we could still bring it in to the other funding scheme [corporate research], but there we had already made our choices. Or we could use a new instrument, which we call a lab venture, and that is how we run it now...'

> '...the lab venture is an activity that runs inside the lab, which we treat like a new venture. So actually we make some kind of business plan and research is going to provide the initial funds, but after a certain moment of time the project should re-earn the invested money. And the planning for Zapim was that we [the Research Department] would invest for two years, and then by selling prototypes and getting in some public funding, the project would refinance itself. Including the initial investment...'

The response of the Zapim research team and the RPIS management team was to search for other ways of funding the research and development activities of Zapim. After the Technology Office of AlphaSys had not agreed to sponsor the project, the research team and Fred Boisson looked for other ways to continue with Zapim and found the lab venture procedure to be suitable. Boisson was member of the decision making group at the Research Department that decided about the lab venture grants and the other members were relatively easy convinced of the potential of Zapim and suitability of the lab venture to fund it. As such, this response is characterized as a *selection* strategy in which another established group with better matching interests, procedures and norms is found to support the radical innovation.

**The future of Zapim**

During 2006 and 2007, the research work on Zapim continued by means of the lab venture. The research team, led by Jake Berkovich, was able to apply for a large government grant in collaboration with a local university to develop particular aspects of a Zapim scanner prototype. Moreover, a research group from a highly renowned university in the United States wanted to buy a prototype Zapim scanner for research into particular biomolecular phenomena. The interest of the academic community was growing and the Zapim researchers still hoped that Zapim would evolve into a similar established imaging technology as MRI.

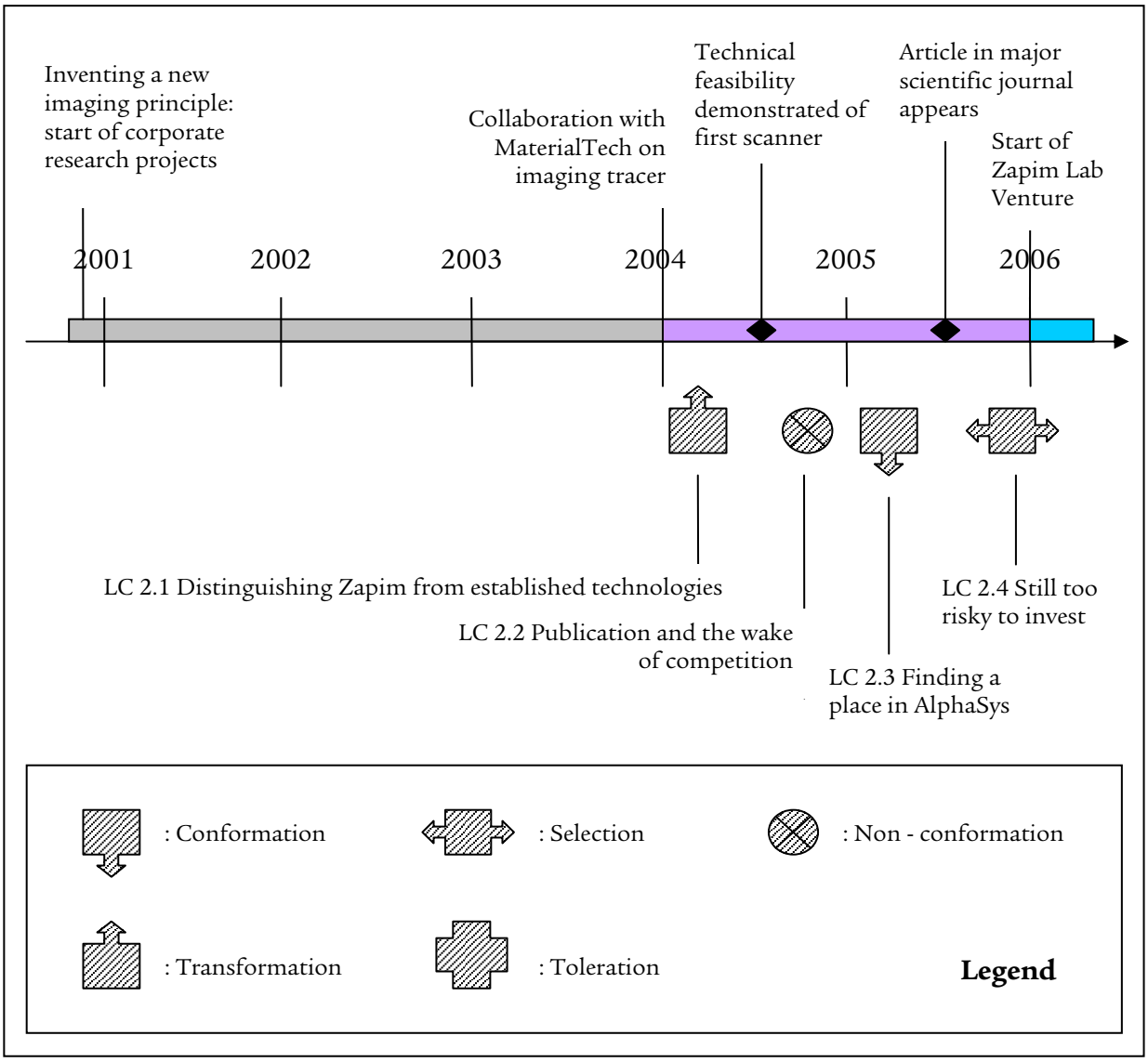


**Figure 4-5 Timeline of the Zapim case.**

## 4.5 Case 3: AlphaSys - Icon

### *4.5.1 Case background*

The initial concepts for Icon for healthcare were developed around 2001 and 2002 at the Omega Design group responsible for the product designs for AlphaSys. The case description describes the major design and development activities, decisions and issues that occurred during the period from 2001 to 2006. It describes the innovation process from the ideation of the design and product concepts to the industrial development and commercialization of several Icon suites. Interviews were held with: Dr. Tom Eckard (marketing manager of the business unit MRI at AlphaSys), Mr. Justin Kingsley (program manager Healthcare at OmegaCom Applied Technologies), and Mr. Dale Cooper (the global design director for Healthcare at Omega Design). The case description was validated by the interviewees and by Dr. Ed Greenland (senior director technology strategy at the Technology Office of AlphaSys) and Mr. Vince Petrakis (senior director software technology at the Technology Office of AlphaSys).

### *4.5.2 Case description*

**Some emerging ideas at Omega Design for Icons**

Omega Design is the design studio for the different product divisions of OmegaCom Electronics. In different studios around the world about 450 designers work on novel product designs for OmegaCom. Within the Eindhoven design studio a group of designers work specifically for AlphaSys, which is headed by Dale Cooper (during the period 2001 – 2006). During 2001 and 2002 Omega Design had initiated several Design Research projects to investigate and develop new design services and approaches that could be offered to its customers (i.e. the product divisions). One of the concepts (or new approaches) that emerged from these Design Research projects was 'Icon' design. Central idea of the Icon concept is that you design technological solutions that enhance and improve user experiences and integrate all kinds of OmegaCom technologies with elements of the architectural environment. So the (architectural) environment in which the user normally makes use of a particular technological product is involved in developing an effective and integrated design solution. For typical OmegaCom Electronics products such as televisions and audio systems, this meant involving the whole living room in developing design solutions. For the application area of healthcare (i.e. medical systems) the Icon approach would mean that the offered 'solution' (making x-rays for instance) included medical system technologies, but also lighting products and audiovisual technologies (and other OmegaCom technologies) that were integrated in the environment (the x-ray room and department) to improve the experience of patients and doctors. The Icon concept for healthcare particularly aimed to improve patient comfort (mental and physical), patient contact (with relatives and clinicians), patient workflow (through the process) and personalization. The designers of Omega Design expected that

the Icon approach would help to discover and develop new added values to healthcare solutions and enables the development of a new product vision. This new vision would have a strong focus on the patient's emotional and physical well being, instead of the traditional focus within the medical systems industry on the product's technological performance.

During 2001 and 2002 the basic ideas for the Icon approach had been developed. Not all aspects were completely worked out and some still had to take shape, but Omega Design could offer and work together with its customers to develop Icon solutions for existing and new products (and product lines). Dale Cooper and his team of designers really believed that the Icon approach for healthcare provided a new way of thinking, and as such could realize new added values and improve the position of AlphaSys in the market. They only needed the opportunity from AlphaSys to demonstrate the benefits and relevance of the concept.

**Initial project on Icon for the St Francis Hospital**

In the end of 2002, Victor Wooten, one of the sales directors of the North American Sales department of AlphaSys, completed a big deal with the St. Francis Hospital for advanced medical imaging systems. After making the deal, he suggested to the management of St. Francis Hospital that OmegaCom might be able to do something extra for their organization and its market positioning. He suggested that St. Francis Hospital could improve its total patient experience with other OmegaCom technologies like lighting and audiovisual systems. Wooten invited some designers from Omega Design and sales people from the product divisions Lighting and Displays to come over to Indianapolis and develop some kind of total Icon solution for the St. Francis Hospital. This was one of the opportunities looked for by the group of Cooper of Omega Design, which would enable them to experiment with the concepts and find out what the interests of end-customers would be for such an approach.

The designers from Cooper group worked together with Wooten and the architects from St. Francis Hospital to create the concept for an Icon solution. The idea was to use the history of Saint Francis and his roots in Italy (Assisi/Umbria) as a general theme in the design of an integrated Icon solution at hospital level that guided the patient through his or her healthcare process. After developing these initial ideas, all involved parties seemed very enthusiastic. However, after a couple of months, the involved people from OmegaCom felt they were not organized in the right way to tackle these kind of projects (that involved multiple products and technologies in one integrated offering) and the interest at St. Francis Hospital was lost. Although the team of Dale Cooper from Omega Design did get extra insights in the potential of the Icon concept, they still hadn't realized an actual design based on the concept.

**Interest of the AlphaSys Business Unit MR for an Icon solution**

In 2003, Tom Eckard, marketing manager of the business unit MR (Magnetic Resonance Imaging), faced a serious issue. They had to come up with a 'new' MRI system, because their existing MRI system was nearing the end of its lifecycle and their market share had decreased during the last years. The business unit MR really felt the urge to introduce a new system to win some customers back and improve its market share. However, the business unit did not have enough funds available to realize a big technological innovation or major performance improvement. Eckard thought they might be able to do something innovative to the design of the system instead and in that way add new value. He said:

> '... After four years there was a real necessity to come up with something new... because our market share was going down a little bit... And because we didn't have the money to develop a wholly new system, we said what can we do to improve the design of the system? And together with Omega Design we then pushed the boundaries a bit... We asked them if it was possible to use the concepts of Icon for our patients [patients that go through the MRI process] and whether they could also include the environment of the MRI scanner, namely the MRI suite, in the design of a solution...'

The management team of the business unit MR agreed to start a small Icon research project in collaboration with the Utrecht University Hospital to investigate patient and user experiences with existing MR imaging systems. Based on this investigation Omega Design developed several ideas for an Icon solution for MR imaging. Eckard noted:

> '... And Omega Design came up with some fantastic ideas... We said this is the right way for the design of the suite. This is very appealing and thus supports our sales process, because you immediately involve the emotions of the customer during sales. So we wanted to do this for the modality MR and use this vision in all our marketing collaterals... So the new MR system is no longer a dull grey box, but a beautiful, attractive and aesthetically pleasing suite...'

Eckard and the management team of the business unit MR were very enthusiastic about the Icon concepts for their new MR scanner and suite. Eckard expected that the Icon concept with its focus on improving patient experiences could also be a solution for a bigger issue that had emerged during several discussions and meetings of the AlphaSys Marketing Council in which all marketing managers of AlphaSys participated. At that time the Marketing Council of AlphaSys was discussing and thinking about new ways to present and position AlphaSys to its customers. The various acquisitions of new business groups by AlphaSys in recent years had resulted in a lack of shared identity and a lack of coherency in the presentation of its product lines and the Marketing Council wanted to solve this

problem. Coopers' team from Omega Design and Eckard developed an appealing (Flash) movie that demonstrated the Icon concept for MR to convince the Marketing Council. The Icon concept for healthcare was presented at a meeting of the Council and the marketing managers attending the meeting were blown away by the idea. All marketing managers were genuinely enthusiastic about it. They all felt that this was a very powerful vision that could bridge the differences between the individual businesses and could give AlphaSys as a whole a strong identity and vision. It was decided by the Marketing Council that at the most important industry trade show of 2003 (called the RSNA) an Icon Pavilion would be shown. This futuristic pavilion would demonstrate the Icon concepts for the MR imaging suite, and would show a new patient focused vision for AlphaSys.

**Demonstrating the Icon Pavilion at the RSNA 2003**

At the RSNA of 2003 the Icon Pavilion was demonstrated and the initial customer responses were very positive. The pavilion was the talk of the day among the OmegaCom people attending the RSNA. At the dinner for the OmegaCom people at the end of the RSNA, Icon was mentioned often by members of the board of OmegaCom Electronics and AlphaSys. A small survey was conducted among potential customers of the Icon solution for MR at the RSNA which showed that it fulfilled a clear need of customers, and that hospitals would be prepared to pay for such a an extra option.

**LC 3.1 Cancelling the development budget for Icon/MR**

*Legitimacy crisis*

At the end of 2003, Tom Eckard, the marketing manager of the business unit MR wrote a formal request for funding of a development project for the development of Icon for MR, with components that could be shared with CT and CV systems. The request was directed at the CEO of AlphaSys (and the management team) because for the year 2004 the business unit MR had no budget available for financing this project. At the beginning of 2004 the CEO of AlphaSys agreed with the request and necessary funds would be made available to start the development project. However, after a couple of months the decision and funds were recalled by the CEO of AlphaSys. The main reason for recalling these funds was that AlphaSys had to realize high financial targets for the year 2004 (a target of 14 % profitability for the whole of AlphaSys). This was part of a general strategy to realize good financial performance and shareholder value after a period in which AlphaSys had made a number of large acquisitions. Eckard mentioned:

> '... I got the permission to spend 1 million euros on a development project. We wanted to develop Icon for MR and ingredients that could be shared with other systems like CT and CV... And in June of 2004 the budget was recalled. So we started a project, but our CEO recalled his decision. But there were good reasons to do so because 2004 was a crucial year for

> AlphaSys. We had to realized 14 percent IFO. So all budgets were decreased to reduce all slack. Thus after three months the project was stopped...'

Justin Kingsley, one of the project leaders from Applied Technologies (an internal technology supplier) that was involved in the realization of some components of the Icon solution for MR said about this episode:

> '... At the RSNA we introduced Icon as a concept and many customers gave a very positive response. So we thought we really must go on with it. We have to try to make a product out of it. You only saw that AlphaSys had other internal priorities. The regular business was more important. And the CEO of AlphaSys got the assignment from the OmegaCom Board of management to show good financial results... and I think that target has resulted in cost savings and killed a couple of innovation projects... The result was: we had a proposal, the people were enthusiastic... so let's begin. And then it was stopped. The project on hold and the people frustrated...'

The proposal to develop a real Icon solution for the MRI scanner got initial support from the CEO, but due to internal priority shifts the budget was cancelled and the project was put on hold. At that time the proposal did not match the existing *interests* and dominant focus of the CEO and his management team to maximize shareholder value. The proposal did not help to improve bottom-line profitability of the existing businesses at the short term and thus was cancelled. As such, this issue can be characterized as a *pragmatic* legitimacy crisis.

*Strategy*

The budget for the development of an Icon solution for MR was recalled and the project was stopped. At that time the involved actors did not take any further actions to overcome this issue and complied with the immediate interests and goals of the CEO and AlphaSys. This can be categorized as a *conformation* strategy in its most definite and stringent form. At that time, the innovative actors postponed and cancelled their innovative ideas to respond to the immediate interests of the company[12].

**LC 3.2 Developing an Icon pavilion for CT at the RSNA of 2004**

After the cancellation of the Icon development project for MR it seemed that the ideas for Icon slowly faded out of memory. There was however a potential customer of AlphaSys, Dr. Christos from the Lutheran Hospital in the US, that had seen the Icon demonstrator pavilion at the RSNA of 2003 and he was convinced of the benefits of this concept. He was interested to buy new CT imaging systems from AlphaSys and wondered whether he could get an Icon solution for CT instead of MR. The North American sales organization involved in

[12] Again, we categorize this response as a conformation strategy and not as a new sub-category of postponement or withdrawal to keep the model and categories clear and relatively simple.

closing the deal with Dr. Christos did not know if it was possible to offer an Icon solution for CT because there was no industrialized version available (not even for MR), but said they would to their best to get it done. Around the same time, the AlphaSys people that were responsible for the exhibition management at the RSNA thought it would be great when the Icon 'vision' would be continued at the next RSNA (end of 2004) because it had received such a good customer response. The idea emerged to develop again an Icon showcase solution, but this time for a CT scanner and suite. This could then be demonstrated at the next RSNA conference in the end of 2004 and also be implemented *ad hoc* at the Lutheran Hospital of Dr. Christos.

*Legitimacy crisis*

However, the management team of the business unit CT was not at all interested in funding and developing an Icon solution for CT. They were not really interested in offering a CT solution including all kinds of new lighting and audiovisual components (extending into the direct environment of the CT scanner). They were used to offer only a CT scanner, which could be put and delivered in one box. Cooper, director of design for medical systems from Omega Design, said:

> '... With CT the interest came much more from the sales organization because they had contact with the Lutheran Hospital, and they noticed that there was a real need within hospitals, especially within CT [i.e. radiology] departments. So the sales organization came to us to start this development... the business unit CT instead was not really interested. They just want to push boxes around. They have a strong focus on cost reduction and want a product offering that can be send in a single box to the customer...'

The proposal to develop an Icon solution for CT that would improve patient and user experiences in the CT environment could not count on much support from the management team of the business unit CT. The idea to develop a solution that included all kinds of 'extras' to improve the patient experience did not match with their focus on cost reduction, and with their focus on a simple solution that fitted into a single box. The proposal for Icon was not legitimate with respect to their established *view* and *approach* of the market (cost reduction/simple box) and as such also conflicted with their *goals* and interests to realize this approach. This issue can therefore be primarily characterized as a *cognitive* legitimacy crisis with *pragmatic* legitimacy implications.

*Strategy*

As the proposal to develop an Icon solution for CT was not supported by the business unit CT, the proponents of the proposal started looking for other internal parties that instead would support and fund the idea. Mary West, one of the North American sales people in favor of Icon, took up this challenge and

talked to various marketing managers of the different OmegaCom Product Divisions (Lighting, AlphaSys, DAP) whether they would support the idea. These cross-PD marketing managers had to deal with a complicated issue around that time, namely how to position and promote OmegaCom (as a whole) within the North American market. Miss West thought that the Icon proposal would be an excellent example of how OmegaCom should promote itself – because it included different OmegaCom products like medical systems, lighting, and audiovisual components, and it focused on users and their personal experiences. Through these PD marketing managers Mary West came in contact with Frank Rosso, the Chief Marketing Officer of OmegaCom Electronics. She was able to convince him and he saw it as a great opportunity to strengthen the OmegaCom image in North America. He made around 300.000 euros available to start the development project of a first of kind solution for CT (the pavilion at the RSNA), and the ad hoc solution for the Lutheran Hospital.

This response of the proponents of the Icon solution to search for internal stakeholders for which the idea was more legitimate can be characterized as a *selection* strategy. They didn't adapt the proposal or idea, but instead found an internal party (the cross-PD marketing managers group, and CMO of OmegaCom) that had matching interests and a shared view of positioning and promoting OmegaCom.

**After the RSNA of 2004: starting real development projects at MR and CT**

Potential customers of AlphaSys that attended the RSNA of 2004 again responded very well to the Icon Pavilion and the solution offered. The Icon solution for the Lutheran Hospital was not realized in time for the RSNA of 2004. But when it was realized, Dr. Christos made a small video in which he explained the concept and its advantages to his little daughter for demonstrative purposes. Dr. Christos told Omega Design (and the other OmegaCom people involved in developing the solution) that he expects that the Icon solution will also have real clinical benefits; as patients are more at comfort and more relaxed, less scans will fail and need to be redone, and thus patients will receive less radiation dosage.

After the positive responses from customers at the RSNA, the marketing manager of the business unit MR, Tom Eckard, prepared a business case to convince the management team of his business unit to start the development of an industrialized Icon solution for MR. According to his analysis the investment was justified, not because the Icon option itself would have a high profit margin, but because offering the Icon option would lead to extra sales of MR systems. And these were extra sales of MR systems on top of already planned sales for the next years. So it was expected that offering an Icon solution would lead to marginal growth of sales and market share. The management team was convinced and funds were allocated to a development project for the Icon MR suite.

The showcase of the Icon concept for CT at RSNA of 2004 created a real customer demand for Icon for CT. Seeing this, the business unit CT also wanted to offer this solution to its customers. However, for the year 2005 the business unit CT had made no budget reservations for an official development project and so it seemed that this project could not start. One of the supplying partners of technologies and components for the Icon solutions at the RSNA and the Lutheran Hospital, was OmegaCom Applied Technologies. OmegaCom Applied Technologies had a strategy to improve and intensify the relationship with AlphaSys, because the medical systems industry had been designated as an important growth area for OmegaCom Electronics. The Icon projects so far had enabled them to do just that. Therefore, OmegaCom Applied Technologies wanted to continue these projects and agreed with the business unit CT that they would finance the development costs of an industrialized version for CT. The business unit CT would pay these initial investments back based on actual sold systems. In this way a formal development project was started in 2005.

During the development projects of Icon solutions for both MR and CT, the Omega Designers working on the concepts encountered two major issues when dealing with the business people and technologists from the respective business units. One issue concerned the designers' ideas for integrated Icon solutions that crossed multiple levels in the hospital environment (i.e. solutions at the level of rooms, departments and hospital) that didn't match shared perceptions and interests at the business units. And the other issue concerned the designers' ideas about true patient and user focused Icon solutions that conflicted with commonly held ideas and interests at the business units.

**LC 3.3 Multilevel solutions and business boundaries**

*Legitimacy crisis*

The Omega Designers working on the Icon concept for healthcare had developed all kinds of solutions and ideas that crossed the different spaces and levels within a hospital. Their ideas not only included design improvements to the individual scanning systems of CT and MR, but also included all kinds of design solutions (and technologies) at the room, department and hospital level. They had developed design ideas that extended the traditional imaging system level because they wanted to improve and support the experience of the patient along the *total* care process. And in the designers' view the patients' care process already starts at home, then goes into the hospital (literally), through various departments, into the waiting room, into the scanner/imaging system, and finally back home again. In the Icon concept as defined by the designers, you should improve patient experiences throughout this whole process and use OmegaCom technologies to do so. However, their ideas for Icon solutions that extended the established imaging system boundaries did not get much support from the business people from the business units MR and CT at AlphaSys. The people from the business units were focused on their own responsibilities and product portfolios; all kinds of ideas that

transgress those business boundaries got low to no support at all. This let to much frustration on the part of the Omega Design team. Cooper, the director of design said:

> '... besides that you talk about the individual modalities, its systems and direct environment, the Icon concept is about the total experience process of a patient in the hospital. And that starts already at the entrance of the hospital. It can even start at home already ... And that is one story... what we actually do is that we use innovative technologies to improve the processes in hospitals and the experiences of people with those processes. And we link those new technologies with the architectural environment...'

> '... what has been very difficult, and still is, even after all the successes we've had, is to find a connection within the AlphaSys organization. The biggest problem is that it doesn't fit with the existing business structure. The business structure exists of specific business units that are based upon a particular technology [CT, MR or others]. And every business unit has its own financial bottom line that has to be realized each year. So doing investments in an area that extends the own business unit, is an investment that will not realize sales for them immediately. Which has an impact on their bottom line. And that makes it very difficult to set up these kind of programs that cross different business units within AlphaSys... And the same problem you have at a higher level within OmegaCom, to set up programs that cross the boundaries of individual product divisions. And that also applies to Icon, because we need involvement of Lighting, Semiconductors, and Consumer Electronics, and so on...'

> '... As soon as you talk about concepts that cross the boundaries, and you want for instance to offer an Icon solution for a whole radiology department or cardiology department, then the business unit MR will not take responsibility for that...'

Tom Eckard, the marketing manager of MR, said about this:

> '... So for MR we are developing the Icon suite option and that's it. Of course you could think of all kinds of other things, for the waiting room, for the whole hospital, which is all great ... but not for the business unit MR...'

> '... those multiple level solutions are going nowhere... I am convinced of that. And Cooper [director of design] also knows that and that is because of practical circumstances. We don't have a project organization within OmegaCom that can offer and execute multi-product offerings... You can't say to the management of a hospital give us the money and we will take care of everything and do a turn key project... we don't have something like that within OmegaCom... we are not structured like that...'

Justin Kingsley, program leader from Applied Technologies, and involved in executing the development projects, mentioned the issue also:

> '... for Design, the current solutions for MR and CT are not yet really satisfying. In their view the concept is much broader. You don't only sell a couple of nice lights, but you sell the concept. And that starts already at home and goes all the way into the diagnostics room... but the individual business units only sell a system to make images. So they find it difficult to extend that idea into other levels like the department or hospital... So that is a story difficult to grasp within AlphaSys...'

> '... furthermore, Eckard [the MR marketing manager] has another problem; you have a limited amount of money, so you can't do everything... you have to make choices. And there is the problem what their traditional product portfolio is. And this [the Icon option] has to fit to that... and that doesn't include ideas for the waiting room... that is not part of their portfolio...'

The ideas to develop Icon solutions that transgress the traditional boundaries of the MR and CT systems (room, waiting room, department, hospital) were not supported by the business people from the individual business units. The business units are organized and structured based on the different imaging technologies (CT, MR and so on) and are responsible for making profit by manufacturing and delivering only those systems. The 'multilevel' ideas for Icon did not match the established organizational structure and established distribution of *responsibilities* and business *interests*. Investing in ideas outside of their business scope was not seen as *beneficial* and in the *interest* of the business units. This part of the issue can thus be characterized as a *pragmatic* legitimacy crisis. Besides this, the legitimacy crisis also has a *cognitive* dimension that precedes the mismatch of interests. The people from the business unit *define* their business scope and product portfolio in terms of the traditional technology, namely MR, CT, and so on: they offer imaging systems, and 'a producer of imaging systems' is what they *are*. Developing Icon solutions that transgress those boundary definitions, don't really make sense in the context of these boundary definitions. Consequently, they are also not in the interest of the embedded business unit actors.

*Strategy*

The designers from the team of Cooper were frustrated by the lack of support for their multilevel ideas of the Icon concept. However, they also realized that the organization of the business units and their individual business scopes could not be easily changed. Although they tried to convince the marketing managers and management team of AlphaSys to create a new organizational group within AlphaSys responsible for the higher level Icon solutions, the Design team decided to follow the primary interests of the established business units in the end. They focused their design efforts on developing Icon options for the MR suite and CT

suite, with a limited inclusion of only the direct environment of the imaging scanners. The ideas for Icon solutions transgressing traditional business and system boundaries were no longer actively pursued and remained in the concept stage. As such, this response of the proponents of the Icon ideas is characterized as a *conformation* strategy. The proponents adapted their ideas to the established logic and interest (in this case they cancelled the multilevel solutions), in order to overcome the legitimacy crisis and continue with the innovation process.

**LC 3.4 Patient experiences versus technological solutions**

*Legitimacy crisis*

Another major issue that arose when the development projects for CT and MR started, concerned the different worldviews and foci of the Omega Designers and the engineers from AlphaSys and Applied Technologies. The Icon innovation did not have a strong technology focus. It is not based on a technological breakthrough and does not improve the performance of the imaging technologies in a major way. Instead it aims to provide improved patient and user experiences by changing form and color of the imaging systems and their direct environment and introducing existing audiovisual and lighting technologies to enable personalization, comfort and contact. For a technology driven company in a technology focused industry that is a different way of thinking, and especially the engineers had some difficulties in understanding this new approach. Cooper, the director of design for healthcare at Omega Design, said:

> '...this is strange for a company like AlphaSys, because it doesn't really has a technology focus as innovation... You can also see this when you look at the presentations we did at the RSNA. Before [Icon] the story was completely about the technological innovations that each of the companies introduced, in particular GE, OmegaCom and Siemens. So for CT it was about going from 16, 32, to 64, 128 and eventually 256 slices. And for MR it was about a stronger system of 3 Tesla and a shorter magnet... those were the stories. And the first time that OmegaCom showed the Icon pavilion, that was completely different...'

> '... a trend that [Icon] follows is the current attention not only for the practical and technological aspects of the healthcare process, but also for the emotional aspects. People realize that those emotional aspects have an influence on the healing process. When you feel better and have better emotional guidance, your healing process can improve...'

> '... But as soon as you go into a development project, you have to deal with people that just develop a technology... while we from Design have defined a concept that is grounded in an experience, and that [experience] is also what we want to achieve. And if then for practical reasons like time, money or availability, a different lighting technology is chosen, we still evaluate

> whether that solution will give the same result as what we intended in the beginning of this whole story. And the people that work as project leader or engineer in the development project, they haven't walked the whole nine yards... so they don't have this picture before their eyes. They just have a project plan, with deadlines and a fixed budget, so that is what they can do. And that for only parts of the whole... The link with the whole picture and strategy is not being made at project level... An engineer from MR that has to realize dynamic lighting, doesn't work with that total view in the back of his mind...'

Kingsley, one of the project leaders from Applied Technologies and responsible for parts of the Icon development projects, also noted the conflicting perspectives of engineers, managers and designers:

> '...We have always had heated discussions about the 'real' realization. Omega Design people have all the concepts and the connections between them in their minds. And we had intense discussions about what they find a minimal realization and what AlphaSys finds a minimal realization. I think Design is not very happy about the current situation...'

> '... we [the engineers from Applied Technologies] focus more on the technical realization of something. And Design focuses more on the form. And that is usually about the details of which we as engineers think: that can't be important, whether it is a dot or a stripe, or hollow or round... but for Design that can be very relevant. So you have to get used to that. And it sometimes hits on technical constraints. We had lots of discussions about the lighting solution for instance; LED versus fibers. Those fibers don't give a nice smooth change of color on the wall. You can see dots on the wall from the fibers' light beams. And for Design that is not really acceptable, while we think: guys, come on!'

> '... I think that is the fate of Omega Design a bit; that it is difficult to get these ideas in front of the light. Somebody like Tom [marketing manager from MR] is really a believer, but if you go a bit further away then a lot of people are dismissive, who say it is just a projector here and some lights over there, and that's it...'

> '... But the fear of Omega Design might sometimes be justified; that the concept degenerates into ... a couple of lights in a room. And we have seen it happen. OmegaCom is a chaotic company sometimes and a couple of months ago, a sales manager from Germany just put some LED lights in a MR room in a hospital. And that was sold as Icon and was given lots of attention. But it was only a couple of lights. And Omega Design is focused on the whole concept, which is violated in that way...'

The main difference between the worldview and focus of the engineers (and some of the sales and business people of AlphaSys) and the designers of Omega Design is that the designers want to develop and sell 'an experience', while the engineers develop (and sell) 'a technological product', or 'technical artifact'. For the designers the technological solutions chosen follow the criteria set by the intended experience, and not vice versa. The engineers instead choose a particular technological solution based on available time, money, and technical and physical constraints, next to the functional requirements. Also some of the sales people from AlphaSys primarily think of the Icon solution in terms of technical artifacts like 'a couple of LED lights in a MR room'. This issue shows that the engineers and designers have inherently different *worldviews* of the Icon solution, grounded in their disciplinary backgrounds (engineering science versus industrial design). The engineers consequently *think* in terms of *technical requirements* and *constraints* (i.e. LED or fiber lights in a room), while the designers think in terms of *patient experiences* and how these can be influenced. The clash of these *worldviews*, in which the designers' focus on experiences is often overpowered by practical engineering decisions, is therefore characterized as a *cognitive* legitimacy crisis. The approach and focus of the designers on patient experiences is as such not highly legitimate within the dominant and established logic of engineering and technological product development at AlphaSys.

*Strategy*

The designers of Omega Design fight hard for the realization of their ideas to deliver optimized patient experiences for MR and CT and the engineers from AlphaSys and Applied Technologies also learn to appreciate and understand the designers view of experience design. However, the tension between practical engineering decisions and optimal Icon solutions is not easily solved. In the end this means that the business units from AlphaSys (CT and MR) act as arbitrator and decide what and how something is going to be realized. Usually, this means that for reasons of money and time certain technological solutions are chosen, which are, in the view of Omega Design not always optimal. Kingsley from Applied Technologies said:

> '...The intensive collaboration with Omega Design was new to us. But I do think we developed a better understanding and appreciation of their worldview. Because from a hard engineering background it is pretty different... But it still remains a field of tension... They developed certain concepts and how it should look, but that does present certain technical problems. And because of that, it gets twice as expensive, or it takes twice as long to realize... and in the end the customers then acts as arbitrator... and that is AlphaSys. If you present the bill to them, they usually take the decision. And in most cases, that is not to the advantage of Omega Design. Because it just involves costs and in the end the amount of money is the most important criterion, wherever you go...'

The Omega Designers of course tried to improve the legitimacy of their ideas to develop 'experiences'. In the end however pragmatic reasons of time and money decided against some of their intended solutions. They had to let go of some of their ideas and follow the technical, financial and timing constraints dictated by the dominant business units and their established interests and logic. As such, this response is primarily characterized as a process of *conformation* to the established and institutional logic at AlphaSys.

**Selling Icon suites for MR and CT**

In the end of 2005 the development projects for Icon solutions for MR and CT were finished. At the yearly medical imaging systems exhibition RSNA the Icon solutions were shown and quoted in the product catalogue of AlphaSys. From this date on customers of AlphaSys could buy Icon solutions for CT and MR. During 2006 the business unit MR had at least sold and installed about 5 Icon suites for MR systems. Moreover, the Icon suite for MR won the 'One OmegaCom' award for collaboration between OmegaCom' product divisions that create innovative integrated solutions that are valued by customers. Seeing this, most of the other business units of AlphaSys got more convinced of the potential of the Icon concept and also freed money to go through their respective concept development and initial experience design process during 2006.

**LC 3.5 Initiating an Icon research program to sustain innovation**

*Legitimacy crisis*

After the relative successes of the Icon solutions of MR and CT, and the growing support from the other business units at AlphaSys, the design team headed by Cooper wanted to start up a formal research program together with Omega Research and Applied Technologies. This Icon research program should investigate and validate the Icon concepts as developed by Omega Design and also result in new ideas for future solutions. The goal of this research program is to be able to make the right choices about the Icon solutions provided. Those solutions have to provide real patient and user benefits and that has to be validated by doing research. With this, they also followed the ideas of Dr. Christos from the Lutheran Hospital, who said that these Icon could have real medical benefits as well; because patients are more relaxed, less problems occur during imaging, meaning that less images have to be redone and patients thus receive less radiation (in the case of CT). These medical benefits however, have to be scientifically validated when you want to make that case. Besides, the Icon solutions were hard to protect with patents (only some intellectual property had been arranged) so Omega Design thought it necessary to realize continuous innovation for Icon and a research program could do just that. The ideas for a general Icon research program was however not widely supported by the business units of AlphaSys. They didn't want to support and finance a general research program of which clear benefits for the

individual business units was not evident. Moreover, they had strict financial targets to be achieved during 2005 and 2006. Cooper, director of design, said:

> '... and in the meantime, after a couple of years now, we think it is important to start concept validation... and setting up a research program to ensure continuous innovation. Of course we have applied for some IP in this area, but if it really takes off and becomes a success, then our competitors can do pretty much the same. And then we have to make sure to be a step ahead already and that we have continuous innovation. So we wrote a proposal together with Omega Research and Applied Technologies to start a research program in 2006. But that has been rejected during all the discussions between the business units [of AlphaSys] in which they focus only on their own interests... so that is again an example of a program that transgresses business unit boundaries and is very difficult to get started...'

> '... AlphaSys is of course standing in the spotlights right now and has to meet its financial targets, because that is promised to the shareholders five years ago when they did all those acquisitions. So everybody is very busy in reducing costs and achieving targets. And as a consequence making extra investments is very difficult...'

The proposal to start up a research program on Icon for healthcare solutions didn't get much support from the individual business units of AlphaSys. Cooper says that the business units are primarily focused on reaching their individual financial targets and limiting investments in innovation. A research program that transgresses the business boundaries doesn't seemingly satisfy the individual interests of the business units. As such, this issue can be characterized as a *pragmatic* legitimacy crisis and the proposal doesn't match the fragmented interests and priorities of the various business units at AlphaSys.

*Strategy*

Although the Marketing Council of AlphaSys, and especially Tom Eckard, try to implement a new financial tax measure to free money for Icon in general and overcome the fragmentation of interests and conflicts between business units, the Icon research program does not get support for the year 2006 and these innovative ideas are no longer pursued. As such, this response can be categorized as a *conformation* strategy in its most definite and stringent form, where the ideas are cancelled at the time and postponed to a later stage, in order to meet established interests and goals.

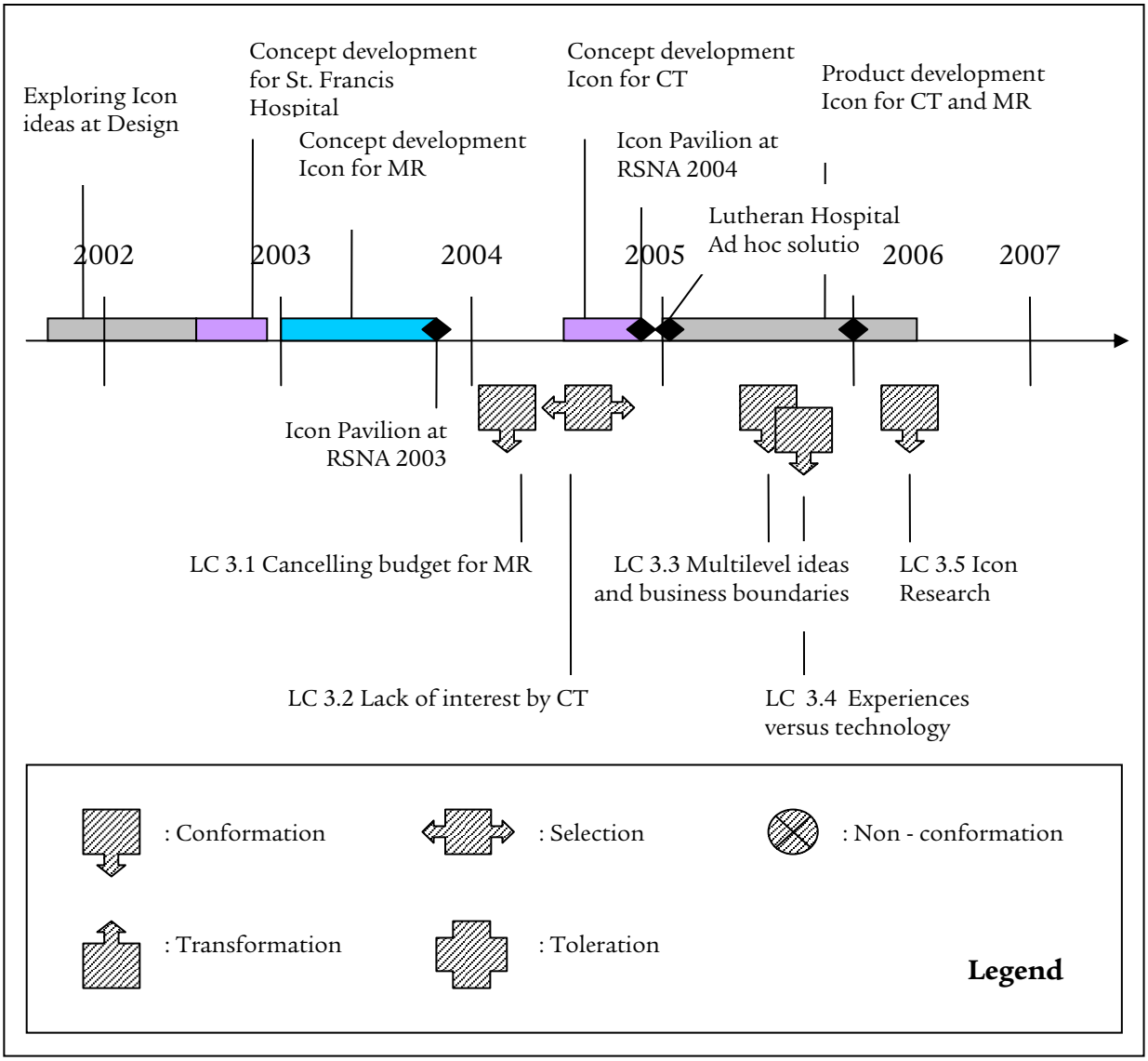


**Figure 4-6 Timeline of the Icon case.**

## 4.6 Case 4: PhemCo - Treemax

### *4.6.1 Case background*

The research work leading to the Treemax solution started around 1994 at the research department of PhemCo, more particular within the research group on fundamental aspects of coating systems that worked primarily for the SBU Coatings Resins. The case description describes the major research and development activities, decisions and issues that occurred during the period from 1994 to 2006. It describes the innovation process from the discovery of Treemax to the development and commercialization of a platform of chemical solutions based on Treemax. Interviews were held with: Dr. Dan Morris (former research project leader and business developer of Treemax), Dr. Nick Sheridan (the current general manager of the Treemax venture), Dr. Martin Quinn (the product sales manager of the Treemax venture), and Mr. Rick Steinbach (former director of the Corporate Venturing & New Business Development Group of PhemCo). The case description was validated by the interviewees.

### *4.6.2 Case description*

**The end of the beginning: initial research on dendrimers**

Research on dendritic polymers (dendrimers) started in the end of the 80′s and researchers of PhemCo succeeded in developing a perfectly symmetrical (and spherical) dendrimer based on a specific PhemCo polymer, namely di-amine butane (DAB) during the 90′s.

Normally, a polymer has a small number of active (or functional) groups at the ends of the polymer. A dendritic polymer ('starburst'-shape) instead concentrates a large number of active groups in a much smaller area and can fixate the relative positions of these active groups. Unlike 'classical' polymers, dendrimers have a high degree of molecular uniformity, narrow molecular weight distribution, specific size and shape characteristics, and a highly- functionalized terminal surface. These characteristics/functionalities of dendrimers open up lots of interesting applications, amongst others: drug delivery and release systems, synthetic enzymes, LCD-like applications, new catalysis polymers, coatings with special functions, or new additives for lubricants. The manufacturing process is a series of repetitive steps starting with a central initiator core. Each subsequent growth step represents a new "generation" of the polymer (or dendrimer) with a larger molecular diameter, twice the number of reactive surface sites, and approximately double the molecular weight of the preceding generation.

The research on dendrimers at PhemCo had been sponsored directly by the CTO (the Director of PhemCo Research) Giles Peyton, who became Vice Chairman of the Board of Directors in the end of the 90′s. The expectations of this new technology were very high at PhemCo. It got lots of media attention and was seen

as the 'white gold' of PhemCo. Although the expectations of new applications were very high, market research and business development showed disappointing results in the end of the 90's. Although dendrimers offered improved characteristics and functionalities, the production costs of the product were too high for most application areas and their customers. After researching many application areas and business opportunities, the director of Corporate New Business Development Rick Steinbach stopped the dendrimers-project eventually in 1999 and said to the Board of Directors:

> "...I'm really sorry, but I have tried everything, we researched an enormous amount of potential markets, but this product is a solution for the problem that has not yet been defined ... and even if we could find that specific problem, than it is still too expensive for our customers ... so we have to stop it..."

**LC 4.1 Research on hyperbranched materials – continuing after failure**

The commercial failure of dendrimers inspired researchers working for the business unit PhemCo Coatings and Resins to continue the search for dendrimer-like materials. Dendrimers were considered by some of the researchers at PhemCo to be such a brilliant invention with very interesting properties and functionalities, that it would be a shame to let the idea slip. They made it their challenge to develop a dendrimer-like material that could be manufactured at lower costs and could also be made at the existing manufacturing plants of PhemCo. Dendrimer-like materials (dendrimers that are not perfectly symmetrical and thus cheaper to manufacture) are also called hyperbranched materials. These hyperbranched materials were considered of importance to the established Coatings Resins business of PhemCo because their properties were highly valued in developing new coatings and paint systems. Dan Morris, project leader for research on fundamental aspects of coating systems, wanted to start research on (dendrimer-like) hyperbranched materials in 1994, for the SBU Coatings Resins.

*Legitimacy crisis*

The research project on hyperbranched materials for Coatings and Resins would be a very fundamental and difficult project. However, researchers working for the business unit Coatings Resins were normally not allowed to work for a long time on uncertain projects such as this. Although the BU was interested in having hyperbranched materials, it was also hesitant to support a high risk project on hyperbranched materials for a long time. The project leader Dan Morris experienced this pressure as follows:

> "... If you do not come up with positive results after a couple of months, you then start to feel the pressure to switch to another promising topic, with which you might instead be able to score ... and in this case we just

> kept on muddling through, and we [the research group] continued to believe that this topic was a good topic..."

As such the research project on hyperbranched materials was not very legitimate to the business unit Coatings Resins. The project leader experienced pressures to switch research topics as no promising results were realized on the short term. This can be categorized as a legitimacy crisis with *normative* and to a lesser extent *pragmatic* aspects; continuing with 'failing' projects on the short term is experienced as *not good* by the project leader, and as such it is a normative rule directing individual behavior. Next to this, stopping with failing projects also protects established interests and needs of the business unit by *limiting waste of investments and resources*.

*Strategy*

However, although the research project on hyperbranched materials did not realize promising results on the short term they were allowed to continue with it by the business unit Coatings Resins. Morris mentioned two reasons for this. First of all, the business unit did acknowledge that hyperbranched materials could be important for their future business, even though dendrimers had been a commercial failure. Second, the research group of Morris was able to hire a so-called Temporary Academic Employee (TAP) that did most of the research work on hyperbranched materials. This TAP-employee did not cost PhemCo or the business unit anything because he was subsidized by the government. At that time the government had started this TAP-policy to reduce the number of unemployed academic professionals in the Northern Europe. This policy enabled the research group of Dan Morris to work on this risky project without requiring much resources from the business unit Coatings Resins, as expressed by Morris:

> "... If it had been sponsored by the business unit, we probably would have stopped it after a couple of months. Because of course the results were negative during the first months, and you cannot justify [to the business unit] to work on something for such a long time when its results are negative..."

As such the strategic response of the business unit Coatings Resins can be categorized as a *toleration* strategy, where the project is allowed to continue, although it does not really match their short term interest and conflicts with their established norms for sponsoring business unit research. The topic is however seen by the business unit as potentially important for their future business and at the moment doesn't require direct sponsoring because external resources have been found.

**LC 4.2 Starting 'Treemax' application research for the BU Coatings and Resins**

Around '97-'98 the researchers of Morris group were successful and invented a particular hyperbranched material. It was not as perfect as the DAB-dendrimer but could be made with lower costs and still had much of the same properties. It was called 'Treemax'. After the invention of the Treemax technology they investigated potential application areas of Treemax for the Coatings and Resins business. Because hyperbranched molecules had intrinsic qualities that were very valuable in the coatings and paint business, many application areas were identified as highly promising, amongst others: powder coatings, alkyd resins, and can & coal polyesters. The ideas for these potential application areas were initially developed by the research group of Morris, however the business unit Coatings Resins had to make a final selection and would have to sponsor the resulting application research projects and in the end integrate it within their business.

*Legitimacy crisis*

The business unit Coatings Resins had a strong focus on realizing short term business targets and day to day issues and did not want to evaluate and introduce many new products at that time. Instead of investing in research and evaluation of the different high-potential application areas for Treemax they only chose one application area, namely powder coatings, and invested a limited amount of resources in a research and development project for about 2-3 years. Or, as stated by the inventor Dan Morris:

> "... From [the research group], where the fundamental research takes place, you can make all kinds of suggestions, but if the business unit is focused completely on day to day issues, then they will also evaluate these kind of new product ideas in a very limited way... And that is what they did, they only selected one topic which they thought would be interesting... And I think there we made the wrong choice, in the end."

This limited choice of potential application areas and the limited amount of resources dedicated was much against the wishes of the research group. The focus on short term goals and interests of the Business Unit conflicted with the wishes and ideas of the research group and can be categorized as a *pragmatic* legitimacy crisis.

*Strategy*

The research group that proposed the different potential application areas for their hyperbranched technology was very eager to continue research on the applications. Although the Business Unit only wanted to finance and investigate one potential application area (powder coatings), this enabled the research group to continue their research on Treemax and its potential applications. So they

accepted the limited selection of application topics by the Business Unit and started the investigation of the application of Treemax in powder coatings. As such the research group *conformed* to the *interests* of the Business unit Coatings Resins, in order to continue with the research on Treemax applications.

**Investigation of other market opportunities for Treemax technology**

The project leader on the fundamental aspects of coating systems, Dan Morris, who was one of the inventors of the Treemax technology, left the research group to work for the Corporate New Business Development Group around '98-'99. Initially he worked on business development for another new product but the director of the CNBD Group, Rick Steinbach, asked him if he would also take care of business development for dendrimers. Although Morris was skeptical about the price/performance ratio of dendrimers, he would do his best. He also mentioned to Steinbach that there might be many promising applications for the Treemax technology, other than what the business unit Coatings Resins was doing. Treemax could substitute dendrimers because it had more or less the same performance, but at lower manufacturing costs. It was then decided that Morris would take over business development for dendrimers and at the same time start the exploration of market opportunities for Treemax that were outside the business scope of the business unit Coatings Resins. So Morris developed a plan in which dendrimers were offered to customers that demanded the best performance, and Treemax was offered to customers that demanded a better price/performance ratio. The Advisory Board of the Corporate New Business Development Group agreed with this proposal and granted Morris a limited amount of money to start the exploration of market opportunities and related application development for Treemax. With a small group of people (about 3) they send Treemax samples to more or less than 300 external parties and potential customers and asked for their responses and interests. They gave presentations on conferences and talked to people and professors at many universities. Out of the many potential application areas a smaller list of ten promising application areas was distilled, of which amongst others oil-field chemicals, paper coatings, and dental applications. The exploration of application areas for Treemax and related research work and application development had continuous support from the management of the Corporate New Business Development Group at PhemCo. As such it did not suffer from any serious legitimacy crises during this period.

The development of a Treemax application for the business unit Coatings Resins (for powder coatings) had also been finished around this time (1998-2000). The developed Treemax solution for powder coatings was looking good, but unfortunately the price of competing powder coating systems had dropped considerably. Because of this, customers were less interested in buying the improved Treemax powder coating solution of PhemCo Coatings Resins. The business unit Coatings Resins concluded that they had missed this market opportunity and therefore decreased research and application development efforts for Treemax solutions. Although the interest in Treemax solutions at the business

unit Coatings Resins faded, some enthusiasts kept working on it, but no serious projects were started on the topic at this business unit.

**Starting up the Treemax venture**

At the Corporate New Business Development group they continued with the exploration of market opportunities other than the Coatings Resins business. The opportunities they had identified seemed both economically and technologically feasible, and it was decided in 2002 to start up a venture for Treemax and bring profit and loss activities together in a formal entity. After two to three years of sampling the market and exploratory collaboration with potential customers and partners, the management of Corporate New Business Development wanted to see if it could really work, and whether Treemax was able to survive and grow. Or as mentioned by one of the current business developers for Treemax, Dr. Nick Sheridan:

> "...after two, three years of sampling, something had to be done. We wanted to see it for real. The time seemed right, knowing the opportunities and expectations, to start a formal new venture and to keep up our own pants..."

**Starting up collaboration with paper chemicals partner**

One of the promising new business areas for Treemax was the paper chemicals and paper coatings business. This was at that time (2001-2002) a business area in which PhemCo had no activities and no experience. PhemCo was no chemicals supplier to the large paper mills and paper production industry. To get access to this industry the Treemax team got into contact with a smart and eager paper coatings company and started up an application development collaboration. Eventually this collaboration should evolve into a production, distribution and sales partnership or licensing agreement.

**Starting up collaboration with Maxoil Global Solutions**

After talking about Treemax applications with a professor at a European university of technology he suggested that Maxoil Global Solutions might be interested in the Treemax technology. The group working on Treemax for CNBD send two samples to the lab of Maxoil Global Solutions which demonstrated the potential performance of the technology. Maxoil Global Solutions became very interested in Treemax because they could implement this in chemical products they used in oil-field exploration. The Treemax group and Maxoil Global Solutions agreed to start some collaborative research and application development work on Treemax applications (applications in oil field chemicals). After some time Maxoil Global Solutions mentioned that they knew an oil and service company that would be interested to have such a product in their product portfolio. This oil and service company had about 40 percent of the global market share and could become an

important partner in selling and distributing the Treemax based oil-field product. Consequently, the Treemax team and Maxoil Global Solutions decided to involve this oil and service company in development work on the Treemax solution for oil field chemicals.

**LC 4.3 Canceling Treemax Dental-applications**

After starting up partnerships with important parties in the business of paper chemicals and oil field chemicals, one of the business developers of the Treemax venture, Dr. Martin Quinn, developed a detailed business plan for Treemax applications in the dental care business. According to Quinn, these dental applications could become the most profitable business for the Treemax venture. It could become a chemical specialty business with very high profit margins. Around that time (2001-2002) the former Corporate New Business Development group had been transformed into a new business group called PhemCo Venturing & Business Development. This also meant that a new director of the V&BD group was installed. As the V&BD group invested in the Treemax venture, Quinn had to present his business plan to the management and finally to the new director of the V&BD group. They had to evaluate and agree with his plans before he could pursue this business opportunity.

*Legitimacy crisis*

Quinn presented the dental business plan to the director of the V&BD group and expected a positive response from him. However, the director was not enthusiastic at all. The director doubted very much whether PhemCo could become good in such a low-volume specialty business, because they had no experience in that kind of business at all. Or, as told by Quinn:

> "... the director at that time said, guys, what are you doing with that dental care business? That does not belong to PhemCo... It just didn't fit into his frame of reference. During his whole life he hadn't seen such a thing at PhemCo, that such a thing was possible. So he had very big doubts about whether we could do it ... he didn't believe we could pull it off... that was what he believed... instead just sell kilograms to the paper chemicals boys, that's much easier..."

The director of the V&BD group at that time thus did not agree with the plans to start a dental care business, and Quinn and the Treemax team were not allowed to pursue this course of action. The dental care business was according to the director not *legitimate*. This legitimacy crisis consists of *cognitive* and *pragmatic* aspects. The idea for a low-volume specialty business conflicted with the frame of reference of the director and his view of what PhemCo was, namely a bulk chemical company. As such, it didn't belong to PhemCo according to him. The incongruence of the dental care business with his established *frame of reference* and *definition* of the company PhemCo, corresponds to the *cognitive aspects* of the legitimacy crisis. Next

to this, he doubted very much whether PhemCo could succeed in a business that didn't really fit with PhemCo. Investing in such an idea was consequently against the *interests* of PhemCo, and he favored that they focused more on the paper chemicals business instead. This forms the *pragmatic aspect* of this particular legitimacy crisis.

*Strategy*

The dental care business plan did not get support from the director of the V&BD group. The director did not agree with the choice for the dental care business. Quinn and the Treemax venture group obeyed the decision of the director and did not start any follow up actions on this topic. The business plan disappeared from the table, or as mentioned by Quinn:

> "... And that is the consequence, if you have been to the director to discuss your plan, you cannot continue with it [if he doesn't agree]... Maybe we should not have asked his approval and tell him, but instead just do it. But when we knew his opinion, then you also have to listen to it. Otherwise it is just asking for problems... the idea may not appear anywhere in the books anymore..."

As such, obeying the decision of the director and stopping the proposed course of action (in this case, the dental care plans) can be characterized as a *conformation* strategy in its most definite form.

**LC 4.4 Cutting back the Treemax venture**

Between 2002 and 2003 the Treemax venture group focused primarily on the development of the oil field chemical business and the paper chemicals business. The Treemax team realized that if they wanted their venture to survive and get continued support from upper management, they had to realize growth of sales relatively fast, in markets that could potentially have a large sales volume. Based on their own estimates this was also what they expected to be possible for these two businesses, and what they also had promised to the Board of PhemCo. Based on these estimations the Board of Directors had agreed with continued investments in the Treemax venture and allowed the Treemax team to grow from 4 to about 10 FTE working on application and business development in the years of 2002 and 2003.

*Legitimacy crisis*

In the beginning of 2004 the annual strategic review process was started up at PhemCo and all strategic plans and ideas were evaluated to determine necessary budgets. The Treemax venture team also had to present and defend their business plans for the next year. Unfortunately, in the year 2003 their actual sales did not match the promised results and the sentiment at the Board of Directors became

negative towards supporting the Treemax venture for 2004. The Board of Directors felt cheated and was no longer convinced that the Treemax business could indeed become an interesting growth market. They wanted to stop investments in Treemax. The current business developer for the oil field chemicals business, Nick Sheridan, expressed what happened:

> "... so we focused on the applications in paper chemicals and oil field chemicals [during 2002 and 2003] and we made a plan for this. And this plan is always a result of the interaction between your own assessment and what upper management would like to see... And I think it is fair to say that we fell into to the trap to promise too much, too fast..."

Also former business developer and inventor Dan Morris mentioned this issue:

> "...at a certain moment you realize that your project will only survive if you can realize a sufficient amount of sales. So you go big, or you don't go at all... But that was totally unrealistic... we had sales of about half a million euros, and I had committed myself for the following year to realize sales of about one and half million... so growth with a factor of three. We did some studies that showed that this was really the maximum we could achieve... So if you succeed in achieving this, it is fantastic. But the chances that you will are very small. And then [in 2003] one of our important customers backed out and it was total panic..."

One of the former directors of the Corporate New Business Development group Rick Steinbach expressed the negative sentiments of the Board of Directors of PhemCo as follows:

> "... tell us why we still should continue with Treemax? Because you have lied to us for a couple of times now, and why would it be otherwise this time? Maybe when we turn the screws on you, you might stop it..."

Moreover, there was serious doubt at the Board of Directors whether the Treemax venture was really of strategic relevance to the future of PhemCo. Quinn, one of the Treemax business developers said:

> "... it's the question whether it really fits with PhemCo. From the start of the Treemax venture there has been discussion about the strategic relevance of it to PhemCo... Everybody understands that you should work on it in the established Coatings Resins business, but [the Treemax venture] is outside of the established PhemCo markets. And there has been no clear strategic decision at high level that this is something we should do within PhemCo... and that we may spend money on it... Giles Peyton [member of the Board of Directors] at that time said it must stop, because it is going nowhere and it's not strategic and so on..."

So the Treemax venture had lost support of the Board of Directors considerably and the legitimacy of the idea to continue investing in the Treemax venture was low. As the Treemax venture could not live up to the 'fabricated' expectations of the past years, the Board of Directors felt it had 'damaged' their interests, or at least it did not longer match their *interests* to realize growth of the PhemCo company. As such, these conflicts of interest can be characterized primarily as a *pragmatic* legitimacy crisis.

*Strategy*

The initial plans for 2004 for the Treemax venture were aimed at continued growth with the same amount of personnel working on it (avg. 10 FTE). However because sales had fallen back in 2003 and Treemax was not seen as really strategic, the Board of Directors of PhemCo seriously doubted whether they should continue to support the Treemax venture. In a last attempt to save the venture, new business developer Nick Sheridan proposed to trim down the whole venture to about 2-3 FTE and focus only on the oil field chemical business. He really believed in the potential of Treemax and wanted to fight for its survival. By trimming down the Treemax venture and asking only for a small amount of resources he hoped that the Board would let him continue. Because he only required 2-3 FTE to do so, the Treemax venture would realize a zero-sum financial result, so it would not hurt anyone. Their expenses would be matched by sales in the oil field chemicals business for which they already had agreements with customers. Sheridan was convinced that their sales would probably be higher and he hoped that in the end everybody would see and believe again that Treemax is still a promising business. Sheridan said:

> "... So we decided in 2004 okay trim down ... we trim it down completely, right to the bone ... So if you want to know how I solved it? I'll answer you without much thinking ... by disappearing under the blanket and putting down the performance... Just trim down and show them that we are right... and what happened is that we went back from 10 to about 3 employees... and we have proven something in only one market segment during that year, and the rest we just kept alive, literally..."

Although the Treemax venture team had reduced their ambitions and resource needs considerably, the Board of Directors still doubted whether Treemax was 'strategic' to the future of PhemCo and should get continued support. At that time however, innovation was (again) an important topic to the Board of Directors. They wanted to show their shareholders that PhemCo was an innovative company, and that many promising technologies and new businesses were underway. They wanted to talk a lot about innovation to the outside world and show an interesting portfolio of new technologies and businesses. Throwing out Treemax at that time just didn't seem right to the Board of Directors and would not help them demonstrating an interesting innovation portfolio. So although the Treemax venture was not seen very strategic for PhemCo at that time, the Board

decided that the Treemax team could continue their work because it didn't cost much and it did contribute to the 'innovativeness' of PhemCo. Or, as mentioned by the other business developer Quinn:

> "... So the whole innovation cycle started up again ... Peyton [the Board of Directors] also realized, hey 'innovation', that might be important to the company ... and maybe we even want a lot of innovation, even more than we are doing now. And we need new areas and maybe we could use this [Treemax] in that... so Treemax stayed alive... and we are drifting on this wave of innovation. But still the question why we are doing it, is not answered."

> "... So in 2004 it could have crashed. But it didn't, because it didn't hurt. If we wouldn't have enough sales to pay for those 2,5 people, then it would certainly have crashed..."

This strategic response to the lack of legitimacy of the plans to continue full scale with the Treemax venture can be characterized as a *toleration* strategy. The Board of Directors of PhemCo allows the Treemax venture to continue in a very trimmed down form, even though at that time the strategic relevance of it is not clear to them. However, because they do think 'innovation' is important to the future of PhemCo and relevant in the communication to shareholders and other external stakeholders the continuation of the Treemax venture is tolerated.

**Showing results**

During 2004 and 2005 the Treemax venture team worked hard to realize good results in the oil field chemical business and to a lesser extent in the paper chemicals business. Because they were able to meet their targets and improve sales during these years, the Treemax venture team could again expand to 4 FTE's. The team demonstrated that you indeed could make money with the Treemax business and did not experience much interference from upper management and the Board of Directors of PhemCo during this period.

**LC 4.5 Strategic fit, or no strategic fit**

The Treemax venture team demonstrated in the past years that it could realize increased sales in the oil field chemical business and in the paper chemicals business. However, in 2006 new issues arose between the team, upper management of the PhemCo Innovation Center (a newly formed business unit that originated from the Venturing and Business Development group) and the Board of Directors, about the future direction of the Treemax venture and the strategic fit with PhemCo.

*Legitimacy crisis*

In 2006 the Treemax venture team wants to know if they get full support from the Board of Directors of PhemCo and upper management of the Innovation Center to continue with Treemax in the oil field chemicals and paper chemicals market. However, the Board of Directors states that the Treemax business in these two particular markets has no fit with the end-markets that PhemCo aims for. According to them the Treemax venture focuses on the wrong markets in which little synergy can be realized with other existing PhemCo competencies. The oil field chemicals business and also the paper chemicals business are not a businesses in which PhemCo as a whole wants to invest and expand. The Corporate Planning department has investigated these businesses and concluded that these were not attractive for PhemCo as a whole. Next to this, the current Treemax technology platform has little synergy with the existing markets of PhemCo (except with the business unit Coatings Resins of course). Also the larger domain of 'functional polymers' to which the Treemax technology belongs is, according to the Board of Directors, not a business area in which they want to expand. One of the business developers of Treemax, Martin Quinn, expressed his frustration with this:

> "... it is just not there... even today ... there is no strategic fit between what we are doing and what PhemCo wants. The businesses in which we are active, oil and gas, paper chemicals... it all has no fit with PhemCo's strategy. It falls outside our strategy..."

> "... end-markets... they reason from end-markets. For instance the end-market paper chemicals, which has also been investigated by our Corporate Planning department, and they said we never want to expand into that market... So if we would be successful with Treemax in the paper chemicals market, we would not get a place within the PhemCo business structure. And it's too small to start up its own business group, so it would then be sold... so the strategic purpose of Treemax is lacking, from day one actually... From that day on, nobody has said that we want to sell these kinds of products, these functional polymers, as you can call them... there have been all kinds of attempts to give it a name and let it be broader than Treemax alone ... but functional polymers is not an area that PhemCo wants to turn into a business group..."

However, the Treemax team sees the Treemax technology as a perfect fit with the technological competencies of PhemCo. Moreover, according to them it offers unique opportunities to develop new markets with it, as expressed by Quinn:

> "... it fits perfect with PhemCo's technological competencies, because we have the factories, we have the technologies, we have the knowledge, we can make it, we are unique, we have the patents and with these patents we have a unique position in this world. So it fits with our competencies. Only it doesn't fit with markets..."

Next to this, Treemax is a technology push innovation according to the Board of Directors and they only want market pull, or in other words market driven innovation. The Board wants PhemCo's innovation efforts focused on clearly identified problems in markets that are attractive and where they can realize synergies with existing products and technologies. However, according to (former) members of the Treemax venture team you could use Treemax very effectively to get into difficult new markets where a market pull approach would not work. Morris said:

> "... Look, I have always seen [Treemax] as a door opener. The question is what do you actually want with a New Business Development group within PhemCo? And I thought if we could offer something unique then doors get opened and then it will also be possible to sell all kinds of other proprietary technologies. And in that way you could develop a whole new branch of sports, such as performance materials or performance polymers..."

> "... so we have something unique for oil field chemicals, so now we can look inside PhemCo for other technologies we could offer ... But since the last years, this is something PhemCo does not want. We don't want technology push. We only want market pull... we want to have clearly described problems before we do anything... But if you do only things from a market pull then it happens often that if you didn't see the problem, there are twenty others that did see it. And the one that has the best technology at that moment will make it. Or the one that is already in that market for ten years, he will make it... So for our existing markets I totally agree, because you see your customers every day and know what is going on... but if you want to start with something totally new and you learn through market reports and so on that there is a particular market need, then you are already too late..."

The Board of Directors have designated specific future end-markets that PhemCo should focus their innovation efforts on and the Treemax markets oil field chemicals and paper chemicals are not part of that (the corporate strategy plan Vision 2010). Continuing with these two non-strategic markets is thus not aligned with the interests and future growth goals set by the Board of Directors. As such, this lack of alignment with established interests can be characterized as the *pragmatic* aspect of the legitimacy crisis. Besides, the Board of Directors and the Treemax venture team use different kinds of reasoning regarding innovation and new business development. The Treemax team thinks from a 'technology push perspective' and 'strategic fit with technological competencies' and believes this is a viable way to develop future new business for PhemCo. The Board of Directors instead reason from end-markets and market driven innovation to develop future new businesses for PhemCo. In the view of the Board the line of reasoning by the Treemax team is not legitimate. This part of the legitimacy crisis can be

characterized as *cognitive*, because different thinking models and concepts are used to evaluate and justify the Treemax innovation.

*Strategy*

As a response to these issues the Treemax venture team decides to look for Treemax application areas that are closer to the existing and designated markets of PhemCo. Currently they are developing Treemax applications that are closer to established businesses even though these are not as lucrative as options farther away from PhemCo. They also do continue with the oil field and paper chemicals businesses. Quinn said:

> "... Now we made choices to do things closer to PhemCo businesses, so we would have a better connection with the current PhemCo... So those discussions [about the strategic fit] had an enormous impact, also on the choices for particular application areas... We didn't do that in the last years, but now we must. And that's because of our environment [upper management of the Innovation Center and the Board of Directors]. We didn't choose for it ourselves... we used to focus only on whether it was attractive and as such we did the most exotic things... it had to be financially attractive and it should have a chance to succeed. And those are the criteria that you would use if you would start up an independent new business. But after this strategic discussion about Treemax, we realized we had to look for the relevance with the rest of PhemCo and we want back to our basics... you can behave like a rebel and just do what you like, and that's what we also did for the major part, but on the other side you're also part of a larger conglomerate and that is PhemCo. And you also want to make a career here at PhemCo, so you don't want to step on everybody's toes. So of course you are very alert to your environment and look at the signals you get from them..."

This response to focus more on application areas and markets that are closer to the established business of PhemCo can be characterized as a *conformation* strategy. They incorporate the needs and interests of the Board of Directors in their plans for Treemax and seek better alignment with established businesses and their market problems.

Furthermore, members of the Treemax venture team try to influence upper management of the Innovation Center and the Board of Directors to gain support for the broader business area of functional polymers. In the strategic plans of PhemCo, PhemCo has expressed its goals to become a specialty chemical company, instead of a bulk chemical company. A specialty chemical company is focused more on innovative and tailored products with higher profit margins than a bulk chemical company. However, although these ambitions have been expressed by the Board of Directors, it still remains rather vague what 'becoming a specialty chemical company' actually means to PhemCo and what steps should be taken to

achieve this. Members of the Treemax venture team try to demonstrate that the Treemax business is an excellent example of a specialty business, and they demonstrate to upper management and the Board how you could develop such a business and what that implies for PhemCo. As such they try to work out and explicate more precisely what PhemCo as a specialty chemical company would look like and use all kinds of examples of successful specialty polymer companies they encountered in the Treemax business. Current business developer Nick Sheridan said:

> "... So you can't escape the question how to proceed in the future? What is its raison d'ètre, why should we do it? The business model is, we have a product-technology platform and we should bring it to the market. And then we see clear examples in the industry that do just that, and those are the specialty polymer companies. And we have as an ambition to realize that for PhemCo in the next five or ten years. We see the Treemax technology as a valuable component in this process... And PhemCo has stated in its 2005 and 2010 strategy that we want to be a specialty company. Well, what does that mean? And we are currently shaping and filling this in... because these are not precise directives from the top, no, these are just broad guidelines in the end..."

> "... look, all those specialty polymer companies are the size of 500 million dollar to 1 billion dollar... and they usually have five to seven focus areas in the market and they have three to four product-technology platforms. And these focus areas and platforms are connected in all kinds of ways to each other... And these companies can exist based on their knowledge and know-how of the market needs. And to do so they have very large technical service groups ... And I would say we have such a technology platform, namely Treemax. So now I choose a couple of markets that I want to develop. But I would be crazy if I don't try to look for and sell a couple of other technologies of PhemCo in those markets... and slowly people start to realize that a specialty business consists of connecting and combining smaller clusters of revenues of product/market combinations in a very smart way... instead of what we are used to do in the coal and mining business, or petrochemical business, or the nylon business.

> "... but then if that is still not a good idea, what else? Should we sell it to one of those [specialty polymer] companies where it does fit? But if you have the personal ambition as employee of PhemCo to direct it that way, then I don't think its strong to throw it away when you have a bit of opposition ... you have to fight for it and look for sympathizers... and we are right in the middle of this debate ... it is also a debate in which the company wants people to demonstrate their vision, show the evidence, get outside parties involved in projects. And when these projects are more successful, you have a better case..."

This other response from the Treemax venture team to demonstrate and develop new ways of thinking about the future PhemCo as specialty chemical company can be characterized as a *transformation* strategy. The future of PhemCo as a specialty chemical company is defined in a rather broad and still fuzzy way and the Board of Directors stimulate the internal debate about how this future vision could get shape. The Treemax venture team aims to demonstrate what this future vision in terms of novel business models and related revenue streams looks like and uses Treemax and the specialty polymer companies that operate in the functional polymer industry as prime examples. As such the Treemax team aims to stimulate new ways of thinking and new interests that could become embedded in the established institutional logic of PhemCo.

**LC 4.6 Into the future: changing a culture of risk aversion**

Currently (in 2007), the Treemax venture is still well on its way. During the innovation process the proponents of the Treemax technology within PhemCo have overcome and solved many important strategic issues, as mentioned above. A more general issue that occurred during several episodes in the process had to do with risk aversion of senior management. Members of the Treemax venture team mentioned that it has been very difficult to realize relatively high-risk innovations such as Treemax, because they encounter risk averse behavior of senior management. Sheridan, the business developer of Treemax said:

> "... if you tell managers this story [about Treemax], in this company, then they don't see their own interests, because the timeline is longer than four years... and at the short term they only see the risks. And they don't want to make wrong decisions, and thus they slow it down..."

This risk averse behavior was also mentioned by Quinn:

> "... For a manager to become successful, it is easier to kill ideas than to support them. Killing ideas is without risks... if you're wrong it can never be proven... so that can never be a danger to you... so for managers it is best to do nothing... So a large part of those guys are very risk averse. And now you try to realize a successful innovation with them... that is very difficult..."

And by Steinbach, one of the directors of the former Venturing and Business Development group:

> "... And the risk/reward ratio that drives people is very different between different levels within this company... it is an important factor in our environment, which person of the Board has what ratio? Our new CEO has a completely different ratio. But the old order was very conservative. And conservative meant that they were paid to prevent any risks... but that is also related to the large scale manufacturing plants we had, and the long times you're stuck to those. And now, when we move up in the value chain

towards specialties, [product] lifecycle times become much shorter. So we have much more dynamics. And therefore we should also allow that much more in the cultural setting of the company ..."

Although it is not possible to categorize the risk aversion of senior management as a specific issue of legitimacy regarding Treemax, the quotes of members and supporters of the Treemax venture do point out that 'risk aversion' is part of the established institutional logic. Avoiding risks can be interpreted as a consequence of a dominant focus on short term interests and as a rule to safeguard investments in large scale manufacturing plants with long payback periods. 'Avoiding risks' as such consists of primarily pragmatic and normative aspects; it protects established interests and functions as a socially shared normative rule that it is 'good or better' to avoid risks .

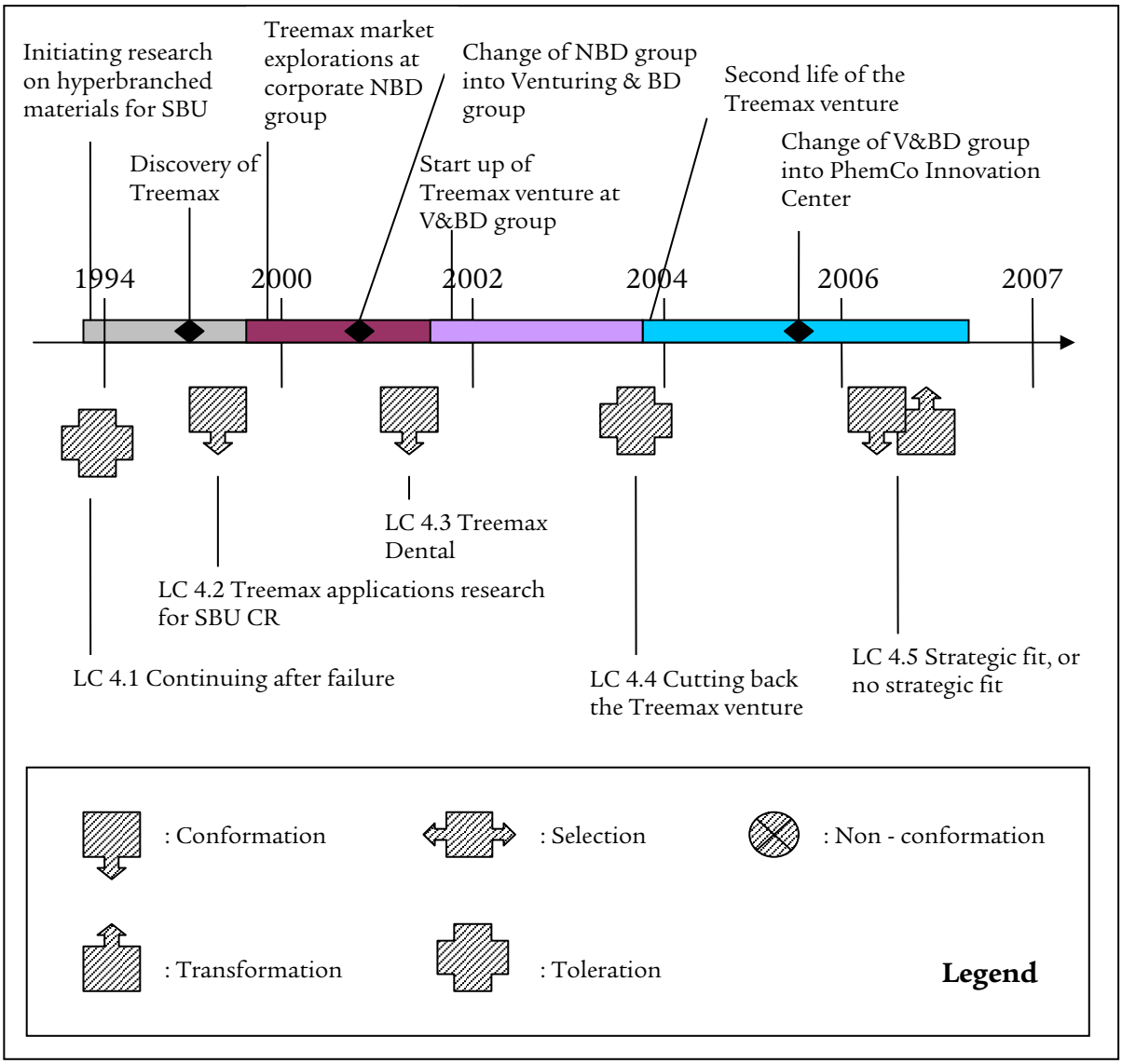


**Figure 4-7 Timeline of the Treemax case.**

## 4.7 Case 5: PhemCo - Reflactone and Reflactix

### *4.7.1 Case background*

The Reflactone and Reflactix technology principles were invented around 2001 at the Shared Research Unit of PhemCo and initially sponsored by the Unotech business unit. The case description describes the major research and development activities, decisions and issues that occurred during the period from 2001 to 2006. It describes the innovation process from the discovery of the chemical principles to the development of commercial anti-reflective coating solutions and a business model for glass coatings. Interviews were held with: Dr. Adam Coleman (senior scientist and the current Reflactix research project manager), Dr. John Hyneman (business developer for Reflactix), and Mr. Rick Steinbach (the former director of the Corporate Venturing and New Business Development group of PhemCo). The case description was validated by the interviewees.

### *4.7.2 Case description*

**Initiating research on antireflective coatings for PhemCo Unotech**

Around 2001, the Shared Research Unit of PhemCo was asked by the business unit PhemCo Unotech to start research on antireflective coatings and its technological principles. The Shared Research Unit of PhemCo primarily worked on research of Performance Materials and was lead by Prof. Dr. Jerry Maddox. The business unit PhemCo Unotech was market leader on (UV curing and hardening) coatings for fiber-optic materials and had been growing very fast during the internet and telecom hype in the 90's. To get access to the Asian market, Unotech had a joint venture called Fury Real Materials (FRM) with the Japanese company FTI, which offered coatings for fiber-optic materials and for display applications. Unotech contributed technology and intellectual property in the area of coatings for fiber optics, and FTI contributed technology and intellectual property in the area of coatings for display applications. Over the years FTI had developed also interesting technologies for the fiber-optics business, while Unotech had not contributed anything to the display business. PhemCo Unotech felt it had to restore the balance in the joint venture and expected that they could develop interesting technology in the area of antireflective coatings for displays. To do so, PhemCo Unotech supported the research of the PhemCo Shared Research Unit on this topic. Dr. Adam Coleman, a young researcher that got his PhD in polymer optics and liquid crystals was leading this research project.

**Collaborating with Rivolo**

In April 2001, Dr. Coleman and his team came around a publication of the Suisse company Rivolo Research in a major scientific journal on their approach to antireflective coatings. Their approach was a breakthrough compared to the

conventional ways to make displays (e.g. LCDs) antireflective, in terms of processing and ease of use. Normally, it was necessary to put at least three to four optical layers (i.e. 'coating layers') on a display surface to achieve a certain amount of antireflection. With the Rivolo approach it was possible to achieve that in just one optical layer by de-mixing binary blends of mutually incompatible polymers during coating, and subsequent removal of one of the polymer components, which generates nanopores in the residual film. The resulting nano-structured surface consists of small nanopores (with a diameter of 200 nm and height of 120 nm) that reduce the effective refractive index of the film such that it meets the antireflection criterion. The invention of Rivolo was an extension of their photo-aligning and photo-patterning technology for liquid-crystal displays (LCDs) and liquid-crystal polymer films with smooth surfaces to optical polymer films with controlled surface topologies. Dr. Coleman thought this was a very powerful solution and they started a collaboration with Rivolo for one year.

**Discovering and developing the Reflactone system**

Dr. Coleman and his team played around with the Rivolo system for a year and identified an important limitation of that solution: the process to create the nano-structured surface that had the antireflective function was difficult to control. The two chemical components that were used to mix and demix did this in different ways, with different effects on the antireflective function. The system developed by Rivolo was based on kinetics which is a more difficult process to control. This limitation motivated the small research team of Dr. Coleman to experiment with different kinds of systems that influenced the surface topology of materials. One day in February of 2002, one of the team members had an interesting observation. He had been experimenting with a completely different system (solution) and said that is was slightly antireflective, only by a percent or so. This solution and effect had been found by luck and the team of Coleman thought that if they could understand how it worked in a better way, they might be able to control it and amplify the optical effect. The next weeks they studied their solution and improved the antireflective effect. It resulted in a system that worked better than any system they had previously seen. They called their solution 'Reflactone'. Coleman described this period as follows:

> "... it was really serendipitous, if Grant [one of the team members] hadn't made that observation, he has very good eyesight, he is almost like a walking spectrometer, and he said "this is strange", and if we hadn't seen that, we might still be working on the [Rivolo] system. So first thing is you need a bit of luck, and you need observation, and I always say if we are going to be active in an area, a brand new area, then we should have a certain amount of time. I see the Rivolo time as a time to play; we were playing with their system, were trying to understand thinking like that. And suddenly because you have this knowledge, and something out of the blue comes along, you can say "wow, okay". And if we hadn't had that observation, we still would be working with Rivolo and I'm glad we are not,

> because it is horrible. So it is a bit of luck, observation, and then going for it..."

> "... it was enough for us to start thinking, hey wait a minute, how can we, if we get this tiny effect just by luck, maybe if we can understand how it works and we could control it, maybe we could amplify the effect. And so, basically based on how little round nano-particles pack to form a structure, and then we rationalized on what was going on, and we said to ourselves these little tiny round particles pack this way, then particles with different shapes will pack less efficiently and... Well the way I tell the story now it's startling because from the point of realizing how this worked to making it work optically better than any system I've ever seen took us six weeks. And three of those weeks were waiting for the materials. Getting from there to the point that we had a system that meets all the other requirements took us three years... The antireflective function that was the easy thing, getting it hard, scratch-resistant and chemically feasible and processable, that took us three years..."

These promising results with the Reflactone system got the business unit Unotech more interested and the research of Coleman got continued support from them and from the Shared Research Unit. Unotech issued some people from their marketing team to start working on the details of the business case for Reflactone for the display market. Coleman said:

> "... Well the thing was ... we produced a film like the one you see on that picture [points to a picture on the wall showing two pieces of glass of which one is almost completely invisible because it has no reflection], and we made one or two films of that and showed the management and said look this is completely new technology, which is not dependent on anybody else, and it's a single layer, there is no washing, there is no phase separation , you just dip it and let it dry, hit it with light and finish. And of course that gets people very excited. And that is one of the aspects of this research which makes my job easier: when I want to show what I'm doing then I show a piece of glass that reflects and I show a piece of glass that doesn't reflect, and you around see that. So I don't have to say much, the technology sells itself. So we did that and then we start growing the group, year on year. And putting in more effort as we hit our targets for development, we increased the size of our group..."

**LC 5.1 Strategic problems threaten research on Reflactone**

In the next months Coleman and his team worked hard on further development of the Reflactone system. Aiming to make it not only antireflective, but also scratch resistant, durable and easy to process. However, in the end of 2002, the business unit Unotech that was sponsoring the research project ran into strategic problems.

*Legitimacy crisis*

Unotech had sponsored the research project on Reflactone, which was the rule within PhemCo; an initial research project (or program) could only continue when a business unit would stick out its head to support it and bring it to the market. However, in the end of 2002, Unotech ran into financial and strategic problems due to the economic downturn in their primary business. The internet bubble had burst and the demand for fiber optic materials and related coatings as made by Unotech strongly decreased. Unotech trembled on its foundations and almost collapsed because of this downturn. As a consequence, the Unotech management decided to cut all costs of activities that did not contribute to their immediate survival. To them the research project on Reflactone was one of the first candidates to be cancelled because it was aimed at longer term goals of Unotech to establish a new business in coatings for displays. The Shared Research Unit and the Reflactone research team were told that Unotech would not sponsor it for the next years.

Due to the financial problems in their established markets Unotech had to focus investments and business activities on surviving in this market. The longer term Reflactone project did not help Unotech to safeguard its established position in their primary business; instead it was focused on developing a new business in the future. As such it did not match the established interests and needs of the business unit Unotech at that time. Consequently, we categorize this problem as a *pragmatic* legitimacy crisis.

*Strategy*

Prof. Dr. Jerry Maddox, the director of the Shared Research Unit who was in the end responsible for the research project on Reflactone, started a search for new sponsors of the Reflactone project within PhemCo. He looked for people that would understand what they were doing and who had access to funding. His search ended when he talked to Rick Steinbach, at that time director of the Venturing and Business Development Group of PhemCo. Steinbach and the V&BD group were responsible for funding and supporting innovative activities at PhemCo that would help to create the PhemCo of the future – a specialty chemical company. According to Steinbach the Reflactone project was very promising and indeed could contribute to this future vision. However, he didn't want to fund a project that only focused on antireflective coatings for display applications as defined by the business unit Unotech. According to him, if Unotech had designated this as a important growth future opportunity, then they had to also fund it themselves. The director of the Shared Research Unit and members of the research team however explained that although the Reflactone system aimed at displays, the expertise they had concurrently developed enabled them to develop different surface coating systems with all kinds of functionalities. It was broader than only antireflective coatings, they could develop all kinds of functional coating systems with different properties, with many potential application areas of which

some closely related to existing PhemCo businesses (i.e. coating resins). The expertise and system solution developed could be turned into a technology platform with many potential applications. This broader focus and aim related to the Reflactone project matched very well with the ambitions and view of Steinbach and his V&BD group to build the future PhemCo. Steinbach said:

> "... There was some kind of dream that if we as specialty company of the future could put very thin layers on all kinds of materials so that you could still see thru the material, and that we could also add unique properties to it... then we are doing the right thing for the new PhemCo... And then I said I want to fund this research from the Venturing and Business Development group, because I really think this is an opportunity... and I see this much broader than only antireflection..."

> "... we broadened the scope of the research project when I started funding the research... because I was not going to fund it to help Unotech, they have to keep up their own pants..."

> "... [the ideas to broaden the scope] existed already ... also Jerry Maddox had thought extensively about it. But you know that when you work in a large company, you should not come up with too fuzzy concepts, because these usually don't stand a chance. But you have to keep them at hand, so that you can play that card at the right moment..."

> "... so with a little amount of money we can learn a lot in this area, and then we will broaden it to functional coatings... and then we will go to the key markets of PhemCo and ask them which function do you want? And then we will try to embed that function into such a thin layer of coating..."

So the response of the director of the Shared Research Unit and the research team on Reflactone was to find a new sponsor within PhemCo that would understand them and have access to money. Steinbach and the Venturing & Business Development group were found willing to fund the Reflactone project and even broadened the scope of the research. The research into functional coatings, and Reflactone as one of the first applications, matched the *ambitions* and *goals* of the V&BD group, and also their *view* of what the future PhemCo should look like. As such, this strategic response is characterized as a *selection* strategy.

**LC 5.2 Opting out Reflactone**

In 2003 and 2004 the research team of Adam Coleman continued work on improving the Reflactone antireflection system. During this period the Board of Directors of PhemCo initiated a strategic study of the opportunities in the electronic display market for PhemCo. The general idea was that PhemCo could potentially become an important supplier in this display market. Not only with antireflective coatings, but also with other existing products and chemical

solutions of PhemCo. They started a strategic analysis project with people from Unotech, business intelligence people from the Corporate Strategy group and people from the Venturing & Business Development group in a pressure-cooker like atmosphere and investigated the display industry, its value chain and technological developments in the display product architecture. If the results of the strategic analysis were positive and the market seemed promising, they would use the Reflactone solution to gain entrance into this market.

*Legitimacy crisis*

After extensive strategic analysis of the electronic display market they concluded that trying to develop new business in the display market would entail high risks. It would be necessary to invest lots of money into new and local laboratories, development of market knowledge, hiring people, while potential revenues would come only in the far future. Competitors of PhemCo had already established themselves in this market and could offer much more solutions and products than PhemCo was able to do. The team that made the strategic analysis concluded that entering the display market (with Reflactone) is too risky and should not be pursued. This conclusion was shared by the Board of Directors and the director of the V&BD group. Steinbach said:

> "... we are very late, there are many other systems... the centre of gravity in the world is a combination of Japan, Korea and Taiwan. Application development is the name of the game, otherwise you will not be able to enter the market. So you must have local labs en speak the language of the people that make decisions. We also learned that for the next generation of flat-screen televisions the designs are already completely frozen. Those will not be changed. So you will not be able to get in anymore... In the 31 layers of a display, we only could offer something in 3 of them, for the other layers we had nothing. And our competitors are able to offer solutions in many more of those layers. And then we said we should not do it. It will be very tricky. It is a much too high risk project..."

Bringing the Reflactone solution to the electronic display market was seen as a too high risk project with potential revenues far into the future. As such the Reflactone solution for displays did not contribute to the *interests* and *needs* of PhemCo to grow and create synergies with existing PhemCo solutions and products. This issue can be characterized as a *pragmatic* legitimacy crisis.

*Strategy*

Although Reflactone for displays was seen as too high risk, everybody agreed that the Reflactone technology was something unique. So it was decided to try to sell and license out the Reflactone solution for displays. The partner of Unotech in the Asian market, the Japanese company FTI was interested in the Reflactone solution. After negotiations with FTI the V&BD group decided to sell the display business to

FTI, including all customer contacts and the license for Reflactone for electronic displays. The license for Reflactone was limited to displays only. All other potential application areas (for instance glass and picture frames, and solar cells) were excluded from the license. The other applications were still of interest to PhemCo and the V&BD group and they wanted to focus future research efforts on these areas. Steinbach explained:

> "... But, we had something unique, so let's try to get money for it. Our partner in Japan [FTI]... is a company that is specialized in electronic materials and chemicals. They were our partner for those coatings on fiber optics, and they evidently don't have that enormous amount of cash out to start in Japan, because they are already there. And we offered the Reflactone technology to them, with the limitation: only electronic displays... Because we want to give those other options a chance. Why would we sell those [options] to somebody else that didn't ask for it. So then we made this split and we also thought up the term 'Reflactix' [which denotes the Reflactone system for glass and picture frames]... It was a bit 'cash your credit and run'. But then we could focus the team that had developed Reflactone completely on Reflactix... "

Selling and licensing out the Reflactone solution for displays and focusing the research efforts for antireflective coatings on other application areas implied adaptation of the research and innovation plans of the Reflactone research team. Licensing out Reflactone better matched the interests and needs of the Board of Directors to grow the company and create synergy with established units of PhemCo. As such the strategic response to license out Reflactone and focus research on other application areas is characterized as a *conformation* strategy.

**Developing the Reflactix system**

The ideas to develop a new system like Reflactone for displays, but then for glass applications emerged during the summer of 2004, around the same time that the strategic analysis of the display market was made and negotiations with FTI had started. The research team of Coleman did a market launch of Reflactone at the society for information displays (SID) in Seattle and talked to potential customers and partners. One of them was Dr. John Hyneman who was running an antireflective coating business in the US at that time. He still used the older multilayer technology to put antireflective coatings on glass. During this conversation with Hyneman, Coleman thought it would be interesting to replace the older multilayer technology for glass with a single layer. He thought well if we can do this on plastic films, if we change the chemistry we should be able to do it on glass. When he was back in the lab the research team started working on this idea immediately. In the mean time Hyneman and Coleman kept in contact and exchanged ideas as research partners. And then in January of 2005 the 'Reflactix' system for glass had been fully developed and had the antireflection function, perfect optics and perfect mechanical properties. The difference between

Reflactone and Reflactix is that Reflactone is an inorganic/organic system which is cured with UV light, and Reflactix is fully inorganic system with high-temperature curing, just like some glass technology, sol-gel chemistry. But both were based on the same principles of nanostructured surfaces and nanopores.

Dr. Hyneman came to the research lab to see the Reflactix system as a potential partner or customer. He was so impressed by the results that he decided to leave his own company and help the research team to further develop it and bring it to the market. After the decision to license out Reflactone and focus more on Reflactix, it was agreed that Hyneman could join the research team, which happened during 2005. Coleman explained:

> "... And then in January of 2005 we had one post-doc working on it for six months, and by the time the post-doc worked on it for six months we had perfect optics and perfect mechanical properties. And then [Hyneman] came back early in the part of the year and I was able to show him a piece of glass which was fully inorganic and said you can produce this in your current facility without any problem. But I think we impressed him so much that he has left his company and decided to come here and help us develop it. Which is very powerful because not only ... you know what a one-man-band is? Well, [Hyneman] was a one-man-band in his last company, he did research, production, sales and the marketing, everything. So that is for us very powerful. [Hyneman] is a celebrity in the glass industry. Where ever we go to conferences everybody knows [Hyneman] and [Hyneman] knows everybody else. So it is a powerful combination..."

**LC 5.3 Selling glass... that is something weird**

After the research team had developed the antireflective coating system for glass (specifically for picture frames) and met necessary customer requirements they started thinking about how to bring the product to the market. Samuel Monico, a marketeer from the V&BD group joined the team and together with Hyneman did an extensive market analysis. Because Hyneman formerly owned a glass company that offered glass with antireflective coatings they had good insight in the established business models and customer needs in this industry. The obvious choice for PhemCo was to sell antireflective coatings to glass manufactures which then put it on the glass. This option was very similar to the business models of established PhemCo business units like Coatings Resins. Or they could license out the technology to glass manufactures and take less then 2 euros per square meter. However, based on the insights of Hyneman and the market analysis, both these options meant that you would give away all the value to the customer. If instead PhemCo would put the antireflective coating on pre-manufactured glass themselves, they could sell the antireflective glass for much more than 15 euros per square meter. This would be however a completely new business model for PhemCo, in which they moved up several steps in the value chain. The team working on Reflactix thought this was the best idea to bring Reflactix to the

market and had to defend it to their sponsors at the new Innovation Centre (that originated from the V&BD group of PhemCo).

*Legitimacy crisis*

The proposed business model to produce coatings and then to buy and coat glass met initial skepticism within the Innovation Centre, but also the Reflactix team members themselves found the idea still a bit weird. If they compared the idea with the traditional business activities and competencies of PhemCo they had to conclude it was very novel in three different dimensions; it was a product based on new technological principles, for a new market, with a new business model. People at the Innovation Centre and at the established business units considered the Reflactix business idea to have little strategic fit with PhemCo. Steinbach said:

> "... the fit with the businesses of PhemCo is the weakest point. If we only want to sell the coating, we will never become rich. So we have to make a step forward. And if it then becomes a big business, you can take a step backwards again. And in the future you would probably have a joint venture with a large glass company that goes from picture frames to solar panels, to architectural glass and so on... and then you would see indeed large shipments [of coatings] going to large factories. And then PhemCo would be back home again. But selling 50 by 50 centimeters of glass, that is a bit tricky..."

Also John Hyneman who developed the business idea said:

> "...PhemCo is not used to this type of business. It is very strange that a chemical company would handle glass now, that's something weird..."

Coleman referred to the radicalness of the idea and the initial skepticism encountered by saying:

> "...None of us new anything about any of this four years ago. So every single competence is developed at the research side, but also many at the business side is brand new for PhemCo. We had to understand nanotechnology, we had to understand surfaces, we had to understand the chemistries of those length scales, we had to know brand new chemistry for Reflactix, it was inorganic chemistry which we had never done before. We had to think about how a company like PhemCo would get coatings and coating glass, and distributing it. In a way we are probably the most risky project in PhemCo's history because we have done new, new and newer. We have a new product, brand new technology story, in a market which is brand new to PhemCo, with a business model which is brand new to PhemCo. So it is three times new. Ordinarily that says to management don't touch that, don't go anywhere near ... if all is new, new, new, it is a little bit dodgy..."

The new business model to buy, coat and sell glass for picture frames was considered weird and strange by the involved actors. A chemical company that would handle glass does not match the *established view and perception* of what a chemical company is and does (its *identity*), namely producing and selling chemical raw materials in business to business markets. Only when this business will grow big and can be extended into other types of glass, large amounts of antireflective coatings can be sold which will then *resemble* the established coatings business of PhemCo. This part of the issue is characterized as a *cognitive* legitimacy crisis, in which interpretations and conceptions of what the company is and does conflict with the innovative idea.

Next to this, the business idea has *little fit and synergy* with the established business of PhemCo. It is not a market in which other products of PhemCo can be sold. This part of the issue is characterized as a *pragmatic* legitimacy crisis, in which the new idea does not benefit or contribute to the established interests and needs of existing business units of PhemCo.

*Strategy*

The Reflactix team wanted very much to pursue their plans for Reflactix and the related new business model. They defended their plans with great enthusiasm before the management of the Innovation centre. The management of the Innovation centre in the end decided to let the Reflactix team go on with their plans, although the doubts about the strategic fit with PhemCo were not resolved. The main reasons for the management team to allow this was that the rewards versus the risks ratio was very interesting. With little initial investments and a good value proposition to its customers, large revenues could be realized. Next to this, although strategic fit was lacking, the Innovation Centre and also the Board of Directors of PhemCo wanted to demonstrate to its share- and stakeholders that it could successfully do really new things and be an innovative company. Rick Steinbach said about this:

> "... At the moment nobody in the business is ready for this. But luckily in the Innovation Centre they are... And strategic fit is important for a quick start, but you shouldn't be put down by a lack of strategic fit. Because what's not strategic yesterday, can become strategic today ... just look at the change of course of PhemCo... And when you can make a fast buck with it, then it's always interesting..."

Project leader and researcher Coleman stated:

> "... And then our management made actually a very brave decision I think to say well this is very unusual for PhemCo, but again the risk versus the reward is such a strong argument that why don't we give it a try, and see if we can make it work. The other thing is we don't have any existing customers in this area, so if we go further on in the value chain than which

> is usual for PhemCo then we are not competing with our customers... So there was no roadblock in that direction..."
>
> "... There are two reasons for it I think [for letting the Reflactix team continue with their plans]... The first one that I am pretty sure about is that PhemCo's history of successfully commercializing its own technology in new markets is fairly limited. The last twenty years, if you look at the new products in performance materials I can think of two or three. Maybe Treemax. [Novel product X] took twenty years to break even. And the [product Y] stuff. So three new products in twenty years. So there is a real will of top management also to our investors to show we are capable of doing new stuff..."

The response of the management of the Innovation Centre, which ultimately decides about these business proposals, was to allow the Reflactix team to continue with a partly illegimate plan. Strategic fit was not to be expected on the short term and the idea that a chemical company like PhemCo would start handling glass remained strange. These issues were not resolved. However, at the same time management wanted to demonstrate that PhemCo was able to do new things and is an innovative company. Next to this, all involved actors considered the risk/reward ratio very interesting. Making a lot of money in a fast way benefited the Innovation Centre as it would flow into their revenue stream. As such the Reflactix project would result in high returns on their initial investments. This response of the management team of the Innovation Centre can be characterized as a *toleration* strategy in which a partly illegitimate plan is allowed to continue.

**Going forward... solar cells and patent complications**

In the end of 2005 and beginning of 2006 the Reflactix team continued research and development on the Reflactix system and started up business development for picture frames glass. Next to this, a pilot line for the glass coating process was set up. The Reflactix team also started thinking about an other promising application area for the antireflective coating system, namely the glass for solar cells. This was expected to be a billion dollar business, much larger than the picture frame glass. However, the solar cell application is still really difficult from a technical point of view, the antireflective coating has to last for many years and keep its function in the outdoors. These difficult requirements first have to be met, before a decision can be made to start business development in this enormous market. Some researchers of the Reflactix team were allowed to spend time on exploring solutions for these technical difficulties. But Coleman does not want to rush it. Their aim is to first demonstrate business success with Reflactix for picture frames and then extend into other businesses and potentially other functional coatings systems. Coleman said:

> "... Obviously, if we went up for the solar cells and we came out as the winner for the AR-coating, well then it would be an enormous business for PhemCo. Absolutely enormous. But the chances of success are probably ten percent. Or maybe less then ten percent. Ten percent is still interesting, but let's make sure that the technology can intrinsically work with a smaller application like picture frames or display cases..."

> "... So we build a momentum, and I think the management now believes in our team's competences and motivation, because you can't only be good, you got to want it. The guys must work harder than anybody else, that is just the truth of it. And you got to maintain that continually. So what we are going to do is we are going to keep pushing picture frames, but at the same time, given the fact that the solar cell market is a billion dollar market for the glass, the way we see it, we should start now to investigate where do the problems lie... So at the beginning of this year we had another strategic meeting after the corporate strategic dialogue, where we expanded the program again. Because we worked on some of these other functionalities in the past... 2004 and 2005 we were told to focus on anti-reflection only... and now we are spreading out a little bit again. So we are in a phase of growth. So, yes solar cells is being looked at, but I am trying to make people aware that this is not something to be rushed. Let these [research] guys do their thing in the background and see what happens, and at the same time we really push a shorter term application.

The Reflactix team moved forward and had continued support from upper management. In the autumn of 2006 it was time to decide about a large investment in a full scale coating facility for the picture frame glass. Right at that time a Japanese patent landed on their desks that seemed to have an overlap with their Reflactix system. This threw a big spanner in the works and they had to find out if they had to, and were able to work around the Japanese patent. When this would be solved the Innovation Centre would very likely agree to start up production and get into the market. Coleman mentioned about this exciting period:

> "...Basically it is intellectual property which never showed up for Reflactone, because it was displays and it was a different system ... so we naturally assumed that it would be fine, because it never showed up during Reflactone ... it is basically the same thing but slightly different chemistry. And then suddenly something like this lands on the desk, and then you think well, alright ... and it came not from a chemical company, but from a glass company. So that is a difference..."

> "... [So] we are right at the crossroads. We need the green light now to go and make a fairly sizeable investment to build a coating facility with a proper production size, with clean rooms and everything. For a normal PhemCo plant the amount of investment involved is about 1 million euros,

> so it is not huge compared to a new Stanyl plant, or a new factory somewhere, but still 1 million is enough to make me nervous. So now we are at a point where we have different things to answer. And three of them are: is our business plan ready? Yes. Is our technology satisfying the customers on all parameters? Yes. Do we have unambiguous freedom to operate with this technology? Hm ... not entirely sure. If all those decisions were a clear yes, then I am sure we would get a green light from the Innovation Center to make the investment and go forward. So now is perhaps the most interesting time in terms of difficult decisions..."

During the rest of the year 2006, the Reflactix research team worked hard on the emergent complex patent situation and remained determined to launch a successful new anti-reflective coating system.

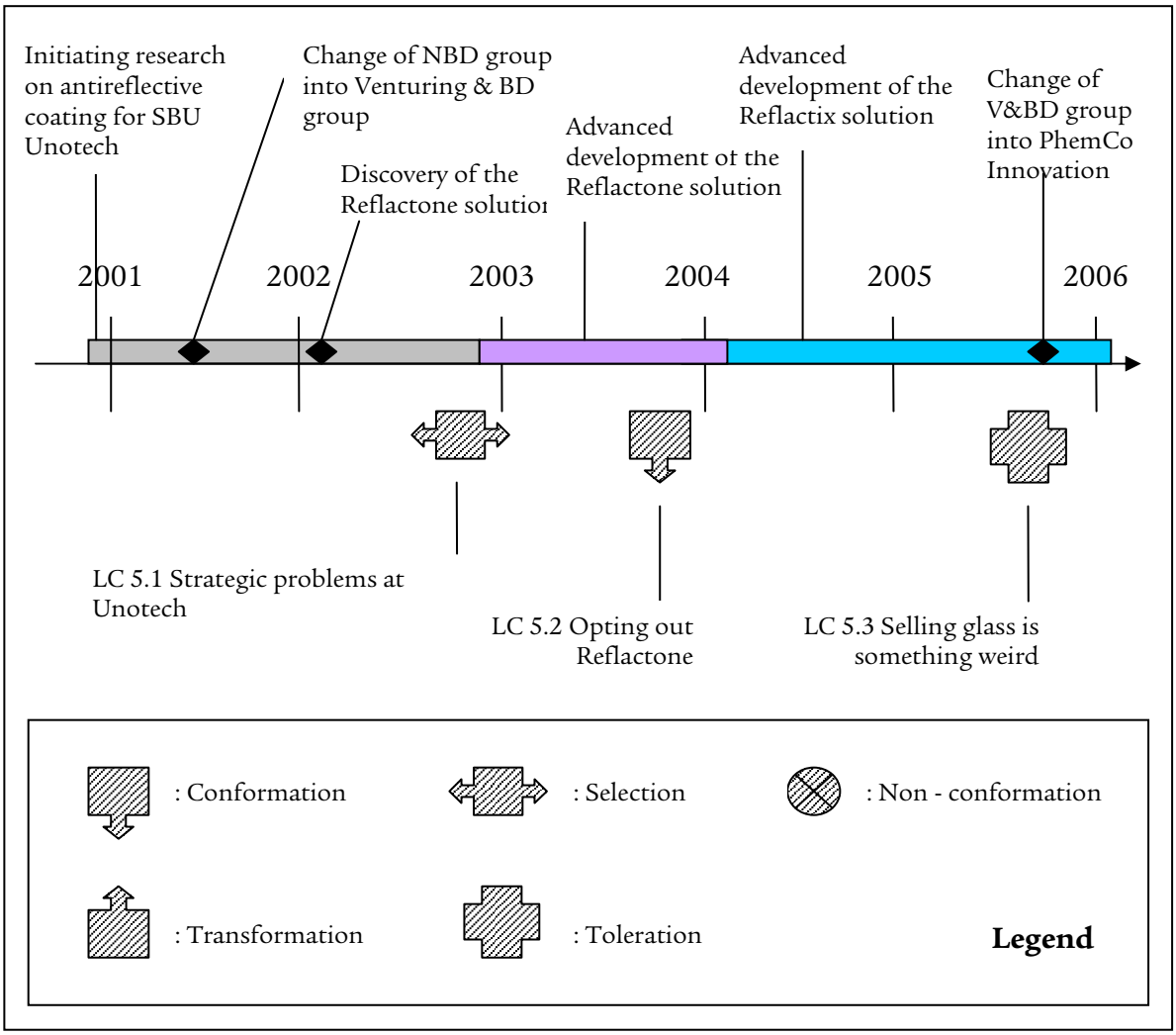


**Figure 4-8 Timeline of the Reflactone case.**

## 4.8 Extension of the micro-institutional perspective

### *4.8.1 Introduction*

In this section we broadly summarize the main findings of the case studies and restate in more detail two conceptual additions to the initial outline of the micro-institutional perspective of chapter 2 based on the qualitative analysis of the data (*i.e.* the strategic responses toleration and non-conformation). For a summary overview of the contents of legitimacy crises and strategic responses in each of the radical innovation cases we refer to Appendix 1.

In the five (nested) case studies of radical innovation processes at the two established high-tech companies we identified in total 24 different legitimacy crises with either *or* both pragmatic, normative or cognitive aspects (as argued in chapter 2 and 3, a single legitimacy crisis can have related pragmatic, normative and cognitive dimensions). In the DaXo case, LC 1.6 'Golden standard in sepsis diagnosis' is a legitimacy crisis that concerns institutionalized logics *external* to the organization, and falls therefore outside the scope of this thesis and will not be treated further. In 22 instances of the other relevant 23 legitimacy crises we could identify a clear strategic response to overcome or circumvent the crises; for LC 4.6 'Changing a culture of risk aversion' we could not identify a clear strategy that was used by innovative actors to deal with it, which makes it unusable for further analysis in chapter 5. In LC 4.5 'Strategic fit or no strategic fit' of the Treemax case, we found two separate strategic responses to overcome the legitimacy crisis, which were both included in the table (so the total number of strategic responses is 23). This makes a total of 23 nested cases (based on the number of strategic responses, N=23) that will be used for the qualitative analysis and cross-case comparisons in the next chapters.

| | Legitimacy crises | | | Strategic responses | | | | |
|---|---|---|---|---|---|---|---|---|
| *Cases* | *P* | *N* | *C* | *Con* | *Sel* | *Trans* | *Tol* | *N-Con* |
| DaXo | 1 | 2 | 4 | 1 | | 4 | | |
| Zapim | 3 | | 3 | 1 | 1 | 1 | | 1 |
| Icon | 4 | | 3 | 4 | 1 | | | |
| Treemax | 6 | 2 | 2 | 3 | | 1 | 2 | |
| Reflactone | 3 | | 1 | 1 | 1 | | 1 | |
| *Totals* | 17 | 4 | 13 | 10 | 3 | 6 | 3 | 1 |
| | | | | | | *N = 23* | | |

**Table 4-7 Overview of legitimacy crises and strategic responses.**

### *4.8.2 Legitimacy crises*

Based on the case histories and occurrences of legitimacy crises over time (see the figures of the case timelines in each of the case paragraphs) we can state that the majority of legitimacy crises do not emerge within the beginning of the innovation process. Usually, the first 2 years of the invention and innovation process, researchers are allowed to work on their invention in relative peaceful circumstances and with several degrees of freedom (*e.g.* within the context of a Corporate Research Department). Then, when the linkage between market requirements and technological possibilities has to be made, and the invention is developed into a technological product, legitimacy crises emerge. An explanation for this is that when we move downwards in the innovation and development process, other competencies and knowledge are needed, and usually larger resource investments are required. This means that new organizational groups (*e.g.* product divisions, strategic business units, external parties) have to be involved and new organizational sponsors are sought. As soon as departmental or group boundaries are crossed within the company, radical innovation ideas and plans have to be legitimized anew with respect to (partially) new sets of established departmental interests, norms, rules and beliefs. So when the internal radical innovation process gets more complex, requires larger amounts of resources and involves multiple organizational groups, we expect that the number of legitimacy crises will increase.

| | No. of legitimacy crises | No. of strategic responses | | | | |
|---|---|---|---|---|---|---|
| *Type* | | *Con* | *Sel* | *Trans* | *Tol* | *N-Con* |
| P | *7* | *5* | 1 | | 1 | |
| N | 1 | 1 | | | | |
| N & P | 2 | | | | 1 | |
| C | 4 | 1 | | 3 | | |
| C & P | 8 | 3 | 2 | 2 | 1 | 1 |
| C & N | 1 | | | 1 | | |
| *Totals* | 23 | 10 | 3 | 6 | 3 | 1 |
| | | | | *N = 23* | | |

**Table 4-8 Overview of legitimacy crises versus strategic responses.**

The majority of identified legitimacy crises that occurred during the radical innovation processes had either *or* both *pragmatic* and *cognitive* dimensions (19 of the 23 crises, as can be seen Table 4-8). Thus most legitimacy crises involved a clash between the radical innovation ideas and established interests, goals and responsibilities, and between the innovation and established frames of reference and commonly held views of organizational identity. Relatively less crises with *normative* dimensions could be identified (only 4 of the total of 23) in the case data.

So, the radical innovation ideas and related courses of action conflicted only in a minor way with established and institutionalized norms, rules and organizational procedures, in the cases observed. Dougherty and Heller (1994) and also Vermeulen et al. (2007) identified relatively more legitimacy problems or institutional pressures that involve a clash with institutionalized norms, rules and procedures. An explanation for the difference between our findings and that of these authors is that we have studied two established high-tech companies that already have a strong track record in innovation in general and relatively much experience with technologically complex research and development processes. During their years of innovating, our case companies have developed relatively effective norms, rules and flexible procedures for dealing with innovation, although members of these organizations state that radical innovation remains difficult for them. So, based on the specific characteristics of the companies involved in this study, we can conclude that radical innovations in established high-tech companies are not so much endangered by legitimacy crises of a normative nature, but instead are more often hampered by legitimacy crises of a pragmatic (interest/goals) and cognitive (frames/identity) nature.

### *4.8.3 Strategic responses*

In total 23 instances of strategic responses to legitimacy crises have been identified. We can see in Table 4-8 that legitimacy crises with a predominantly pragmatic dimension are in most cases solved thru conformation strategies (5 out of 6 cases). This means that in most cases of a pragmatic legitimacy crises established and institutionalized interests or needs are incorporated in the ideas and plans for innovation, or in its most definite and constraining form, (parts of) innovative ideas are postponed or cancelled. For legitimacy crises with normative dimensions no particular preference for a strategic response emerges out of the data. Purely cognitive legitimacy crises are in most cases solved or overcome thru a transformation strategy (3 out of 4). This means that in these cases established and institutionalized beliefs, frames of reference or cognitive schema are influenced, changed and adapted to legitimize the innovation ideas and plans in a better way (i.e. a change in the institutional logic). Legitimacy crises that have both pragmatic and cognitive dimensions are instead solved or overcome by using a variety of strategies and no particular preference emerges. This most importantly implies that there might be other characteristics of the institutional context, the radical innovation ideas or involved actors that influence the use or execution of particular strategies. In the next chapter these other characteristics and circumstances will be analyzed in more detail.

An important result of the qualitative analysis of the nested cases is the confirmation and extension of the initial outline of the micro-institutional perspective as presented in chapter 2, which was partly based on the typology of Suchman (1995). The *a priori* defined strategies of conformation, selection and transformation have been identified in the cases 10, 3 and 6 times respectively (see Table 4-8). As argued during the analysis of LC 2.3 'Finding a place within

AlphaSys' of the Zapim case, the conformation strategy also includes two highly similar types of responses; both postponement and withdrawal responses will be treated as specific instances of conformation throughout the analysis. In order to develop a clear and not too complex model we chose to introduce *no* new categories for postponement and withdrawal. The postponement/withdrawal response resembles the characteristics of the conformation category (adapting innovative ideas to incorporate and comply with established interests, norms and beliefs) and must be seen as conformation in its most definite and constraining form; adaptation means in this specific form postponing, delaying or cancelling innovative ideas or proposed actions to comply with established institutional logics and structures.

Four responses in dealing with legitimacy crises could not be categorized along the three *a priori* strategy types because they differed considerably in their characteristics. Based on a comparison of these four instances of alternative responses we defined two novel categories, namely: non-conformation and toleration. An important characteristic of both these novel strategies is that they do not, or only partially, solve a particular legitimacy crisis. They do however, enable proponents of the radical innovation to continue with their innovation process. This suggests that under particular circumstances (as will be further explored in chapter 5) actors are able to pursue illegitimate actions and do get access to necessary resources and networks, because either they can operate relatively independent from the institutional context, or when institutional actors are relatively tolerant to deviations from the institutional logic. This also implies that although high legitimacy is an important enabler for getting support and access to resources and networks, it is not always a necessity in order to continue with the innovation process. Under particular circumstances innovative actors pursuing illegitimate actions have more leeway to do so and can operate within the shadows of the institutional twilight zone. In the next sections the two novel strategies and respective exemplary instances are discussed to make the differences with the *a priori* strategies clear.

*Non-conformation*

As opposed to a conformation strategy, a non-conformation strategy is defined as the deliberate continuation with a perceived illegitimate course of action (and related goals) by ignoring the objections of organizational actors or organizational groups that reproduce the institutional logic. In the context of radical technological innovation, non-conformation means that proponents of the innovation do not adapt their goals and course of action to match the institutional logic. In the case of non-conformation, the institutional actors that object against the illegitimate course of action would indeed want to correct these actions, but have little means to do so. As a consequence, a non-conformation strategy does not solve the legitimacy problem and does not build up legitimacy vis-à-vis the institutional actors.

The single example of a non-conformation strategy is found in case LC 2.2 'publication and the wake of competition' of the radical innovation Zapim within the established company AlphaSys (see paragraph 0, pp. 77). In this case, the researchers and their management from the Omega Research department had the idea to publish about Zapim in a major scientific journal to get the academic community interested in their invention. Members of the product division AlphaSys (more specifically from the AlphaSys Technology Office) objected strongly against this idea. To them the publication idea (and the idea to interest and potentially involve the academic community) was not legitimate with respect to their 'business potential and competitive advantage' frame of reference and related business goals. They were afraid that publication would waken up competition and the possibility that academic groups would develop additional patents, endangering their competitive position and increasing dependency on external parties. The responsible management team of Omega Research and the Zapim research team nevertheless pushed forward, arguing that the patents had been filed and published publicly anyway. They ignored any further objections made by members of the Technology Office of AlphaSys, although some members of AlphaSys tried to delay the publication, and did not feel strongly obliged to comply to the concerns of AlphaSys. The research on Zapim had been completely sponsored out of the Corporate Research budget of Omega Research itself, so they felt free to do as they liked and not obliged to the AlphaSys product division.

The reaction of the research team and the management team was thus to push forward and not change their ideas to conform to the dominant group and established way of thinking at the Technology Office of AlphaSys. They also didn't try to change the way of thinking and reasoning at AlphaSys, but instead just went ahead with their plans. As such, this response to the lack of legitimacy of their ideas cannot be categorized under the *a priori* defined strategies of conformation, selection or transformation. Central characteristic of those three strategies is that either illegitimate plans or ideas are adapted to conform to the established institutional logic, or that another institutional group with a different logic is selected, or that adaptations and shifts are made to the dominant institutional logic, in order to improve the legitimacy of these ideas. In this case none of the *a priori* defined strategies capture the response of the proponents of the illegitimate idea in an adequate way. Based on this particular case we developed the category of *non-conformation*, in which the proponents of the illegitimate course of action deliberately continue with the course of action without solving the legitimacy crisis.

The developed non-conformation category bears strong resemblance with the strategic response of *defiance* and the related tactic of *dismissing* as defined by Oliver (1991) in her article on 'strategic responses to institutional processes'. Defiance and its related tactic of dismissing involves the deliberate ignoring of institutional norms, rules and expectations. This option is, according to Oliver (1991), more likely to be exercised by actors (or organizations) when the potential of external enforcement of the institutional logic and resource dependence is both perceived

to be low. In the next chapter we will further investigate and identify under which circumstances the non-conformation strategy was exercised based on our own qualitative case data.

*Toleration*

Toleration is defined as the continuation with a perceived illegitimate course of action or related goals, which is deliberately *allowed* or tolerated (*i.e.* not penalized, regulated or corrected) by the organizational actors or groups that reproduce the institutional logic. These institutional actors or groups do have the means and influence to regulate the actions of the proponents of radical innovation, but deliberately refrain from exercising their power to stop the illegitimate action. Consequently, proponents of an illegitimate course of action can make use of the apparent tolerance of institutional actors to pursue their ideas. Toleration as such, implies an appreciation of difference and pluralism within institutional systems, and the protection of minority groups with alternative ideas from the regulative influence of the dominant majority. In the cases in which a toleration response occurs we can also see that toleration usually implies a shift in the (hierarchy of) institutionalized interests, norms or beliefs. For instance, an illegitimate radical innovation that does not match with established shorter term business interests, is tolerated because it can contribute to the longer term survival of the company in an uncertain future (longer term interests). Or, although an illegitimate innovation does not match particular business interests, penalizing and correcting proponents of the innovation can lead to the unintended effect of de-motivating personnel to come up with innovative ideas in general and creating a repressive culture. And in the end, this may damage institutionalized norms of personnel empowerment and entrepreneurship. Consequently, institutional actors can tolerate the illegitimate action (with respect to direct business interests) because it instead does contribute to the institutional norms of empowerment and entrepreneurship, in this hypothetical example. This also makes a toleration strategy distinct from the previously defined non-conformation strategy where proponents of an illegitimate action also continue with the action, but where we do not see deliberate allowance by the institutional actors and preference shifts within the set of institutionalized interests, norms or beliefs.

A primary example of a toleration response occurred in the case LC 4.4 'cutting down the Treemax venture' of the radical innovation Treemax in the established PhemCo company (see paragraph 0, pp. 108). The initial plans for 2004 for the Treemax venture were aimed at continued growth with the same amount of personnel working on it (avg. 10 FTE). However because sales had fallen back in 2003 and Treemax was not seen as really strategic for the long term growth of PhemCo, the Board of Directors of PhemCo seriously doubted whether they should continue to support the Treemax venture. Consequently, a pragmatic legitimacy crisis emerged. In a last attempt to save the venture, the Treemax new business developer proposed to trim down the whole venture to about 2-3 FTE and focus primarily on the oil field chemical business. By trimming down the Treemax

venture and asking only for a small amount of resources he hoped that the Board would let him continue. However, although the Treemax venture team had reduced their resource needs considerably, the Board of Directors still doubted whether Treemax was 'strategic' to the future of PhemCo and should get continued support. At that time however, 'innovation' was an important topic to the Board of Directors. They wanted to show their shareholders that PhemCo was an innovative company, and that many promising technologies and new businesses were underway. They wanted to talk a lot about innovation to the outside world and show an interesting portfolio of new technologies and businesses. Throwing out Treemax at that time just didn't seem right to the Board of Directors and would not help them demonstrating an interesting innovation portfolio. So although the Treemax venture was not seen very strategic to PhemCo at that time, the Board decided that the Treemax team could continue their work because it didn't cost much and it did contribute to the 'innovativeness' of PhemCo.

This particular response to the pragmatic legitimacy crisis cannot be categorized under the *a priori* defined strategies of conformation, selection or transformation. Initially, one could argue that the response is part of a conformation strategy in which plans and ideas are adapted to match the dominant institutional logic. However, the ideas for Treemax are not specifically adapted to improve strategic relevance and create a better fit with established interests (around which the legitimacy crisis evolves). Instead, only the resource demand of the plans and ideas is reduced to diminish the troublesome nature of the Treemax venture and to reduce the resource impact on the organization (*i.e.* improve the cost/potential benefit ratio). Moreover, we can identify a shift between different established institutional interests. Although opponents don't acknowledge the strategic relevance and fit of Treemax, they do think that it contributes to the innovative image of the company. And the proponents and champions of Treemax can appeal to these multiple different established interests and shift the attention to other interests that instead do legitimize the innovation. The Board has formal authority to cancel projects and withdraw support and resources, but in this case deliberately allows the Treemax venture to continue, although the innovation idea is not legitimate to the complete set of institutionalized interests (and norms and beliefs). The characteristics of this particular response thus do not match well with the *a priori* defined strategies of conformation, selection or transformation. Based on this case (and the two others) we developed the category of a *toleration* strategy.

In this chapter we have presented a detailed overview of the dynamic histories of each of the radical innovation processes and identified emerging legitimacy crises and related strategies to overcome or circumvent these crises. In the next chapter we will finalize our analysis by investigating the different institutional circumstances under which each type of response occurred.

# Chapter 5 Institutional circumstances and strategic responses

## 5.1 Introduction

The adoption of a micro-institutional perspective has helped us to understand the emergence of discrepancies between radical innovation ideas and the established institutional order within high-tech companies; the so called legitimacy crises as identified and analyzed in the previous chapter. We also have been able to define and identify several types of strategies that innovative actors use to overcome or circumvent legitimacy crises during the radical innovation process. In this chapter we will extend the previous analysis and investigate the local institutional circumstances that either enabled or constrained innovative actors in their choice and pursuit of particular strategies. This means that we will more closely look at the different instances (cases) of each of the strategies and will identify characteristics of the institutional context and institutional position of innovative actors that enabled or constrained them in their strategic response. The identification of relevant circumstances and characteristics draws on the inductive analysis of our qualitative case data (as explained in chapter 3).

Before we go into the analysis of each of the strategies, it is important to clarify some of the terms and phrases used in analyzing the cases. In the previous section we used the specific formulation of 'circumstances that both constrain and enable actors', which might suggest that we adopt a perspective that primarily focuses on how 'institutional structures *constrain* and *limit* action' (which is an instance of the classic 'structure determines agency' argument, see for instance, Reed, 1988; Child, 1997; which resembles the 'paradox of embedded agency' argument in institutional theory, see Greenwood & Hinings, 1996; Seo & Creed, 2002; Greenwood & Suddaby, 2006). However, two important notions of our framework that have been explained in chapter 2 (on theory), prevent the analysis and approach of becoming too deterministic and leave more room for the free will and creative nature of human individuals.

First of all, although actors can be constrained in their action by institutional structures, they are also enabled by their embeddedness within the institutional system and can make use of their specific institutional role and position to pursue particular actions (*cf.* the *duality of structure* assumption; Giddens, 1984). This means that by appealing and stepping onto different pillars of the same institutional structure they can initiate change, find other institutional groups or defy institutional pressures to adapt radical innovation ideas. Institutional structures and embeddedness provide innovative actors with a repertoire of roles, action sequences, and meanings to be made use of (Giddens, 1984; Barley & Tolbert, 1997; de Ronde, 2003; Pozzebon, 2004). Institutional structures thus

concurrently limit their opportunities for particular courses of action, but their embeddedness within these structures also opens up opportunities for different courses of action.

Secondly, as argued in chapter 2, structures (e.g. institutions) are not objectively defined, but instead are enacted and reproduced by actors. This means that although institutions and structures can have a strong objective and almost tangible quality, variations in enactment and interpretation among actors open up the way to change and transform existing structures and the creation of new structures (as also is demonstrated by our 'transformation' strategy in the previous chapter). Giddens (1984) suggests that actors can *reflect* on their actions and institutional situation, and may enact institutional structures and logics unchanged; enact them with some slippage or error; or change them perhaps dramatically. Actors, or more correctly, individuals are not exclusively part of a particular institutional system except, perhaps for instances like incarceration or conscription. However, institutional roles and related tasks and responsibilities indeed are part of the institutional system (in the form of logics and structures). Individuals usually perform different roles in different institutional (and other) settings and are structurally linked to these roles and systems through formal contracts or informal social obligations. Because individuals perform different roles in different institutional systems (separated over time and space), they acquire different experiences and backgrounds. These differences in background and experiences fuel the variations in interpretation, reflection and enactment of institutional structures, and thereby open up the possibilities of change and transformation. Moreover, these possibilities reduce the objective and rigid quality of established institutional structures as experienced by involved actors. An important consequence of the structuration perspective on institutional structures is that the 'characteristics' or qualities of these structures are *also* enacted by local actors and are not objective qualities like the weight of a stone, or the length of a tree. The 'institutional characteristics' investigated in this chapter can appear very objective, strong and tangible to the actors involved, but are also deliberately brought into the field of attention by other aware actors, and are open to interpretation and consequently malleable by the actors involved. Some actors (due to their position and experiences or persuasiveness) have a greater ability to change interpretations (and enactment of institutions) than others.

Thus, in the analysis of the various strategies we will show how involved actors are constrained, but also enabled by these institutional structures, and how they can make use of and influence the identified institutional characteristics to pursue particular strategies. We will show how intrapreneurs are constrained by the rules of the institutional playing field in their attempts to win, but at the same time can use these same rules or even influence these rules to win the game.

In the next section we will start with the discussion of the non-conformation strategy and gradually build up the complexity of the argument, involving more characteristics and linking them to the different strategies. Based on this analysis

and argumentation we will develop an empirically grounded model that explains when and how innovative actors are able to make use of different characteristics of the institutional context, their position within the institutional system and characteristics of radical innovation to initiate and pursue particular strategies for legitimation. The micro-institutional model describes how particular institutional circumstances enable and constrain innovative actors in their actions to follow particular strategies for legitimizing radical innovation within established high-tech companies, and is part of the micro-institutional perspective as developed.

## 5.2 Non-conformation

In this section we will identify and discuss the distinctive characteristics of the institutional context that enabled proponents of radical innovation ideas to pursue a non-conformation strategy. Although we have found only a single instance of a non-conformation strategy in our cases, it does shed light on the institutional circumstances that enabled innovative actors to pursue non-conformation, compared to the other strategies. The single instance of non-conformation occurred in the AlphaSys Zapim case, and concerned the desire of the Zapim research team to publish their invention in one of the major scientific journals. At the time, publication was seen as not at all legitimate with respect to the established business logic of the Technology Office of AlphaSys (*i.e.,* LC 2.2 'Publication and the wake of competition').

### *5.2.1 Case analysis*

*Zapim - LC 2.2 Publication and the wake of competition*

The idea of the researchers to publish an article about the Zapim invention was not supported by the people from the Technology Office of AlphaSys. The legitimacy crisis that emerged contained both cognitive and pragmatic aspects. The cognitive aspect concerned the clash between the different frames of reference of researchers and business people at the product division. The researchers sought professional (external) recognition for their great invention, and wanted to get access to many interesting research partners in the academic community, in order to stimulate research and development activities around Zapim. However, this line of reasoning was not legitimate within the 'strategic and competitive advantage' frame of reference of the strategy directors of the Technology Office of Alphasys. According to the dominant frame of reference at the Technology Office, publishing the ideas was not in the interest of the company, nor of the decision makers at the Technology Office of AlphaSys (i.e., the pragmatic aspect of the crises). Technology Office decision makers felt rushed into an adventure with unknown outcomes for which they had not made any plans yet. Thus the ideas of publishing about Zapim did not yet match with their interests and strategic goals. However, the Zapim research team and their respective managers did go forward, dismissing the concerns of the strategy directors of the Technology Office, even though they had many discussions about it and some of the members of the

Technology Office tried to delay the publication. In chapter 4 this response was classified as a non-conformation strategy. We will now analyze non-conformance in this particular case and identify some of the distinctive characteristics of the institutional context that enabled the innovating actors to pursue the non-conformation strategy, based on the quotes of some of these actors.

*A weak regulatory regime*

A closer look at the institutional arrangement between the two groups, namely the Zapim research team at Omega Research and the Technology Office of AlphaSys, reveals some important characteristics that enabled the Zapim research team to follow a non-conformation strategy. Berkovich, the project leader of the Zapim research team said:

> '... So that was a bit of a decision without any procedures at that point of time...we now have the possibility to publish that, the editor says it is okay, and what does AlphaSys think of that, is it approved or not?... And that was a bit vague... I think if we had an exchange about our strategy in terms of publication and their strategy of business earlier in time, that might have been circumvented. But otherwise no harm done...'

Based on this comment, it can be stated that the two groups had not agreed on clear *formal procedures* to deal with decisions about publication in relation to the overall strategy concerning Zapim. There did not exist a clear procedure defining which party has a say and stake in particular strategic decisions. So, if we look at the institutional arrangement in which the two parties resided, it becomes clear that the Technology Office of AlphaSys did not have the authoritative *formal and procedural means* to regulate the actions of the Zapim research team in this case. Thus it can be concluded that the *regulatory regime* governing the arrangement between the two parties was relatively weak, which provided the opportunity to the Zapim research team to follow a non-conformation strategy.

Frank Popper, the former research director of Omega Research and responsible for the Zapim team and Imaging research, highlighted another important characteristic of the institutional context enabling a non-conformation strategy:

> '... But then again, Research said: "AlphaSys thank you, but you are not in control, you have not paid a dime for it. So if you think it is so important, why didn't you pay a dime for it? And now it is ours, and we publish, because we owe this to the inventor"...'

This comment suggests that the Technology Office could not *control* or regulate the actions of the Zapim research team because they had not invested any *resources* in the technology. Because they had not paid for any of the research activities of Zapim in the preceding period, they had neither control nor influence over what was going to happen with the technology. They could not make any (ownership)

claims or appeals based on *previous commitments* or *resource investments*. As such, we state that any regulative influence resulting from previous resource commitments was limited for the Technology Office (i.e. their *resource control influence* was limited). As such, this is another indicator of a relatively *weak regulatory regime* appropriated by the Zapim team to evade control by the Technology Office.

Moreover, based on the same underlying rationale, we also see that the Technology Office could not regulate the actions of the Zapim research team via the control over any *future* necessary resources at that time. The illegitimate course of action to publish about the invention did not require specific additional resources (financial, or otherwise). It did not require particular investments or access to people or knowledge; the Zapim team had all the necessary resources available to execute this course of action[13]. Consequently, this also contributed to limit the regulative influence of the Technology Office over the actions of the innovative actors. Both the limited *ex ante* and *ex post* regulative influence, stemming from any necessary future or past resource investments respectively, are indicators of a *weak regulatory regime* governing the arrangement between the two parties. This increased the opportunities for the Zapim research team to follow the non-conformation strategy and evade to concerns and pressures of the Technology Office.

### *5.2.2 Integrating results*

The analysis of the non-conformation case implies that although there was a serious legitimacy crisis concerning the ideas to publish about the radical innovation, the Technology Office did not have any strong means to regulate, influence or constrain the actions of the Zapim research team at the time. The apparent institutional regulatory regime offered little by way of formal procedures or resource control influence that could enable the Technology Office to force the Zapim team to adapt their plans. Because the Technology Office had made a choice *not* to buy into a situation of control through contributions or resource investments, and the idea of publication about Zapim was novel at this time and in this context, there were no procedures to deal with it. The Zapim team was able to maneuver through these gaps in the institutional structure and logics to seize the opportunity to pursue the non-conformation strategy with respect to their unaltered ideas. We thus conclude and propose that a weak institutional regulatory regime offers proponents of a seemingly illegitimate radical innovation the opportunity to pursue a non-conformation strategy.

[13] The *resource impact* of the proposed innovative actions was also low. This characteristic will be treated more extensively when analyzing the institutional circumstances that enabled innovative actors to pursue a toleration strategy.

| Case | Institutional circumstances | Strategic response |
|---|---|---|
| *Zapim –* | *Weak regulatory regime* | *Non-conformation* |
| LC 2.2 Publication and the awakening of competition | - lack of formal procedures delineating decision authority<br>- lack of resource control influence of institutional actors | The innovative actors push forward to publish the article without consent of the product division. |

**Table 5-9 Institutional circumstances and non-conformation strategies.**

## 5.3 Toleration

In this section we will identify and discuss the distinctive characteristics of the institutional context that offered the opportunities for proponents of radical innovation ideas to pursue a toleration strategy. In the previous chapter we have identified three instances of a toleration strategy in the PhemCo cases, which shed light on the institutional circumstances and the actions of innovative actors seeking to maneuver their radical innovation into the tolerant corner of the institutional system. We will more closely look at two of the instances of the toleration strategy, namely LC 5.3 'Selling glass... that is something weird' of the Reflactone case at AlphaSys and LC 4.4 'Cutting back the Treemax venture' of the Treemax case at PhemCo. The other instance, LC 4.1., will be summarized in the final section because it replicates the findings of LC 5.3 and LC 4.4 and provides no additional insights.

### *5.3.1 Case analysis*

*Reflactone - LC 5.3 Selling glass... that is something weird*

After the Reflactix research team at PhemCo had developed their antireflective coating system for glass during 2004, they started thinking about how to bring the product to market. The team came up with the idea to put the antireflective coating on pre-manufactured glass themselves. In doing so they expected to increase their profit margin in a major way, compared to selling or licensing out only the antireflective coating. However, this would be a completely new business model for PhemCo, moving the company up several steps in the value chain as well as entering a new business and new market, based on a new technology. This idea, to produce coatings and then to buy and coat glass, met initial skepticism within the Innovation Centre and a legitimacy crisis was born. The legitimacy crisis comprised both cognitive and pragmatic aspects. The cognitive aspect concerned the conflict between the idea of selling glass and the established view of what PhemCo as a chemical company is and does (its identity), namely producing and selling chemical raw materials (e.g., coatings) in business to business markets. Besides this, a pragmatic aspect of this crisis concerned the perceived poor

strategic fit and synergy of the radical innovation idea with the established businesses of PhemCo. Consequently, the idea was not seen to directly benefit established and institutionalized interests and needs of PhemCo.

The management of the Innovation Centre in the end decided to allow the Reflactix team to go ahead with their plans, although the legitimacy crisis was not completely resolved. People at PhemCo and the Innovation Centre still thought that selling glass did not match the established view of organizational identity, and the doubts about the strategic fit with PhemCo remained. However, both the Innovation Centre and also the Board of Directors wanted to demonstrate to its share- and stakeholders that PhemCo could successfully do really new things and be an innovative company. Besides, the potential to make a big profit without involving major risks or large initial investments was very appealing to the Innovation Centre. In chapter 4 we characterized this response as a toleration strategy, in which the proponents of the radical innovation are allowed to continue with their course of action although their actions are not (completely) legitimate with respect to the dominant institutional logic and order.

If we take a closer look at the local institutional circumstances that enabled the proponents of the radical innovation to make use of the apparent tolerance in the established institutional context, we can identify two relevant characteristics of the situation. One of the relevant characteristics is the multiplicity of institutional interests and beliefs, which enabled the proponents to shift attention to and nest their project within more favorable institutional interests and beliefs that better legitimize their innovation. The other relevant characteristic is the relatively low amount of resources required to continue with their proposed course of action (i.e., low resource impact and little risk), coupled with the potential of earning large revenues and making big profits. We will elaborate on both characteristics in more detail in the next two sections.

*Multiplicity of institutionalized interests, norms and beliefs*

The actors involved in the toleration strategy to enable the continuation of the radical innovation ideas of Reflactix, Coleman and Steinbach, offer relevant insights. Coleman, the current project leader, said:

> "... There are two reasons for [letting the Reflactix team continue with their plans] I think... The first one that I am pretty sure about is that PhemCo's history of successfully commercializing its own technology in new markets is fairly limited. The last twenty years, if you look at the new products in performance materials I can think of two or three... So: three new products in twenty years. So there is a real will of top management to show to our investors that we are capable of doing new stuff..."

In addition, Steinbach, the former director of the V&BD group noted:

> "... At the moment nobody in the business is ready for this. But fortunately in the Innovation Centre they are... And strategic fit is important for a quick start, but you shouldn't be put down by a lack of strategic fit. Because what's not strategic yesterday, can become strategic today ... just look at the change of course of PhemCo..."

So although strategic fit was not to be expected initially, and the idea that a chemical company like PhemCo would start handling glass remained strange, at the same time top management wanted to demonstrate PhemCo's innovation capability to its shareholders. Moreover, there is a general understanding that, over the longer term, activities that don't seem strategic at the moment might become very important for the future survival of the company. This suggests that within the same institutional regime and logic different goals and beliefs co-exist (and compete). This *multiplicity* of goals and beliefs offers the opportunity to shift preferences and alter the legitimate hierarchy of these goals and beliefs. In this case we see that (partly) illegitimate actions are allowed to continue because they do match with longer term goals, at the expense of achieving shorter term goals. Consistency of the innovation with current views of organizational identity is sacrificed to strengthen the image of the company as innovative. The proponents of the radical innovation can appeal to this multiplicity of institutional interests and beliefs and shift attention to those more favorable criteria that justify and (partly) legitimize their ideas. Opponents of these ideas (i.e., the institutional actors who reproduce and guard the mainstream institutional logic) can then conclude that their demand for full consistency with established interests and beliefs (i.e., full legitimacy) might conflict with other important institutional interests and beliefs. Consequently, they must make a trade-off between these different interests (and beliefs) or rank them differently, which might justify the toleration of (partly) illegitimate actions. As such, the multiplicity of institutional interests and beliefs offers opportunities for the innovative actors to make appeals to co-existing and competing interests and beliefs, and thus a legitimating basis for institutional actors to tolerate illegitimate action.

*Low resource impact and high rewards*

If we take a closer look at another important reason brought forward by the involved actors to justify the radical innovation idea, we see that the required investments to execute the idea are relatively little and the potential rewards are very interesting. Steinbach said:

> "... we can do this with little cash losses in the beginning. Because the pilot plant is already up and running. It is very easy. You take a piece of glass, dip it, get it out, watch the self-assembly take place and put it in the oven. It's just that easy... its simplicity is its strength..."

> "...And when you can make a fast buck with it, then it's always interesting..."

This is also acknowledged by the project leader Coleman, who stated:

> "... And then our management made actually a very brave decision I think to say, well, this is very unusual for PhemCo, but again the initial investments and risk versus the reward is such a strong argument that why don't we give it a try, and see if we can make it work..."

So, the simplicity of the idea and the minimal resources required to execute the idea (versus the potential rewards) is very attractive to both innovators and also to opponents of the idea. We characterize this aspect of the radical innovation idea (within the local institutional context) as a *low resource impact*. The relatively low impact of the innovation idea on the resources controlled by institutional actors enables these institutional actors to tolerate the (partly) illegitimate actions more easily. Moreover, it enables innovative actors to make use of the multiplicity of logics and apparent tolerance in a better way. The rationale behind these observations is that when the resource impact is relatively low and when the radical innovation idea does match with (or contributes to) some of the larger institutionalized interests and beliefs, like profit and revenue growth, it is easier to justify the continuation of the idea, because it doesn't 'cost' institutional actors much. If the resource impact is high instead, then the mismatch between the idea and some of the institutionalized interests and beliefs will probably lead to much more debate and resistance, because the idea has a significant and high impact on the available resources, which limits institutional actors' ability to support other, more legitimate innovation options. Based on this case, we infer that a low resource impact of the radical innovation idea enables the proponents of the idea to make easier use of the apparent tolerance of institutional actors guarding the institutional logic and order. It is important to note that the resource impact of an innovation idea is adjustable (within the physical limits of the innovation) and proponents can try to reduce its impact to make use of the tolerance in the institutional regime (as will be shown in the discussion of the next toleration case).

*Treemax - LC 4.4 Cutting back the Treemax venture*

In the Treemax case at PhemCo we also have identified a toleration strategy (see Section 4.7 in the previous chapter). The institutional circumstances of this instance show large similarities with the previous legitimacy crisis of LC 5.3 in the Reflactix case. The toleration strategy in the Treemax case, suggests that the multiplicity of institutionalized interests and beliefs and the reduction of the resource impact of the innovation ideas are again important enablers for the toleration response. We will shortly elaborate on the legitimacy crisis and strategic response and then discuss the characteristics of the institutional context that offered the opportunities to pursue a toleration strategy in more detail.

The initial plans for 2004 for the Treemax venture were aimed at continued growth with the same amount of personnel working on it (avg. 10 FTE). However because sales had fallen back in 2003, the Treemax venture could not live up to the 'fabricated,' unduly high expectations of the past years. Consequently, the Board of Directors felt it had 'damaged' their interests, or at least it longer matched their interests in growth for the PhemCo company. Because Treemax was not seen as really strategic to PhemCo by the Board of Directors, they seriously doubted whether they should continue to support it. These doubts led to severe conflicts of interest, and we characterized this crisis as a pragmatic legitimacy crisis in the previous chapter.

In a last attempt to save the venture, the new business developer of Treemax proposed to cut back the whole venture to about 2-3 FTE and focus only on one relatively developed and revenue-generating market segment. The Board of Directors in the end allowed the Treemax venture to continue in this trimmed down form, even though it was not seen very strategic to PhemCo in the long run. It did, however, suit the needs of the Board to demonstrate to the outside world that Phemco is an innovative chemicals company focused on the future. In the previous chapter we characterized this response as a toleration strategy.

*Low resource impact*

If we take a closer look at the institutional circumstances that offered innovative actors opportunities to make use of any apparent tolerance among the institutional actors, the deliberate reduction of the resource impact appears to be very important. Sheridan, the new business developer of the Treemax venture stated explicitly:

> "... So we decided in 2004 okay trim down ... we trim it down completely, right to the bone ... So if you want to know how I solved it? I'll answer you without much thinking ... by disappearing under the blanket and putting down the performance... Just trim down and show them that we are right... and what happened is that we went back from 10 to about 3 employees... and we have proven something in only one market segment during that year, and the rest we just kept alive, literally..."

This was also mentioned by Quinn, one of the other sales and business development managers of Treemax:

> "... So in 2004 it could have crashed. But it didn't, because it didn't hurt. If we wouldn't have enough sales to pay for those 2,5 people, then it would certainly have crashed..."

Based on these quotes and other case data, we see that the proponents of the radical innovation idea very deliberately reduced the resource impact of their ideas on the available resources controlled by institutional actors. They hoped that this

would make them almost unnoticeable and that the attention of the institutional actors would be diverted to problems with a bigger impact. In the end, it worked out as they had hoped. The Board of Directors allowed them to continue because it didn't 'cost' them much, although the legitimacy crisis and the issues of strategic fit and relevance here too were not completely solved. Again, we conclude that a *low resource impact* of the radical innovation ideas helped the innovative actors to acquire tolerance among the institutional actors embedded in the institutional system. Moreover, the resource impact of radical innovation ideas appears not to be a fixed variable, but can be influenced and adjusted within certain limits by the innovating actors involved. Similar to the previous case, the low resource impact operated in tandem with the multiplicity of institutionalized interests and beliefs, as will be shown in the next section.

*Multiplicity of institutionalized interests, norms and beliefs*

Although the Treemax venture team had reduced their resource needs considerably, the Board of Directors still doubted whether Treemax was 'strategic' to the future of PhemCo as has been described in chapter 4. Commercializing Treemax in the oil field chemicals business and paper chemicals business (and potentially other interesting markets) were not seen as strategic to PhemCo at the long term, according to the Board, which could still be used as an important reason to kill the venture. However, at the same time, innovation per se was an important topic on the agenda of the Board of Directors. As described in the case study, they wanted to demonstrate PhemCo's innovation capabilities to their shareholders by actively showing many promising technologies and new businesses underway. They needed an interesting portfolio of new technologies and innovative businesses to talk about. Throwing out Treemax at that time just did not seem right to the Board of Directors, since this would not help them demonstrating an interesting innovation portfolio. So although the Treemax venture was not seen very strategic for PhemCo at that time, the Board decided in the end that the Treemax team could continue their work because it did contribute to the 'innovativeness' of PhemCo. This apparent *multiplicity* of institutional goals and interests that enabled the Treemax venture to continue was explicitly mentioned by the Treemax sales and business developer Quinn:

> "... So the whole innovation cycle started up again ... Peyton [as representative of the Board of Directors] also realized, 'hey, innovation, that might be important to the company' ... and maybe we even want a lot of innovation, even more than we are doing now. And we need new areas and maybe we could use [Treemax] in that... so Treemax stayed alive... and we are drifting on this wave of innovation. But still the question why we are doing it, is not answered."

So, similarly to the previous instance of toleration in the Reflactix case, the co-existence of multiple institutional interests and beliefs (strategic fit with current business vs. being innovative) enabled both the innovating and institutional actors

to shift attention to more favorable established interests that indeed justified the toleration of Treemax. In this case, the need to 'be innovative' overruled the initial primary interest of 'strategic fit', enabling the innovating actors to appeal to this alternative and more favorable institutional interest to stimulate tolerance among institutional actors. The multiplicity of the institutional logic in this case operated in tandem with the lowered resource impact of the innovation ideas, and enabled the institutional actors in the end to tolerate the continuation of Treemax.

### *5.3.2 Integrating results*

In this section we have more closely investigated the institutional circumstances that offered innovating actors the opportunities to pursue a toleration strategy to deal with legitimacy crises. In our three instances of toleration strategy, the two most distinctive characteristics identified are the multiplicity of institutional interests, norms and beliefs; and the resource impact of the innovative ideas. Based on the case analysis, both these characteristics are important enablers for innovating actors seeking tolerance among institutional actors. The multiplicity of institutional interests, norms and beliefs refers to the co-existence of (competing) alternative interests, norms and beliefs within the same institutional system, and their sometimes divergent logic (and reproduced by the same institutional actors). By making institutional actors aware of alternative institutionalized interests, norms or beliefs, innovating actors can shift preferences (and relevance) among institutional actors towards more favorable interests, norms and beliefs that better legitimate the radical innovation. As such, they can make institutional actors more aware of the tradeoffs between alternative institutional interests, norms and beliefs and stimulate tolerance for their radical innovation ideas.

As can be seen in each of the toleration instances, the multiplicity of the institutional logic operated in tandem with a relatively low resource impact of the innovative ideas. In each of the cases, the innovative actors reduced their resources requirements to execute the idea, in order to enable the institutional actors to tolerate their innovative activities more easily. Reducing the resource impact made the innovative ideas less intrusive and took the heat off the emerging legitimacy crisis.

Lowered resource demands enabled the institutional actors to tolerate the innovation, because it didn't limit their ability to support other, more legitimate, better fitting, and less radical innovation options. We thus can propose that the multiplicity of institutional interests, norms and beliefs, and a low resource impact of the radical innovation enable innovating actors to stimulate and make use of the implicit tolerance of institutional actors within the institutional system, and consequently pursue a toleration strategy. Table 5-10 gives an overview of the toleration instances and their enabling institutional circumstances.

| Case | Institutional circumstances | Strategic response |
|---|---|---|
| *Treemax –* | *Multiplicity* | *Toleration* |
| LC 4.1 Research on hyperbranched materials – continuing after failure | - the innovation serves longer term business interests<br>*Resource impact*<br>- relatively low resource impact due to external government subsidies | The research project is allowed to continue by the institutional actors (the business unit management) although short term results are negative and do not match established norms for doing research projects. To do so, the innovative actors reduced the resource impact of the innovation project and appealed to longer term business interests. |
| *Treemax –* | *Multiplicity* | *Toleration* |
| LC 4.4 Cutting back the Treemax venture | - the innovation strengthens the corporate image of 'being an innovative company'<br>*Resource impact*<br>- relatively low resource impact due to major budget cut backs in the venture | The strategic relevance and fit of the venture with PhemCo remain weak. However, the Treemax team cut back the resource requirements considerably and appealed to the strategic goals of becoming an innovative company. The institutional actors (Board of Directors and top management of the Innovation Centre) allowed the venture to continue. |
| *Reflactone –* | *Multiplicity* | *Toleration* |
| LC 5.3 Selling glass… that is something weird | - the innovation strengthens the corporate image of 'being an innovative company'<br>- the innovation can become strategic in the future<br>*Resource impact*<br>- relatively low resource impact due to simple pilot plant<br>- potentially high rewards | Although the radical innovation idea remained 'strange' with respect to established views of organizational identity, and had little synergy and fit with established businesses, the Reflactone team appealed to the strategic goals of becoming an innovative company. The institutional actors in the company decided to allow the innovation to continue. |

**Table 5-10 Institutional circumstances and toleration strategies.**

## 5.4 Transformation

In this section we focus on distinctive characteristics of the institutional context that enabled innovative actors to pursue a transformation strategy, in order to overcome the legitimacy crises of their radical innovation ideas. Based on the case data, we propose that the ambiguity of the institutional logic and the expert outsider position of innovating actors are distinctive enablers for transformation response. In the previous chapter, we have identified six instances of a transformation strategy in three different radical innovation cases. We will analyze two highly revealing instances of the transformation strategy in more detail, namely LC 1.2, 'Developing a competency in molecular biology and biochemistry' in the DaXo case at AlphaSys; and LC 4.5, 'Strategic fit or no strategic fit' in the Treemax case at PhemCo. The other transformation strategy instances will summarized in the final part of this section, because these replicate the findings of LC 1.2 and LC 4.5.

### *5.4.1 Case analysis*

*DaXo - LC 1.2 Developing a competency in molecular biology and biochemistry*

To develop the DaXo solution, Omega Research (and AlphaSys) had to develop a competency in molecular biology and biochemistry. This would imply, amongst other things, investing in biological labs, related technologies, hiring experts in molecular biology and educating the existing research personnel. From the case analysis in chapter 4 we learned that the decision to develop a competency in molecular biology was not made easily by the actors involved. The small NBD team of AlphaSys, the CTO office of AlphaSys, and several department heads of Omega Research had long discussions about the pros and cons of developing such a competency. Besides the more practical aspects (potential speed of the build up, in- or outsourcing parts), the main legitimacy crisis during this phase concerned the clash between the idea of building competency in molecular biology and biochemistry and the established view of the organizational identity as an 'electronics company'. According to the actors involved, an 'electronics company' that invests in and develops a competency in 'biology' did not seem to make much sense. In the previous chapter we characterized this clash as a cognitive legitimacy crisis.

The innovating actors lobbied in favor of the DaXo project to demonstrate that building a competency in molecular biology and biochemistry was necessary to stay in the business of molecular medicine and that big benefits could be made. As such they stimulated new interests at upper management levels. They also positioned DaXo in an important trend in the medical field, noting that competitors similar to OmegaCom (hardware oriented companies) are also investing in this competency. They presented it as a paradigm shift in the industry, in which biotech and medical electronics technologies (bioware and hardware)

were merged. As such, they popularized a new cognitive frame that linked novel bio-molecular competencies with the established view of the organizational identity of an electronics and medical systems hardware company. In the previous chapter we characterized this as a transformation strategy to overcome the legitimacy crisis around developing competencies in molecular biology and biochemistry.

*The ambiguity of institutionalized interests, norms and beliefs*

If we take a closer look at the institutional circumstances that enable the innovating actors to overcome the legitimacy crisis of their radical innovation ideas, the ambiguity (and purposeful ambiguation) of established institutionalized interests, norms and beliefs seems to offer an important starting point for transformation strategies. The quotes of innovating actors show how they introduce (and reframe) paradigm shifts and industry changes into the discourse, to challenge and ambiguate the traditional notions of organizational identity and existing beliefs about what an electronics company is and does. Dr. Newman from the NBD team of AlphaSys states that "a paradigm shift" is taking place in the industry in which electronics companies deliberately acquire competencies in molecular biology. He refers to competitors of AlphaSys that do just this:

> '... It is simple. If you would like to stay in the medical business, then you have to. This is a trend... this is a change ... there is a paradigm shift. You saw it as well at our competitors, like for example GE, they acquired Amersion...'

> '...Look at all those kind of exhibitions, such as the medical conferences. What the people are talking about and what is going on in research... And it is really a conscious decision at the management level, do you like to be in that business: yes or no, as there are certain trends...'

Dr. Abbot, one of the senior scientists at Omega Research, also made explicit references to the changes in the industry environment and the actions of competitors:

> '... we see some kind of merging between biotech companies and hardware, medical systems companies. Companies such as AlphaSys. But also our competitors; GE bought Amersion. Samsung is doing things in diagnostics. We are absolutely not the only one...

As can be seen, these innovating actors explicitly question the commonly held perception that an 'electronics and hardware' company should only do things based on 'electronics' competencies. By questioning the dominant logic, they ambiguate the established view of the organizational identity and the traditional role of the company within its industry environment by framing changes in the environment as 'paradigm shifts and large trends'. The resulting ambiguity of the

traditional view of organizational identity enabled a transformation strategy to introduce a new view of the role that AlphaSys and OmegaCom can play in the field of merging bio- and hardware technologies. This new view of organizational identity sees the integration of bio- and electronics hardware competencies as a strategically important capability for the future. The ambiguity of established beliefs and views enabled a transformation of the institutionalized view of organizational identity, which consequently better legitimizes the radical ideas of developing competencies in molecular biology and biochemistry.

As such, we conclude that the ambiguity of the institutional logic and structure offers innovating actors opportunities for transformation. The ambiguity of institutionalized interests[14], norms and beliefs thus refers to a situation where different interpretations of particular institutional interests, norms and beliefs co-exist and conflict; or when the meaning of institutional interests, norms and beliefs is still vague, implicit or inconsistent. The vagueness, inconsistency and multi-interpretability of concepts and terms denoting established interests, norms and beliefs offers opportunities for innovative actors to shape, stimulate and change the established institutional structures and logics in order to better legitimize radical innovation ideas.

*Expert outsiders*

If we take a further look at the institutional circumstances that enabled the innovating actors to initiate a transformation strategy, we observe distinctive characteristics of the institutional position of some of the innovating actors that seem to have helped them in their actions. In this particular instance, the 'expert status' and 'relative outsider position' of innovating actors seems to have helped them in both the ambiguation of established views of organizational identity and the initiation of the transformation strategy. In the interviews and quotes from this case, reference is made to the involvement of (external) experts and internal innovating actors with an expert status, to support the ideas of industry change and paradigm shift. Moreover, some of the internal experts involved still had a relative 'outsider' status, which means that they only have worked for a couple of years for AlphaSys or Omega Research, and before that worked extensively in other environments. Consequently, they are still able to critically reflect on established institutional logics and structures and are more aware of alternative views and perspectives. Dr. Abbot, one of the senior scientists in favor of the radical innovation explicitly said:

> '...Well, we did lobby a lot, at least the people from Newman's [NBD] team and also people from Research. It really is an area we should not miss, and that is about the whole area of molecular medicine. So much is happening, with very large margins, and it is closer to OmegaCom technology than

[14] The ambiguity of institutionalized *interests* resembles the concept of 'goal ambiguity' as defined by March and Olsen (1979). Goal ambiguity refers to the situation in which organizational preferences and goals are ill-defined and potentially conflicting with each other.

> most people think. Of course you have to demonstrate that that is really true. So we brought in people from the field, external experts with their stories. Of course, the usual reports and market analysis... '

> '... And we give a lot of presentations about the role OmegaCom can play in this field... [Burton] has also done a lot of those things. He is from outside OmegaCom and has a history [in bio-molecular technology], and he sees those opportunities also...'

The reference to Burton as an important supporter and champion of these new developments and technologies is significant. Burton is department head of the bio-molecular engineering group at Omega Research, but he is also a professor in molecular engineering at a prestigious university with extensive experience in this field of work and a large network of contacts outside of OmegaCom. He only has worked for OmegaCom for a couple of years. The quotes suggest that his expert status and the fact that he also worked extensively outside of the established company have helped to initiate the transformation strategy and convince upper management of the changing roles and identities of electronics companies in the medical systems industry. His relative outsider position makes him more aware of external developments and alternative institutional logics. And his expert status enables him to convince upper management of these alternatives more easily.

Besides Burton's specific institutional position, Newman's NBD group at AlphaSys also enjoyed an extraordinary position, a *'status aparte'* within the AlphaSys organization, Newman's NBD group was a remainder from the large acquisition of Virotin Healthcare Solutions in 2001 and formed a small, relatively independent business unit explicitly tasked to develop new ideas and technologies in the point of care diagnostics market. Before Virotin was acquired by AlphaSys they already developed extensive expertise in this particular market, which was new to AlphaSys. As such, the Newman group can be characterized as a relative outsider to the AlphaSys organization, which made them more critically aware of alternative institutional models and changes in the companies' environment. By virtue of past experience, they were considered experts on point of care (molecular diagnostics) systems. The quotes and interview data suggest that these characteristics of their institutional position helped them to ambiguate traditional views of identity and capabilities to initiate the transformation strategy. Some of the other quotes by Dr. Abbot support this idea:

> '... Those guys [the NBD team] come from Virotin. They have been acquired by AlphaSys some years ago. They had a business around point of care diagnostics... although it wasn't very successful then, they knew that you could improve added value in a big way... And they know this market very well...'

> '... and it helped a great deal that we had the support of this business unit [Newman's NBD team], even though it is a small one, especially then... But

> they were chosen to develop something completely new... they were told to find a new growth market and link it to the things we are good at...'

Based on the case data and the quotes of the interviewees, we argue that the relative 'expert outsider' status of some of the actors favoring the radical innovation ideas helps to initiate the transformation strategy to overcome the legitimacy crisis. The underlying rationale is that institutional actors will assess pleas and argumentations (about which they themselves are less knowledgeable) to be more legitimate and reliable, when the messenger has a higher expert status and extensive experience on the subject matter. Moreover, because they are less embedded in the established institutional logic, relative outsiders are more aware of alternative institutional logics and perspectives, due to their experiences outside of the established company. Thus, both awareness and status enable them to ambiguate commonly held perceptions and institutional models.

In this instance of a transformation strategy in the DaXo case at AlphaSys, both the prior ambiguity and purposeful ambiguation of elements of the institutional structure and logic, along with the expert outsider status of the innovating actors, enabled them to pursue a transformation strategy. In the next instance of a transformation strategy in the Treemax case at PhemCo, we will observe how the ambiguity of institutionalized interests, norms and beliefs played an important enabling role.

*Treemax - Case LC 4.5 Strategic fit, or no strategic fit*

In 2006 the Treemax venture team wanted to know if they would get full support from the Board of Directors of PhemCo and upper management of the Innovation Center to continue with Treemax in the oil field chemicals and paper chemicals markets. The Board of Directors, however, had designated specific future end-markets for the innovation efforts of PhemCo and the Treemax markets 'oil field chemicals' and 'paper chemicals' were not included. Continuing with these two non-strategic markets was thus not aligned with PhemCo interests and future growth goals set by the Board of Directors. As such, this lack of alignment with established interests was characterized as the pragmatic aspect of the legitimacy crisis in the previous chapter. Moreover, the Board of Directors and the Treemax venture team were using different kinds of reasoning regarding innovation and new business development. The Treemax team reasoned from the perspective 'technology push' and 'strategic fit with technological competencies,' believing that this was a viable way to develop future new business for PhemCo. The Board of Directors instead reasoned from end-markets view of market driven innovation to develop future new businesses for PhemCo. Thus the Board deemed the line of reasoning by the Treemax team as illegitimate. This part of the crisis has been characterized as a cognitive legitimacy crisis in chapter four, because different thinking models and concepts are used to evaluate and to justify the Treemax innovation.

Besides the partial conformation to some of the concerns of the Board of Directors (focusing more on application areas and markets closer to the established businesses of PhemCo), members of the Treemax venture team also tried to influence upper management of the Innovation Center and the Board of Directors to gain support for the broader business area of functional polymers (of which Treemax is an application)., PhemCo's strategic plans had expressed a goal of becoming a specialty chemical company, instead of a bulk chemical company. A specialty chemical company would be focused more on innovative and tailored products with higher profit margins than a bulk chemical company. However, although these ambitions had been expressed, the Board of Directors remained rather vague what 'becoming a specialty chemical company' actually meant to PhemCo and what steps should be taken to achieve this. Members of the Treemax venture team seized the opportunity of this apparent vagueness to demonstrate that the Treemax business was an excellent example of a specialty chemicals business. The Treemax venture team aimed to demonstrate what this specialty chemical vision would look like in terms of novel business models and related revenue streams, using Treemax and the specialty polymer companies that operate in the functional polymer industry as prime examples. As such, the Treemax team aimed to embed new ways of thinking and new interests in the established institutional logic of PhemCo that would better legitimize their radical innovation ideas. In chapter four we characterized this response as a transformation strategy.

*The ambiguity of institutionalized interests, norms, and beliefs*

If we take a closer look at the institutional circumstances that enabled innovative actors to initiate the transformation strategy, some of the quotes of Treemax business developer Sheridan shed light on the important role of ambiguity in this particular case:

> "... So you can't escape the question how to proceed in the future? What is its raison d'ètre, why should we do it? The business model is, we have a product-technology platform and we should bring it to the market. And then we see clear examples in the industry that do just that, and those are the specialty polymer companies. And we have as an ambition to realize that for PhemCo in the next five or ten years. We see the Treemax technology as a valuable component in this process... And PhemCo has stated in its 2005 and 2010 strategy that we want to be a specialty company. Well, what does that mean? And we are currently shaping and filling this in... because these are not precise directives from the top, no, these are just broad guidelines in the end..."

> "... look, all those specialty polymer companies are the size of 500 million dollar to 1 billion dollar... and they usually have five to seven focus areas in the market and they have three to four product-technology platforms. And these focus areas and platforms are connected in all kinds of ways to each other... And these companies can exist based on their knowledge and know-

> how of the market needs. And to do so they have very large technical service groups... And I would say we have such a technology platform, namely Treemax... and slowly people start to realize that a specialty business consists of connecting and combining smaller clusters of revenues of product/market combinations in a very smart way... instead of what we are used to do in the coal and mining business, or petrochemical business, or the nylon business.

These quotes illustrate the concept of 'PhemCo as a specialty chemical company', although an idea generally supported by dominant groups in the organization and tied to the strategic plans and goals of PhemCo, is still rather vague and implicit. The 'open-endedness' and ambiguity of the concept of a 'specialty chemicals company' offered the Treemax venture team the opportunity to link their way of thinking about Treemax and the related business of 'functional polymers' to the future of PhemCo as a 'specialty chemical company'. Treemax and the functional polymer industry are used as 'exemplary templates' of what a 'specialty chemical company' is, and thus aim to redefine and make sense of the characteristics of a 'specialty chemical company' in terms of Treemax and the functional polymers business. So, the ambiguity of the concept offers innovating actors an opening to transform (i.e. redefine and make fresh sense of) an already partially institutionalized idea, linking it to the radical innovation. In the end, this novel and reconfigured conception of what a 'specialty chemicals company' is and does would augment the legitimacy of the Treemax venture in a major way. This analysis supports our proposition that the apparent ambiguity of institutionalized interest, norms and beliefs can be used by innovating actors to initiate a transformation strategy to deal and overcome legitimacy crises of their radical innovation ideas.

*Expert outsiders*

In the former instance of a transformation strategy in the DaXo case at AlphaSys we observed that several characteristics of the institutional position of the innovating actors helped them to make use of the emerging ambiguity of institutional structures and logics to initiate a transformation strategy. In the Treemax transformation, the expert status of innovating actors does not seem to play an important enabling role. Their outsider status however, has helped the Treemax team to be more receptive to alternative interpretations and models of what 'specialty chemicals companies' are and do. The innovating actors favoring Treemax are part of a relatively independent venture business unit (the Treemax venture, which is supported by the PhemCo Innovation Centre) loosely coupled to the rest of the PhemCo organization. They are active in a novel field of business (novel to PhemCo) and are able to critically reflect on widely shared ideas about organizational identity and established strategic roles of PhemCo. Because they are active in this novel field and are aware of typical 'specialty chemicals companies' operating in this field, they can make the translation to the PhemCo situation. Their relative outsider position consequently enables them to perceive alternative

institutional models and initiate a transformation strategy which translates these experiences and ideas to the PhemCo situation. Here again, we see the relevance of an outsider status position of innovating actors for the initiation of transformation strategies.

In the next section we will summarize the findings for each of the other transformation instances with respect to the ambiguity of institutionalized interests, norms and beliefs, and the expert outsider position of innovative actors. We will also present some final rationales for the relevance of these characteristics of the institutional context for transformation.

### *5.4.4 Integrating results*

Based on the case analysis of the micro-institutional circumstances that offered the opportunities for innovating actors to initiate transformation strategies, we identified the *ambiguity* of established and institutionalized interests, norms or beliefs and organizational identity, and the *expert outsider* status of innovative actors of primary importance. In Table 5-11 we summarize the findings for each of these institutional characteristics for all instances of transformation strategies in the cases.

*Ambiguity and transformation*

Based on the case analysis (see Table 5-11) we can see that in all instances of a transformation strategy, the ambiguity of institutionalized interests, norms and beliefs could be used by innovating actors to initiate transformation. The underlying rationale for the relationship between ambiguity and transformation can be best understood if we take a closer look at how a transformation strategy is defined. As stated in chapter 2, a transformation strategy entails the development, introduction and propagation of novel interests, needs, norms and rules, or novel labels, concepts and models in the institutional and established order, such as organizational identity. In its essence, a transformation strategy aims to shape new institutional structures and logics that increase the legitimacy of the radical innovation idea.

Instead of adapting the radical innovation idea to fit within existing institutional structures and logic, a transformation strategy aims to change the institutional logic (and resulting 'criteria') by which the legitimacy of the radical innovation idea is assessed. When elements of the established and institutional order are ambiguous, innovating actors can seize opportunities to make new connections and introduce novel interests, norms, beliefs more easily, thus initiating a transformation strategy. Vaguely or inconsistently defined concepts can more easily be used by actors to be twisted, stretched, redefined and coupled with new meanings that in the end further legitimize the radical innovation. Partly ambiguous institutional structures and logics enable innovating actors to pull loose the threads of the institutional fabric more easily and reweave them with

novel interests, ideals, norms and understandings. In the opposite case of highly unambiguous, consistent, and explicit institutional structures and logics, radical differences stand out, it is more difficult to find any 'loose threads,' so the opportunities to introduce and connect novel interests, norms and beliefs are much more limited. In this sense, the apparent ambiguity of institutional structures and logics offer innovating actors good starting points for transformation strategies.

**Table 5-11 Institutional circumstances and transformation strategies.**

| Case | Institutional circumstances | Strategic response |
|---|---|---|
| *DaXo –* | *Ambiguity* | *Transformation* |
| LC 1.1 Biology is a new way of working | Application of the established procedures and norms on the 'biologists way of working' did not lead to satisfying results, which challenged and ambiguated the applicability of the established procedures and norms.<br><br>*Expert outsiders*<br>- | Adapting established way of working to incorporate novel 'biologists' way of working and giving the biologists more room for experimentation. |
| *DaXo –* | *Ambiguity* | *Transformation* |
| LC 1.2 Developing a competency in molecular biology and biochemistry | Paradigm and industry changes challenge and fuel the ambiguation of the consistency and fitness of established views of organizational identity.<br><br>*Expert outsiders*<br><br>Expert outsiders (Prof. Burton and the Newman NBD team) stimulate and initiate the ambiguation and transformation process. | Popularizing a new industry model and new role that the company can play in the changing industry of merging bio- and hardware technologies, which better legitimates the new competency. |

| *DaXo –* | *Ambiguity* | *Transformation* |
|---|---|---|
| LC 1.3 We don't want to get wet | Presenting facts that ambiguate the established view of organizational identity: 'we are not only a hardware company, but we have also worked for years with fluids in other technologies'.<br><br>*Expert outsiders*<br><br>Expert outsiders (Prof. Burton and the Newman NBD team) stimulate and initiate the ambiguation and transformation process. | Demonstrating the relatedness and familiarity of novel competency with the company and reframing organizational identity accordingly.<br><br>Stimulating novel interests by demonstrating the benefits of the integration of the new competency with the established competencies. |

| *DaXo –* | *Ambiguity* | *Transformation* |
|---|---|---|
| LC 1.4 What is the link with traditional imaging? | The novel and still relatively ambiguous concept of the 'total care cycle' business/product portfolio is used to initiate transformation.<br><br>*Expert outsiders*<br>- | Popularizing and establishing a new model of the AlphaSys business and product portfolio, which incorporates and positions the DaXo innovation in a more legitimate way. |

| *Zapim –* | *Ambiguity* | *Transformation* |
|---|---|---|
| LC 2.1 Distinguishing Zapim from established technologies | Confusion about the categorization of the Zapim innovation as being a variant of the established 'MR-technology' is used to initiate transformation.<br><br>*Expert outsiders*<br>- | Innovating actors invent and popularize a new label ('imaging tracer') for particular components of the technology to make a clear distinction between the 'old' and 'new' technology. |

| *Treemax –* | *Ambiguity* | *Transformation* |
|---|---|---|
| LC 4.5 Strategic fit or no strategic fit | The still ambiguous but generally supported future vision for PhemCo as a 'specialty chemical company' offers opportunities for transformation.<br><br>*Expert outsiders*<br><br>The Treemax venture team is loosely coupled to the rest of the PhemCo organization. They can operate relatively independent in a 'specialty chemicals' business that is novel to the rests of PhemCo. | Innovating actors popularize new ways of thinking about the future vision of the company. They demonstrate that the Treemax venture is a prime example of what the company could be in the future, in terms of business models and competencies. As such they stimulate new ways of thinking and new interests. |

**Table 5-11 Institutional circumstances and transformation strategies.**

The ambiguity of institutionalized interests, norms and beliefs might already have emerged within the company among its members, but it can also be actively influenced by innovating actors when there are reasons to do so. As we can see in the DaXo and Treemax cases (LC 1.2, 1.3, 1.4; and LC 4.5), where larger scale transformation strategies took place, the ambiguity of established organizational roles and views of organizational identity was increased by changes in the industry and environment of the company. In the case of Treemax, the ambiguity about the future vision and identity of the company was already experienced by the members of the organization, and could be used by innovating actors to shape new ideas and connect new concepts. In the case of Daxo (e.g. LC 1.2 and 1.3) the ambiguity of traditional views of organizational identity was deliberately increased by the innovating actors by framing large changes in the environment as directly relevant. The different cases show that already apparent ambiguity within the institutional system can be used by innovating actors to initiate transformation, but that innovating actors can also increase the amount of ambiguity when there are good reasons to do so (e.g., in the case of large changes in the environment of the company).

*Expert outsiders and transformation*

As we can see in Table 5-11, for three of the six instances of a transformation strategy we could identify that the 'expert outsider' status of the innovating actors played an important role in the pursuit of a transformation strategy. Before we elaborate on this difference between the instances with respect to the expert

outsider position, we shortly outline the underlying rationale for the relationship between this characteristic of the institutional position of innovating actors and their choice for a transformation strategy. As argued during the analysis of LC 1.2 in the DaXo case in the previous section, we state that institutional actors will evaluate and judge novel ideas and arguments (about which they themselves are less knowledgeable) as more legitimate and reliable, when the messenger has a higher expert status and extensive (especially external) experience on the subject matter. The personal credibility and prestige of the messenger reflects on the message and will improve the perceived reliability in the eyes of the receiver. This is especially important in the case of difficult messages about which the receiver is less knowledgeable (see also e.g. Zott & Huy, 2007). A transformation strategy that involves the propagation of novel interests, norms and beliefs within established institutional structures and logics is thus benefited if the messenger (i.e., the innovating actor) has an expert and relative outsider status. Their outsider position helps the innovating actors to be more aware of alternative institutional models and environmental changes, and consequently, enables them to be more critically reflective on commonly held perceptions and ideas, that is, institutions. Furthermore, their exposure to alternative institutional models offers them the conceptual resources to introduce and translate these alternatives to the established institutional organization.

As already mentioned, we could not identify the relevance of the expert and outsider status in all transformation instances. We can explain this difference by looking at the *scale* of the transformation strategy that was initiated by innovating actors and the *pre-existence* of institutional ambiguity. In the case of LC 1.2 and 1.3 (DaXo), the transformation strategy involved a large scale adaptation and change of the strategic role and position of the company in a changing environment, while in the case of LC 1.1, and 2.2 the transformation concerned only relatively local adaptations of working procedures (in LC 1.1.) and the introduction of a novel label for the technology (in LC 2.2.). These latter transformation instances involve less drastic adaptations of the local institutional structures and logics. Based on the case data, it seems that for these more minor transformation strategies, the expert outsider status is not necessary to initiate the strategy (although it still could help).

If we compare transformation strategies of similar scale, the difference can be explained by the pre-existence of ambiguous institutional structures and logics. In the instances of LC 1.2 and 1.3 (Daxo) the ambiguity of institutional interests, norms and beliefs was deliberately created by innovating experts with expert outsider status. If innovating actors want to be taken seriously in their attempts to create ambiguity and institutional shocks (which are difficult messages), it thus helps to have an expert outsider status[15]. In the case of LC 1.4 and LC 4.5 we see instead that ambiguous ideas and concepts already reside within the organization and float around in the discussions between organizational members. Hence, in

[15] This offers external validation of the ideas, by proxy: the outsider status corroborates what insiders might say.

those latter instances it is not really necessary for the innovating actors to create ambiguity themselves, but instead they have to appropriate existing ambiguity to their advantage. In that case, having an *expert* position might indeed help to do so, but seems not to be necessary. However, if we focus only on the outsiders position of innovating actors, for instance, of LC 4.5 the Treemax case does show that in those cases as well, outsider position is a relevant factor, because it has helped the innovating actors to identify alternative institutional models and logics that formed the fuel for the transformation strategy.

Concluding, we propose that the expert outsiders status of innovating actors helps them to influence the ambiguity of institutional interests, norms and beliefs, and thus to initiate larger scale transformation strategies. When transformation strategies involve smaller scale and local adaptations of the institutional structures and logics, or when the ambiguity of the institutional system already exists, expert outsider status of the innovating actors plays a less distinctive role.

In the next section we will more closely look at the institutional circumstances that enabled innovating actors to choose a selection strategy to overcome legitimacy crises of their radical innovation ideas.

## 5.5 Selection

In this section we focus on characteristics of the institutional context that have been used by innovating actors to pursue a selection strategy for dealing with legitimacy crises. Based on the case data we will propose that selection strategies are pursued when the institutional context is heterogeneous and when innovating actors have a boundary spanning position within the institutional system. In the next section we analyze a revealing example of a selection strategy (i.e. LC 5.1 'Strategic problems threaten Reflactone' of the Reflactone case) and show how the innovating actors actively used the heterogeneity of their institutional context to initiate selection and were enabled by their boundary spanning position. After that we will summarize the findings for the other two instances of selection (because these offer no new explanations and replicate the findings of LC 5.1) and develop the explanation for the relationship between heterogeneity, boundary spanning and selection.

### *5.5.1 Case analysis*

*Reflactone – LC 5.1 Strategic problems threaten Reflactone*

Initially, the SBU Unotech had sponsored the research project on Reflactone and had identified interesting growth opportunities for it. However, at the end of 2002, Unotech ran into financial and strategic problems due to an economic downturn in their primary business. As a consequence, the Unotech management decided to cut the costs of all (innovation) activities that did not directly contribute to their immediate survival. The research project on Reflactone was one of the first

candidates to be cancelled because it aimed at longer term growth goals and did not help Unotech to safeguard its position in their established businesses. As such it did not match the newly established interests and urgencies of the business unit, and we consequently categorized this problem as a pragmatic legitimacy crisis in the previous chapter.

The director of the Shared Research Unit, Prof. Maddox, actively searched for new sponsors of the Reflactone project within PhemCo. He looked for people who would understand what the Reflactone team was doing and who had access to funding. His search ended when he found the director of the Venturing and Business Development Group of PhemCo, Mr. Steinbach. According to Steinbach, the Reflactone project was very promising and could contribute to the future vision of PhemCo as a specialty chemicals company. However, he didn't want to fund a project that only focused on antireflective coatings for display applications, as defined by the Unotech business unit. The director of the Shared Research Unit, however, explained that their invention was broader than only antireflective coatings; they could develop all kinds of functional coating systems with different properties, with many potential application areas of which some closely related to existing PhemCo businesses. This broader focus of the Reflactone invention matched very well with the ambitions of Steinbach and the V&BD group to build the future PhemCo. We characterized this search process within PhemCo for new sponsors and supporters as a selection strategy in the previous chapter.

*Boundary spanners*

If we take a closer look at characteristics of the institutional position of the innovating actors and champions of this radical innovation within PhemCo, we can identify a distinctive aspect that enabled the innovators to pursue a selection strategy. Based on the data, the position of Prof. Maddox, director of the Shared Research Unit appears to be important. Steinbach said about him:

> "... it has been a quest for supporters and funds by Maddox and the people that believed in this technology. They wanted to find someone who understands what they are doing and who has access to funds. And that's how they found me. And I must say, I can get along very well with Maddox. We agree on a lot of things... And he is a great guy, a real gentleman, who really has a vision and is determined..."

The institutional and network position of Maddox is important in this case. As director of the Shared Research Unit (SRU), he is responsible for most research activities within PhemCo (both contract research for the different business units, as for most explorative research projects). Because of this role, he has access to multiple (social) networks within the organization. He has working relationships with the research groups within the SRU, the development groups at the product divisions and business units, the management teams of the business units, and with the staff department of corporate planning and the PhemCo Innovation

Centre. As such, his position spans multiple network and business unit boundaries. This *boundary spanning* position enables him to get quick access to *diverse* and *multiple* potential supporters and sponsors within the organization who might be interested in the radical innovation. This boundary spanning position is characterized by a central position in-between different (more coherent) social networks within the established organization[16]. This boundary spanning position of one of the innovating actors (moreover, their champion) has helped them to get access to diverse networks within the established organization in their search for a new sponsor. In the summary at the end of this section we will show that in the other instances of a selection strategy the boundary spanning positions of some of the innovating actors were also important.

*Heterogeneity*

Besides the fact that a boundary spanning position helps to get more easily access to diverse social networks and groups within the organization, the mere existence of diverse groups and networks within the organization is of importance for selection strategies. In the Reflactone case at PhemCo we can see that PhemCo has multiple business units working in very different industries, which are based on very different technology platforms, and have their own experiences and identities (e.g., the Unotech, Coatings and Resins, and Performance Materials SBUs, the SRU, etcetera). PhemCo even has a specific business unit (the V&BD group) to support novel business and technology initiatives. This multitude of (sub-)organizational groups within PhemCo, with differentiated and (partly idiosyncratic) sets of institutionalized interests, norms and beliefs, offered Maddox and the other people favoring the innovation many more opportunities to find alternative sponsors; at least much more than in a very 'homogeneous' organization with highly similar institutional sub-groups. We call an institutional context (or institutional system) *heterogeneous* when the innovating actors within the organization face a multitude of established and institutionalized groups (e.g. business units, departments, sub-units) that reproduce their own partly idiosyncratic set of institutionalized structures and logics. (Of course, they also share in the larger institutional logic and structure with the other institutional groups). Based on the case data (and the other instances of selection, as will be shown in the summary), we state that such a heterogeneous institutional system offers more opportunities for innovating actors to find alternative supporters and sponsors for their radical innovation ideas. Both the boundary position of the innovating actors and the heterogeneity of the institutional system enable innovating actors to initiate successful selection strategies.

Making use of any apparent heterogeneity of the institutional system to find and select alternative supporters and sponsors, is of course enabled by the boundary spanning position of innovating actors; boundary spanners are exposed to and

[16] This resembles precisely Burt's argument in the "Structural Holes" logic (1992).

more aware of the multitude of institutionalized sub-groups. But, it sometimes also requires actions of the innovating actors to frame and adapt the radical innovation ideas in such a way that a match with alternative and more diverse institutional sub-groups is possible. Steinbach mentioned this type of action explicitly during one of the interviews:

> "... There was some kind of dream that if we as specialty company of the future could put very thin layers on all kinds of materials so that you could still see through the material, and that we could also add unique properties to it... then we are doing the right thing for the new PhemCo... And then I said I want to fund this research from the Venturing and Business Development group, because I really think this is an opportunity... and I see this much broader than only antireflection..."

> "... [the ideas to broaden the scope] existed already... also Maddox had thought extensively about it. But you know that when you work in a large company, you should not come up with too fuzzy concepts, because these usually don't stand a chance. But you have to keep them at hand, so that you can play that card at the right moment..."

As the quotes show, broadening the scope of the ideas for Reflactone into a kind of technology platform with many application areas, matched the interests of the V&BD unit very well. If the scope of the radical innovation ideas had remained very narrow, specific and focused on a single application (with few options to extend and build upon the technology), it would clearly be much harder to appeal to the diversity of interests of the different institutional sub-groups (the heterogeneous institutional system). So, in order to be able to appeal in an easier way to diverse institutional sub-groups and find an alternative supporter among this multitude, it helps to broaden the scope and potential impact of the innovation (of course, this requires that this is indeed possible for the innovation/invention from a physical and technological perspective). Consequently, innovating actors who want to make use of the apparent heterogeneity of their institutional context, will be more successful when the scope and impact of their radical innovation ideas is relatively broad, or can be reframed and translated in a broader way, with more degrees of freedom. This demonstrates that although the heterogeneity of the institutional system and boundary spanning position of innovating actors are relevant and more 'objective' factors that enable the pursuit of selection strategies, the 'framing' of the scope of the innovation (which is an act of agency) also determines whether innovating actors are able to make use of this apparent heterogeneity.

In the next section, the findings for the other instances of selection are summarized and the underlying rationale for the relationships between heterogeneity, boundary spanning positions and selection strategies is explained.

### *5.5.2 Integrating results*

The analysis of the three instances of selection strategies (see Table 5-12), demonstrates that the *heterogeneity* of the institutional context and the boundary spanning position are important 'resources' for innovating actors to initiate selection strategies. The heterogeneity of the institutional context is defined as the existence of multiple institutional constituents within the organization that reproduce differentiated sets of institutionalized and established interests, norms and beliefs (and control a certain amount of resources). The institutional heterogeneity stems partly from higher degrees of (functional) specialization and (task) differentiation within organizations and loose coupling between the organizational groups, and the growth of complexity of most large firms today[17]. As observed in the cases, a selection strategy entails the search for alternative institutionalized groups within the organization that are willing to support the radical innovation idea because the innovation is more legitimate to them than for the institutional group initially aimed for. It seems logical, that to be able to pursue a selection strategy, it is necessary that there indeed exists a multitude of established institutional groups that have partly differentiated sets of institutionalized interests, norms and beliefs.

The Reflactone case (LC 5.1 ' Strategic problems threaten Reflactone') demonstrates that innovating actors are able to appeal more easily to diverse alternative institutional groups when the aim and scope of the radical innovation ideas are still relatively broad (and the options for applications and products are still open and numerous); or when they can be *reframed* in such *a broader way*. When technological and application options are still open and relatively broad it is more easier to appeal to alternative institutional groups, because it is still possible to frame all kinds of new links and connections between the radical innovation ideas and the diversity of institutional interests, norms and beliefs of the institutional groups within the organization. When radical innovation ideas are already highly specific and targeted, the degrees of freedom in choosing and matching with alternative institutional sponsors and supporters is considerably limited, which limits the potential to exploit heterogeneity.

As can be seen in all of the cases, innovating actors who have a *boundary spanning position* are more aware of (the opportunities offered by) the multitude of institutional groups with partly differentiated sets of institutional logics within the organization, and have a better access to these multiple groups. The boundary spanning position of innovating actors is characterized by a central position in-between different (more coherent) social networks within the established organization (due to either their formal role or informal relationships, or both). This boundary spanning position enables innovating actors to get more easily access to diverse networks within the established organization, which facilitates the search for alternative sponsors and supporters.

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[17] Multi-national organizations, with multiple product divisions, acquisitions, and, increasingly, strategic alliances all add potential heterogeneity.

| Case | Institutional circumstances | Strategic response |
|---|---|---|
| *Zapim* - LC 2.4 Too risky to invest | *Heterogeneity*<br><br>Multiple product / business units within product division<br>CTO Office at product division<br>Multiple technology incubators<br>Research department<br>Multiple research groups<br><br>*Boundary spanner*<br><br>The director of the research program RPIS (Mr. Boisson) at the research department has many working relations with the different business units, CTO Office, but also most research groups, and the different management committees at the research department. | *Selection*<br><br>After a search process an alternative source of funding is negotiated with the Research department itself. The idea for the technology (development) satisfied the funding criteria ('lab venture') and interests of the Research department. |
| *Icon* - LC 3.2 Developing an Icon Pavilion for CT | *Heterogeneity*<br><br>Multiple sales organizations<br>Multiple product / business units within product division<br>Cross business unit networks<br>CTO Office at product division<br>Multiple staff departments at corporate level<br>Cross product division networks<br><br>*Boundary spanner*<br><br>One of the North American sales managers (Ms. West) was also part of a 'cross product division' network and had good working relations with members of the other product divisions, the sales organizations, and staff units. | *Selection*<br><br>After a search process an alternative supporter (corporate marketing executive/CMO) agrees to sponsor the initiative, because he had better matching interests/needs and a shared view of the future of the company. |

| | | |
|---|---|---|
| *Reflactone - LC 5.1 Strategic problems threaten Reflactone* | *Heterogeneity*<br><br>Multiple business units<br>Multiple product divisions<br>V&BD business unit<br>Shared Research Unit<br><br>*Boundary spanner*<br><br>Prof. Maddox, director of the Shared Research Unit has many working relations with the different business units, divisions, V&BD and the research groups. | *Selection*<br><br>Search for alternative internal sponsors. After reframing and broadening the innovative ideas in scope and aim (i.e. technology platform with many different application areas), the ideas matched well with the interests of the Venture and Business Development unit, who agreed to sponsor the project in the future. |

**Table 5-12 Institutional circumstances and selection strategies.**

## 5.6 Conformation

In this section instances of conformation strategy are analyzed in more detail, and the institutional circumstances that led the innovating actors to follow a conformation strategy to deal with legitimacy crises in the radical innovation process are identified. Conformation strategy is the final strategic response to be analyzed and is the only strategy that involves significant adaptations of the radical innovation ideas to better match with established and institutionalized structures and logics (or even the withdrawal or postponement of radical innovation ideas). Although in most cases the conformation strategy indeed helps to overcome legitimacy crises, it is a strategy in which the institutional constraints and pressures have the most impact on the nature of the radical innovation ideas and where (partial) conformation to these constraints seems the only way forward. From the perspective and interests of the innovating actors, a conformation strategy is the least favorable response to legitimacy crises, because it usually implies that the innovation ideas are made less 'radical', which could reduce the initial enthusiasm and commitment of the innovating actors for these ideas considerably. The cases show that especially the strength and strictness of the apparent regulatory regime of the institutional context has an important effect on the choice for a conformation strategy by the innovating actors. We will more closely look at the conformation strategy in the Icon case at AlphaSys, LC 3.3, 'Multilevel solutions and business boundaries'. The other conformation instances replicate the findings of LC 3.3 and will be summarized in the last section, and the underlying rationale for the relationship between stringent regulatory regimes and conformation will be elaborated.

### *5.6.1 Case analysis*

*Icon - LC 3.3 Multilevel solutions and business boundaries*

The Omega Designers working on the Icon concept for healthcare had developed all kinds of solutions and ideas that crossed the different spaces and levels within a hospital. Their ideas not only included design improvements to the individual scanning systems like CT and MR, but also included all kinds of design solutions (and technologies) at the room, department and hospital level. In the Icon concept as defined by the designers, patient experiences should be improved throughout the whole healthcare process, using OmegaCom technologies to do so. However, their Icon solutions transgressed the traditional boundaries of the MR and CT systems (e.g., room, waiting room, department, hospital) and were not supported by the business people from the individual business units. The business units are organized and structured based on the different imaging technologies (CT, MR, and so on), and each is responsible for making profit by manufacturing and delivering only those systems. The 'multilevel' ideas for Icon did not match the established organizational structure, distribution of responsibilities or business interests. Besides this, because the business units defined their business scope and product portfolio in terms of the traditional technology, namely MR and CT developing Icon solutions that transgress those boundary definitions, didn't make sense to them: they could not fit Icon into their existing "imaging systems." In the previous chapter this legitimacy crisis was characterized as being both pragmatic and cognitive.

The Omega designers were frustrated by the lack of support for their multilevel ideas of the Icon concept. Although they tried to convince the AlphaSys marketing managers and management team to create a new organizational group within AlphaSys responsible for the higher level Icon solutions, the Design team decided to follow the primary interests and boundary definitions of the established business units in the end. They focused their design efforts on developing Icon options for the MR suite and CT suite, with a limited inclusion of only the direct environment of the imaging scanners. The ideas for Icon solutions transgressing traditional business and system boundaries were no longer actively pursued and remained in the concept stage. These innovating actors adapted their ideas to the established logic and structures in order to overcome their legitimacy crisis and continue with the innovation process. As such, this response of the proponents of the Icon ideas was characterized as a conformation strategy in the previous chapter.

*A stringent regulatory regime*

If we want to understand why the innovating actors in the end chose a conformation strategy to deal with the legitimacy crisis, the following quotes of involved actors shed light on the institutional circumstances innovators faced. Cooper, the Omega design director responsible for the healthcare designs said:

> "... Ultimately, most decision making power lies with the individual business units... And, we are a bit tired of the battle. We had discussions with almost everyone. But at a certain moment in time, you give up. We are only a service unit after all. We cannot act as coordinator for the whole of AlphaSys..."

> "...And every business unit has its own financial bottom line that has to be realized each year. So doing investments in an area that extends the own business unit, is an investment that will not realize sales for them immediately. Which has an impact on their bottom line..."

Kingsley, program leader from Omega Applied Technologies, and also involved in executing the Icon development projects, stated:

> "... In the end, you have a client that acts as an arbitrator ... and those are the AlphaSys SBUs. If you present the bill to them, they will make the final decision. And that's often not in the advantage of Omega Design... Because it involves costs. And in the end, money is the most important, where ever you go..."

As the quotes illustrate, Omega Design is viewed as a service unit, or internal supplier of design services to the various SBUs of AlphaSys, for which the SBUs have to pay. As such, the SBUs are paying customers and thus determine what is being made and for how much money. The relationship between Omega Design and the SBUs is consequently transaction-based and can be characterized as a supplier/customer relationship. Although Omega Design can develop all kinds of innovative ideas and solutions, the SBUs in the end have the final formal say in decisions about the development activities; SBUs are responsible for the necessary funds for development, and for the production and commercialization of the developed solutions. As such, these quotes point to two relevant aspects of the regulatory regime that governs the institutional arrangement between Omega Design and the SBUs at AlphaSys. First, the *formal decision making authority* (or decision making power) over (Icon) development activities resides at the SBUs. In the transactions between SBU and Omega Design, the SBU is generally seen as the *client* who determines what will, and what will not be developed. The SBUs have the formal final say over the proposed development activities. This aspect of the regulatory regime that governs the arrangement between the SBUs and Omega Design is very clear and explicit and widely accepted by both the institutional and innovating actors. Secondly, the SBUs control the resources necessary to fund the Icon development activities. As such, Omega Design depends on the SBUs for resources to pursue their radical innovation ideas. This means that in the end, the SBUs have a strong *influence* on the eventual execution (or not) of innovative plans and ideas of Omega Design, stemming from their *control over necessary resources* (i.e., resource control influence). Underlying is the assumption that control is legitimate when money has changed hands. When resources are transferred under

a *quid pro quo* regime, the investors or sponsors will get a legitimate stake in outcomes of (and acquire say in decisions about) the radical innovation project ("he who pays the piper, calls the tune," as the old saying has it). Consequently, resource control influence does not only stem from future investments and resources needed to continue, but also from investments made and resources transferred in the *past*.

Both the formal procedures and role definitions that place decision making authority at the side of the SBU, and their influence over development activities stemming from their control over necessary resources, are indicators of a *stringent regulatory regime* in the favor of the established SBUs. Under a stringent regulatory regime (as part of the institutional context) innovating actors have relatively few options open when confronted with a legitimacy crisis. In such a case, conformation seems the best way forward, which means that plans and ideas are adapted to better match with established institutional logics and structures. Institutional actors within a stringent regulatory regime are able to exert a strong influence on the actions and goals of innovating actors, which leads them to adopt a conformation strategy. This is not a bad thing by definition; conformation to established logics and institutional actors does enable innovating actors to continue with their innovative ideas, although these ideas might be changed into something less radical than initially wanted. The case data suggests that when confronted with legitimacy crises under stringent regulatory regimes, the best way forward would be to conform to the established interests, norms and beliefs as long as it doesn't compromise the radical innovation too much. A conformation response as such does enable the innovating actors to continue with innovation (albeit perhaps in a less radical fashion) and grants them legitimacy and support from the established institutional groups.

In the next section all findings on the conformation strategies are summarized and the underlying rationale for the relationship between conformation and stringent regulatory regimes is elaborated.

### *5.6.3 Integrating results*

The analysis of the multiple instances of conformation responses to deal with legitimacy crises (see Table 5-13), demonstrates that a stringent regulatory regime, stemming from institutional regulations on formal decision making authority and control over resources, is a distinctive factor for innovating actors to follow a conformation strategy. In some cases, conformation leads to withdrawal or postponement of radical innovation ideas and proposals. Withdrawal or postponement of ideas occurs most often when the regulatory regime is highly stringent and established interest, norms of beliefs are urgent and non-negotiable. Consequently, the radical innovation ideas are hampered by major illegitimacies that are not easy to overcome. When the innovating actors have to adapt their radical innovation ideas in such major ways that they loose their own interest and commitment, these ideas will be postponed to a later stage or even withdrawn

completely. In most cases however, conformation seems to be the best way forward, even though parts and aspects of the innovation ideas are adapted and limited to less radical variants. In those cases, conformation does lead to more legitimate ideas, increased support from institutional actors, and embeddedness within institutional groups.

A stringent regulatory regime exists when the institutional regulations on decision making authority and resource control and ownership favor institutional and embedded actors. Consequently, institutional actors have multiple means to influence and direct the actions and behaviors of innovating actors, and change the radical innovation ideas into more legitimate ones. For innovating actors this means that, under a stringent regulatory regime, incorporating institutionalized interests, norms and beliefs and adapting the radical innovation ideas and plans accordingly, offers the best opportunities to go forward with their ideas and improve the legitimacy of radical innovation. The formal decision making authority of institutional actors is determined and embedded within the established institutional logic and structure of the company. The same applies to the regulations for resource control and ownership. However, the influence of institutional actors on the actions of innovating actors stemming from their control over resources does not only concern *future* investments and necessary resource transfers (*ex ante* influence on the execution of innovation activities), but also concerns the *past* investments in innovation activities (*ex post* influence on the execution of innovation activities). When money (or other resources) have changed hands in the past, this usually implies that the investors/sponsors will also have a continued stake in the direction of innovation activities in the future. As such, past investments and past resource transfers lead to a partial *lock-in* of innovating actors into the institutional logics and structures of the institutional actors/sponsors, which limits their options to maneuver (their degrees of freedom) when changes emerge or are required in the innovation process.

Based on the case analyses we thus propose that under stringent regulatory regimes in favor of the institutional actors, the best way forward to solve and deal with legitimacy crises for innovating actors, is to follow a conformation strategy. In the next section we will extrapolate the findings of the previous sections and develop an integrated theoretical model of how innovating actors make use of their institutional context and institutional position to follow and initiate the various strategies to deal with legitimacy crises during the radical innovation process.

**Table 5-13 Institutional circumstances and conformation strategies.**

| Cases | Institutional circumstances | Strategic response |
|---|---|---|
| *Daxo –* LC 1.5 Budget and hiring processes don't match required flexibility | *Stringent regulatory regime*<br>- explicit formal procedures for budget and resource allocation strongly embedded in institutional structures<br>- decision making authority resides at upper management levels | *Conformation*<br>Compliance with the established procedures and norms for budget approval and personnel hiring within the company, although this limited the flexibility of the innovating actors. |
| *Zapim –* LC 2.3 Finding a place in AlphaSys | *Stringent regulatory regime*<br>- the decision making authority for 'contract research' projects resides at the SBUs of AlphaSys<br>- the SBUs of AlphaSys have control over the necessary resources for 'contract research' projects. | *Conformation/Postponement*<br>The ideas to integrate the Zapim technology with existing technology are not pushed forward. The innovating actors decide to wait until a later stage, when technical risks are smaller and circumstances at the business unit more favorable. |
| *Icon –* LC 3.1 Canceling development budget for Icon MR | *Stringent regulatory regime*<br>- the final decision making authority for all innovation projects resides at the CEO and board of management of AlphaSys<br>- the CEO and board of management of AlphaSys have control over necessary resources for this project | *Conformation/Postponement*<br>Compliance with the established interests and focus of the CEO and senior management. The radical Icon project was put on hold and budgets were recalled. At a later stage, when organizational conditions seemed more favorable, the project is started up again. |
| *Icon –* LC 3.3 Multilevel solutions and business boundaries | *Stringent regulatory regime*<br>- decision making authority for development projects resides at the SBUs of AlphaSys.<br>- The SBUs own and control the necessary budgets and resources for development projects. | *Conformation*<br>Adaptation of the Icon ideas to match individual business unit boundaries and interests. Most multilevel aspects were cancelled to create a better fit between the scope of the ideas and the scope of the business unit product lines. |

| | | |
|---|---|---|
| *Icon –*<br>LC 3.4 Patient experiences versus technological solutions | *Stringent regulatory regime*<br><br>- decision making authority for development projects resides at the SBUs of AlphaSys. Omega Design is viewed as service unit to the SBU clients.<br>- The SBUs own and control the necessary budgets and resources for development projects. | *Conformation*<br><br>Some 'experience' based aspects of the radical Icon solutions are cancelled or adapted to meet technical, financial and timing constraints dictated by the engineers and SBUs at AlphaSys and their established 'technology driven' logic of 'engineering'. |
| *Icon –*<br>LC 3.5 Icon research program and business unit interests | *Stringent regulatory regime*<br><br>- decision making authority for research and development programs resides at the SBUs of AlphaSys. Omega Design is viewed as service unit to the SBU clients.<br>- The SBUs own and control the necessary budgets and resources for research and development programs. | *Conformation/Withdrawal*<br><br>The proposal for a general research program on Icon was cancelled at that time. No further efforts were made to adapt the research plans or ideas to solve the legitimacy issue. |
| *Treemax –*<br>LC 4.2 Treemax applications versus day to day focus of business unit | *Stringent regulatory regime*<br><br>- decision making authority for application research and development projects resides at the SBUs of PhemCo, and thus at the SBU CR.<br>- The SBU CR owns and controls the necessary budgets and resources for application research projects. | *Conformation*<br><br>The innovating actors adapted the plans and proposals for multiple Treemax applications for the SBU CR and focused only on one of the many potential application areas. As such they conformed to the established shorter term interests of the business unit. |

| | | |
|---|---|---|
| *Treemax – LC 4.3* Canceling Treemax Dental applications | *Stringent regulatory regime*<br>- formal (and final) decision making authority for new business ventures resides at the upper management level (the directors) of the V&BD group of PhemCo. | *Conformation/Withdrawal*<br>The innovating actors of Treemax complied to the concerns of the upper management of the V&BD unit and cancelled their ideas for Treemax Dental applications. |
| *Treemax – LC 4.5* Strategic fit or no strategic fit | *Stringent regulatory regime*<br>- formal (and final) decision making authority for (longer term) strategic initiatives and new ventures at PhemCo resides at the Board of Directors of PhemCo.<br>- The Board of Directors owns and controls the necessary budgets and resources for new strategic initiatives and new ventures at PhemCo. | *Conformation*<br>The innovating actors of the Treemax venture adapted their business plans to create a better alignment with the established and designated end-markets of PhemCo and their typical customer needs. |
| *Reflactone – LC 5.2* Opting out Reflactone | *Stringent regulatory regime*<br>- the Board of Directors of PhemCo have formal decision making authority for novel strategic initiatives and new business/-technology development projects. | *Conformation*<br>After extensive and rational analysis of the business potential of Reflactone in the electronic display market, the innovating actors agreed to meet the concerns and interests of the company and the Reflactone application was licensed out to a former technology partner. |

**Table 5-13 Institutional circumstances and conformation strategies.**

## 5.7 Extension of the micro-institutional perspective

In the past sections we inductively analyzed for each individual strategy how innovating actors are able to make use of specific opportunities stemming from their institutional context and their institutional position to initiate a particular strategy that augments the legitimacy of their radical innovation ideas. We identified specific institutional characteristics that enabled each of the different strategies *separately* (thereby answering research question 3). In this section we will build upon these separate findings and synthesize them into an integrated 'strategy preferences model' that explains which strategies will be preferred and pursued by innovating actors when *multiple* institutional opportunities and institutional constraints are present (and thereby integrating the answers to research questions 2 and 3). This model is *part of* and a relevant extension to the micro-institutional perspective on radical technological innovation within established high-tech companies we aim to develop. Based on the case data and some theoretical notions we develop a model that is both testable, simple and specific enough to explain the choice for particular strategies favoring the legitimation of radical innovation within established institutions by innovating actors.

We will first shortly elaborate on the identified relationships between institutional opportunities, constraints and strategies. Secondly, we will show that there exists a preferential order for pursuing particular strategies from the perspective of innovating actors, based on the case data and several theoretical assumptions. This preferential order will narrow down the number of different strategies considered and pursued by innovating actors, when multiple institutional opportunities and constraints are present. Finally, we will synthesize these findings and present the 'strategy preferences' model. In the next chapter, we will summarize our micro-institutional perspective (consisting of assumptions on organizations as institutions, our understanding of legitimacy crises, strategic responses, and their use of institutional opportunities, and the integrated model) and compare it with recent alternative (micro-)institutional and legitimation theories and discuss its relevance and merits.

### *5.7.1 Institutional opportunities, constraints and strategic responses*

In the previous sections we have identified *seven* distinctive characteristics of the institutional context, institutional position, and characteristics of the proposed radical innovation actions that either offered opportunities or imposed constraints on the innovating actors to initiate particular strategies. Some of the characteristics of the institutional context have an influence on more than one strategy: 1.a) a weak regulatory regime, stemming from a lack of formal procedures delineating decision authority and a lack of resource control influence of institutional actors, enables a non-conformation strategy, while 1.b) a strong regulatory regime instead presses innovating actors to pursue a conformation

strategy. The other characteristics of the institutional context particularly enable specific strategies: 2) the multiplicity of institutional interests, norms and beliefs offers the opportunities to initiate toleration; 3) a heterogeneous institutional context consisting of multiple differentiated institutionalized groups enables selection, and 4) ambiguous institutional interests, norms and beliefs enable innovating actors to initiate transformation, respectively. Additionally, particular institutional positions of the innovating actors enhance the ability of these actors to seize particular opportunities: 5) if innovating actors are located at boundary spanning positions in the institutional network, they are more aware of and are better able to seize the opportunities of heterogeneity; 6) if innovating actors are (considered) expert outsiders, they are more aware of alternative institutional logics, and their expert status (credibility) allows them to be critical and question established institutional logics and structures, thereby enabling them to seize the opportunities of ambiguity more easily. Finally, 7.a) a relatively low resource impact of the (proposed) radical innovation activities allows innovating actors more easily to appeal to the multiplicity of institutionalized interests, norms and beliefs, because these activities do not hinder institutional actors to support and invest in more legitimate (innovation) initiatives also, allowing more easily for toleration. Additionally, 7.b) a relatively low resource impact of innovative activities reduces the resource control influence of institutional actors and the dependence of innovating actors (as dictated by the regulatory regime), thereby enabling a non-conformation strategy. In Figure 5-9 the distinctive institutional opportunities and constraints and their relationships with the strategic responses are summarized in an extension of the initial micro-institutional perspective.

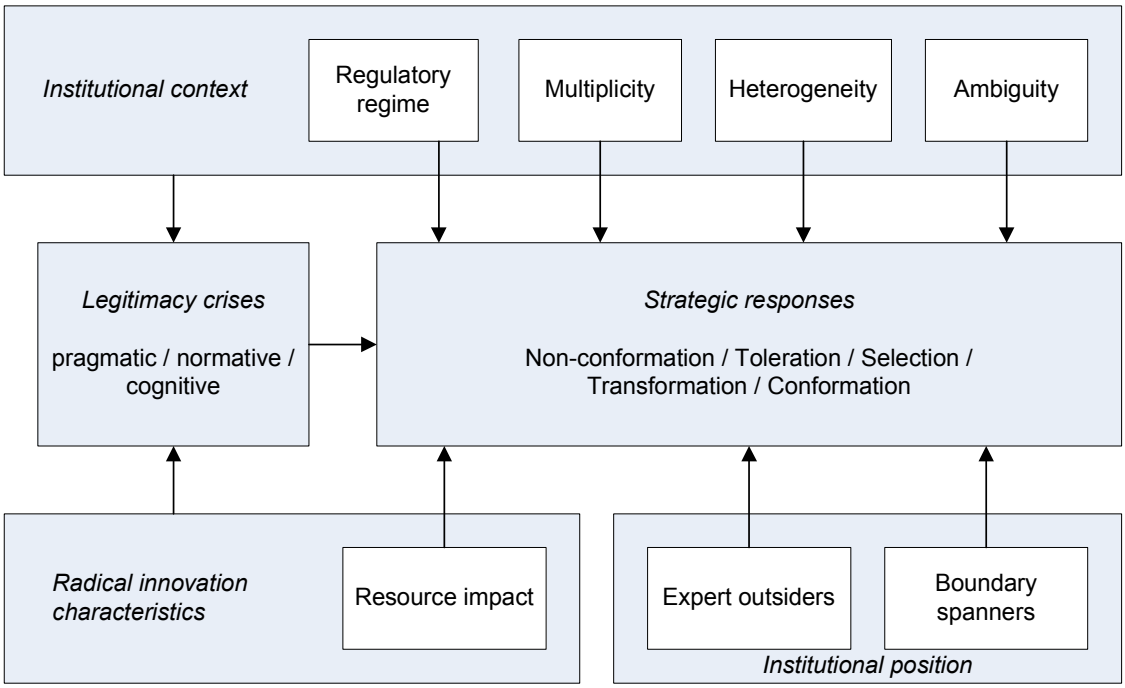


**Figure 5-9 Institutional constraints, opportunities and strategic responses.**

Although the inductive analysis of each of the strategy type instances has revealed how the initiation of each of the strategies was enabled by particular institutional and innovation characteristics, the question remains what innovating actors will do when multiple institutional opportunities and constraints exist at the same time and therefore allow multiple strategies to be pursued? Do innovating actors prefer specific strategies over others when multiple opportunities for legitimation exist and why is that the case? For instance, do we also expect a transformation response when both the opportunities of ambiguity and a *weak* regulatory regime occur together, or do we only see non-conformation in that case? Or, which strategy is preferred by innovating actors when both the opportunities of multiplicity and heterogeneity are present: toleration or selection? To answer these questions it is necessary to investigate whether innovating actors have preferences regarding the different strategies. The case data suggest that innovating actors do have such a preferential order regarding the strategic responses. In the next section we will investigate and define this preferential order, which narrows down the options considered by innovating actors when choosing and initiating strategies in a situation of multiple institutional opportunities and constraints. This allows us to define and propose a more specific and comprehensive model in the end.

### *5.7.2 Preferential order of strategic responses*

In this section we will more closely investigate whether there exists some kind of preference among innovating actors for particular strategic responses over other responses. Intuitively, one could suspect that innovating actors will try to defend and preserve their initial radical innovation ideas as much as possible, because these ideas are of their own making, inspire them, and have their dedication (their dedication goes so far that inventors and innovators would even consider leaving the established company to pursue the opportunity outside and without interference of the company; *e.g.* see Chesbrough, 2003 for examples of this). Adapting these innovative ideas to conform with established logics and structures would seem the least favorable action from the perspective of the innovators. Conformation makes ideas less radical and more traditional, which could reduce the initial enthusiasm and commitment of the innovating actors for these ideas. A non-conformation response, on the other hand, allows innovating actors to ignore the institutional pressures and continue with their initial radical innovation ideas without any alterations, even though they lack wider organizational support. A transformation (or selection) response augments the legitimacy of their radical innovation ideas, preserves its original radicalness (which might even be extended), and enhances organizational support for these ideas. However, transformation responses also incur 'costs' for the innovating actors and take time; it is a strategy that entails numerous actions to lobby, convince, involve external experts, popularize and promote novel and alternative interests, norms and beliefs and change the established institutional logic and structure. So, although transformation can result in wide organizational support for the radical innovation and eliminates institutional obstacles, it is not the easiest strategy to follow in terms of the required efforts and activities to execute.

Based on the cases we identify a specific preferential order for the different types of strategic responses from the perspective of innovating actors. When the legitimacy crisis LC 3.2. 'Developing an Icon pavilion for CT' emerged within the Icon case at AlphaSys, the innovating actors followed a selection strategy to overcome the legitimacy crisis. This was enabled by the heterogeneous institutional context in which the innovating actors resided and the boundary spanning position of one of the innovating actors. However, the regulatory regime during this situation was also stringent; the SBU CT had control over necessary resources for the development of the Icon CT pavilion and also had the authority to decide about the goals and functionalities of this pavilion as it concerned their product-line. Therefore, another option for the innovating actors would have been to adapt all the Icon ideas to match better with the established institutional interests and beliefs of the SBU CT, or even cancel or postpone their ideas to a later time, and consequently follow a conformation strategy. As the case analysis shows, they did not do this, but instead made use of the opportunities offered by the institutional heterogeneity and pursued a selection strategy in the end. This suggest that even when the governing regulatory regime is stringent and strong, innovating actors will rather prefer to make the extra efforts to follow a selection strategy (when heterogeneity is present) to preserve the initial radicalness of the innovation ideas. We thus can state that a selection strategy is preferred by innovating actors over a conformation response to augment the legitimacy of their radical innovation ideas.

In the legitimacy crisis LC 1.2 'Developing a competency in molecular biology and biochemistry' that emerged within the DaXo case at AlphaSys DaXo, the innovating actors seized the opportunities of institutional ambiguity (stemming from large scientific paradigm and industry changes) to initiate a transformation strategy and augment the legitimacy of their radical ideas. However, this situation was also characterized by a stringent regulatory regime; both the CTO of AlphaSys, and the different Research Department Directors at OmegaCom Research, for which the radical innovation ideas were not highly legitimate, were authorized to take decisions about the investments in research projects and related go/no go decisions. This meant for the innovating actors that another option to augment the legitimacy of their radical innovation ideas, would be to conform and adapt the ideas to better match established institutional logics and structures. In this case, that could mean that they would not build up and develop competencies in biochemistry and molecular biology themselves, but instead would completely outsource these competencies to external partners or suppliers. So, even though a stringent regulatory regime was present and governed the actions of innovating actors, the innovating actors preferred to seize the opportunities of institutional ambiguity and make the extra efforts to initiate a transformation response to improve legitimacy, instead of conformation. This suggests, that under a stringent regulatory regime, innovating actors prefer a transformation strategy over a conformation strategy if the opportunities of institutional ambiguity are present.

When the legitimacy crisis LC 5.3 'Selling glass... that is something weird' emerged during the radical innovation process of Reflactone/Reflactix in the PhemCo company, the innovating actors seized the opportunities of the multiplicity of institutionalized interests, norms and beliefs to appeal to the tolerance of the institutional actors, and consequently partly illegitimate radical innovation activities were allowed to continue. The toleration response initiated was only one of the options possible at that time. Around the same time that LC 5.3 emerged in the Reflactone case, a certain amount of institutional ambiguity was also present regarding the vision of PhemCo to become a 'specialty chemicals company'. In the parallel case of Treemax, this institutional ambiguity was used around that time to initiate a transformation strategy to solve the legitimacy crisis of LC 4.4. 'Strategic fit or no strategic fit'. The innovating actors in the Reflactone case however, did not make use of this ambiguity opportunity to initiate a similar transformation response as the actors of Treemax. Instead they more easily appealed to the existing multiplicity of the institutional logic and pursued toleration. Of course, the innovating actors of Reflactone could initiate toleration because this was enabled by a relatively low resource impact of their ideas (which did not apply for the Treemax radical innovation actions), but it also required less efforts to augment the legitimacy through toleration than by initiating transformation. Toleration was much more local and involved relatively few discussions between the innovating actors of Reflactone and their immediate senior management, while the transformation strategy of the Treemax actors involved extensive analysis of the specialty polymer industry, many discussions and presentations, and strong interactions between the innovating actors, senior management at the Innovation Centre and directors of the Board. This example suggests that innovating actors will prefer to initiate and follow toleration over transformation, when both institutional multiplicity and ambiguity are present. Although transformation may lead to wider organizational support and stronger legitimacy than toleration, it also requires more time and more activities to be conducted.

Finally, in the Zapim case at AlphaSys, a non-conformation response was used to circumvent legitimacy crisis LC 2.2 'Publication and the wake of competition'. In the analysis of this instance, we identified that the non-conformation response by the innovating actors was enabled by a weak regulatory regime that governed the actions of innovating actors. However, the innovating actors could also have given into to concerns of the institutional actors regarding the proposed activities and follow a conformation strategy. They did not do so, because conformation and postponing or cancelling the publication went against the interests and dedication of the innovating actors, and they could go their own way because the institutional actors did not have means to influence or regulate their actions. The innovating actors could also have chosen to follow a toleration or transformation response; they could have appealed to the multiplicity of short versus longer term business interests, or could have made use of the institutional ambiguity stemming from changes in the industry environment regarding molecular healthcare (which could be one of the application areas of Zapim), but they didn't. They were able to follow non-conformation because the regulatory regime was relatively weak of course, but

also because both toleration and transformation would involve more discussions, negotiations, lobby activities, and interactions to be executed, which would take extra time and potentially spoil the present opportunity to publish about the radical innovation. This example suggests that when the regulatory regime is relatively weak, innovating actors are enabled and will prefer non-conformation over the strategies of toleration, transformation, and conformation for reasons of efficiency and the preservation of the radicalness of their ideas.

Based on these examples from the case data we argue that innovating actors have specific preferences regarding the strategies that augment the legitimacy of radical innovation activities within established high-tech companies. When multiple institutional opportunities and constraints are present at the same time, innovating actors will prefer to follow those responses that preserve (or extend) the radicalness of their original radical innovation ideas in the best way, and that require the least efforts (in terms of activities to be carried out and time taken to realize a strategic response) by the innovating actors. This *satisficing* (or maximizing) behavior of innovating actors takes place within the institutional context and the apparent institutional opportunities and constraints. The case data suggest that conformation is the least favorable of all strategies from the perspective of the innovating actors. A conformation response directly effects and changes the radicalness of their original ideas, which has a detrimental effect on their initial enthusiasm, dedication and interests. Conformation also requires considerable renegotiation activities and adaptations to plans and proposals. On the other end of the spectrum, we locate non-conformation as being the most favorable strategy, if the institutional circumstances allow it (and that is not very often, as we have seen only one instance of this strategy type). Non-conformation preserves the original radicalness of the innovation ideas and does not require any major efforts of the innovating actors. During non-conformation innovating actors ignore the concerns of institutional actors and just carry on with their innovation activities (independently). Toleration is one of the other more favorable strategies from the perspective of the innovating actors as the case data shows. The innovating actors are allowed to continue with their unaltered innovation ideas and the efforts to appeal to institutional multiplicity are less extensive and more local than in the case of both selection strategies (*i.e.* starting search process, promoting innovation, and negotiations with multiple potential stakeholders and sponsors), and transformation strategies (*i.e.* lobbying, discussing, external experts, environmental scanning, negotiating, implementing change). So, following the toleration response, it is argued that a selection strategy is favored more than a transformation strategy. Both selection and transformation preserve the radicalness of the original innovation ideas (selection and transformation might even extend and broaden it), but a selection response is less difficult to execute and requires less efforts.

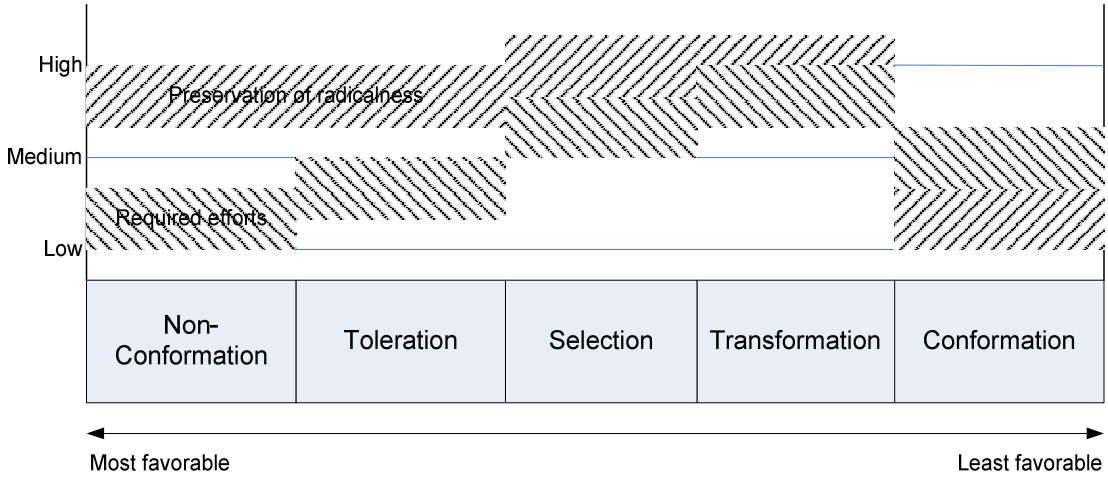


**Figure 5-10 Preferential ordering of strategic responses.**

Transformation involves the implementation of change and institutionalization of novel interests, norms and beliefs, which is a more complex task than finding alternative institutional sponsors within the company, that have better matching and established interests, norms and beliefs in the case of selection. All aspects considered, we argue that if the institutional opportunities and constraints enable and allow it, non-conformation is the most favorable strategy from the perspective of innovating actors, followed by toleration, selection, transformation and conformation as the least favorable strategy (see Figure 5-10).

The preferential order of the strategies favoring legitimation will be used to develop the integrated model in more detail. As the case studies in the previous sections show, innovating actors are both constrained and enabled in their choice for particular strategies, and are not always in the position and do not always have the opportunities to choose the most favorable strategy. We thus have to merge and integrate the preferential order of the different strategies with the different aspects of the institutional context (constraints and opportunities), institutional position and radical innovation ideas, which have been identified in the previous sections.

### *5.7.3 Strategic responses in complex institutional contexts*

The preferential order identified in the previous section and the identified relationships between characteristics of the institutional context, position and radical innovation ideas and the strategies, can now be used to develop a comprehensive and specific model that explains under which institutional circumstances (opportunities, constraints) innovating actors follow particular strategies to augment the legitimacy of radical innovation ideas within established companies. In other words, the model explains which strategy innovating actors follow when multiple institutional opportunities and constraints are present. For

each of the multiple (institutional) characteristics and strategies the relationships will be inferred in the next sections.

*Weak and stringent regulatory regimes*

In the case analysis we identified a relationship between the nature of the regulatory regime and the choice for non-conformation and conformation strategies to augment the legitimacy of radical innovations. We found that innovating actors use a weak regulatory regime to initiate a non-conformation strategy. Under a stringent regulatory regime the easiest way forward is to pursue a conformation strategy. Further, we do not expect innovating actors to pursue either one of the other three strategies (toleration, selection, and transformation) under a weak regulatory regime, because a weak regulatory regime enables them to pursue the non-conformation strategy, which is the most favorable in the preferential ordering of strategies. Under a stringent regulatory regime however, it is more likely that innovating actors will try to initiate and pursue one of these three strategies to prevent necessary adaptations to their radical innovation ideas stemming from a conformation strategy. Conformation is the least favored strategy, and consequently, innovating actors will first try the other three strategies if the institutional opportunities exist and circumstances enable them to do so. We thus infer that toleration, selection and transformation strategies are more likely to be pursued under a stringent regulatory regime, than under a weak regulatory regime (see Table 5-14 for a tabular representation).

*Small and large resource impact*

For the non-conformation and toleration strategies we have identified that the resource impact of the radical innovation ideas on the institutional system was relatively low, which enabled the innovating actors to pursue these strategies. In the case of a non-conformation strategy, a low resource impact of the radical innovation ideas on established institutional groups enables innovating actors to go ahead with their ideas relatively independent of the established institutional groups, because the institutional groups cannot exercise their resource control influence over the actions of innovating actors as there is no resource demand. In the case of toleration strategies, a low resource impact of the radical innovation ideas, enables innovating actors to appeal to the multiplicity of institutionalized interests, norms and beliefs more easily, because the amount of required resource for their ideas does not limit institutional actors to invest in alternative and more legitimate innovation ideas. Radical innovation ideas are more easily tolerated by institutional actors when the amount of required resources (the resource impact) is relatively small (or can be made smaller). Thus, a relatively low resource impact gives innovating actors the opportunities to pursue non-conformation and toleration strategies (see Table 5-14).

If low resource impact occurs under a stringent regulatory regime, non-conformation is less likely than toleration, for reasons discussed above. Under

those conditions, innovating actors can also initiate selection, transformation or conformation strategies, but they will probably try to pursue toleration first because this is a more favorable strategy based on required efforts and impact on the radicalness of the idea (and when characteristics of the institutional context offer the opportunities of multiplicity). However, the necessity to choose either a selection, transformation or conformation strategy, becomes stronger when the resource impact of the radical innovation ideas is larger and cannot be reduced by the innovating actors, and when the regulatory regime is more stringent. In that situation, the options to follow non-conformation and toleration are severely constrained, and innovating actors have to make more efforts to augment the legitimacy of their ideas in order to continue. Based on the preferential ordering of strategies, we expect in such a situation that selection strategies will be tried and initiated at first, then transformation, and at last conformation (of course, selection and transformation are more easily and successfully initiated when any heterogeneity or ambiguity of the institutional logic is available, respectively). In Table 5-14 we give a tabular representation of these results.

*Multiplicity, heterogeneity and ambiguity*

We identified important characteristics of the institutional context that offer opportunities to initiate either toleration, selection or transformation. These characteristics are the multiplicity of institutionalized interests, norms and beliefs, the heterogeneity of the institutional system, and the ambiguity of institutionalized interests, norms and beliefs, respectively. These conditions are particularly differentiating under a stringent regulatory regime. Under a weak regulatory regime and low resource impact of the radical innovation ideas, innovating actors have the opportunities to pursue a non-conformation strategy, which is also the most favorable strategy. Having also opportunities of multiplicity, heterogeneity and ambiguity within this particular situation, does not alter this proposition, because toleration, selection and transformation require more efforts to be made by the innovating actors.

When the regulatory regime is relatively stringent and the resource impact is also large, innovating actors can still make a choice between either selection, transformation and conformation. When in this situation either the heterogeneity is high or the ambiguity is high, innovating actors have to opportunities to pursue either selection or transformation, which are both strategies that are more favorable to pursue, with respect to adaptations required to the innovation ideas and efforts to be made. Consequently, under stringent regulatory regimes and large resource impacts, selection or transformation will be chosen first, but only when the heterogeneity and ambiguity of the institutional context can be used to the innovating actors' advantage. This means, that only when innovating actors cannot make use of the opportunities of heterogeneity and ambiguity, because innovating actors do not have the institutional position to do so or when these opportunities do not exist (i.e. homogeneous, unambiguous contexts), the only way forward is to follow a conformation strategy. Consequently we propose that

when the heterogeneity and ambiguity are absent within the institutional context, innovating actors will be constrained to and follow a conformation strategy (as can be seen in the Table 5-14).

When both ambiguity and heterogeneity are present, a selection strategy is more likely to be pursued, because this is, in general, a more favorable strategy. If multiplicity is present, and resource impact is low, we expect innovating actors to seek toleration, regardless of the presence of ambiguity and heterogeneity, because toleration requires less effort and less changes to the radical innovation ideas.

Based on these inferences we have developed an integrated model of the choice for particular strategies of legitimation based on the opportunities offered by the institutional context, institutional position and resource impact of the radical innovation ideas. The 'strategy preferences' model explains 1) which institutional opportunities and constraints allow innovating actors to pursue particular strategies to augment the legitimacy of radical innovation within established companies; and, 2) how different institutional positions of the innovating actors and the resource impact of the radical innovation ideas enable innovating actors to appropriate more easily apparent institutional opportunities and constraints. Moreover, 3) it shows which characteristics of the institutional context (*e.g.* multiplicity, ambiguity, heterogeneity) and radical innovation ideas (resource impact) can be influenced and manipulated by innovative actors to enable certain strategic responses. And finally, 4) it explains which strategies will more likely be pursued by innovating actors when multiple institutional opportunities and constraints are present, dependent on the preference order of innovating actors. In the next chapter we will discuss the theoretical relevance of this model and the all encompassing micro-institutional perspective, and their relative merits.

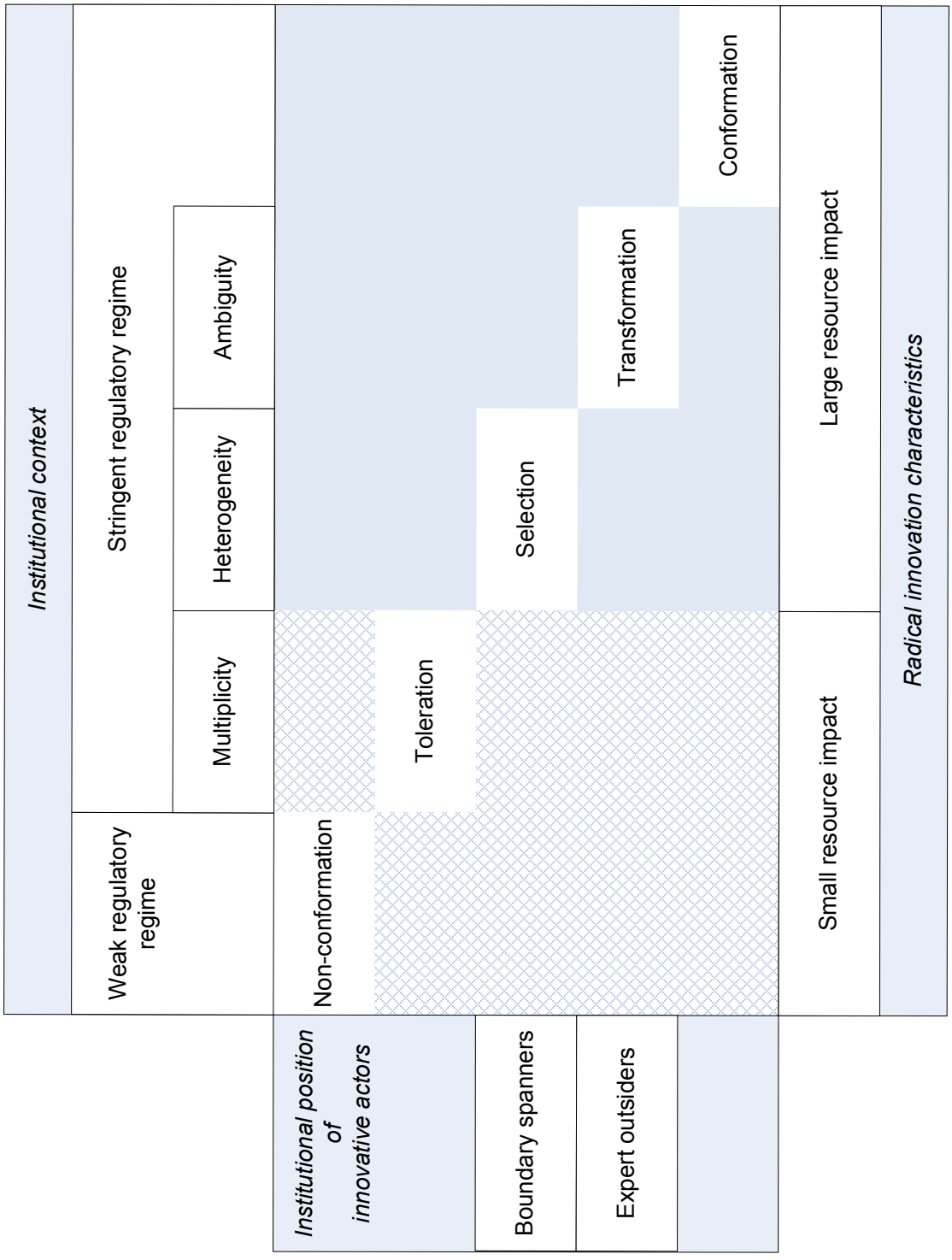


**Table 5-14 Strategy preferences within complex institutional contexts.**

# Chapter 6 Discussion and Conclusion

## 6.1 Introduction

The objective of this thesis was to develop an empirically grounded micro-institutional perspective on radical innovation within established high-tech companies that explains both the difficulty and possibility of radical innovation within established companies. The thesis examines both the constraining and the enabling effects of institutional logics and structures on the actions of radical innovators. In the previous chapters the various elements of this micro-institutional perspective have been identified, categorized and integrated into concepts and their relationships. Building upon previous institutional theory, legitimacy theory and structuration theory, we have refined and developed the concepts of legitimacy and legitimation and their relationship with characteristics of the institutional context and institutional position of actors.

The micro-institutional perspective and integrated set of concepts and relationships explains why institutional logics and structures limit radical innovation within established companies because of the emergence of legitimacy crises. Yet, it is also able to explain why and how these same institutional logics and structures offer opportunities (and constraints) to innovating actors to pursue different strategic responses that allow them to overcome these legitimacy crises and change radical innovation into a possibility.

In this chapter we discuss the theoretical relevance of this micro-institutional perspective with respect to the ongoing debate about innovation and institutions, and the debate about radical innovation within established high-tech companies. We also discuss some limitations of this study and define several relevant future research questions. The final section of this chapter summarizes the main conclusions of this study and links them the formulated research questions. In the next section, the micro-institutional perspective is outlined and its main theoretical claims are summarized.

## 6.2 A micro-institutional perspective on radical innovation

*Legitimacy and legitimacy crises*

We have empirically grounded and refined the typology of pragmatic, normative and cognitive legitimacy crises that limit innovating actors to continue with their radical technological innovation ideas (*cf.* Suchman, 1995). During a legitimacy crisis the innovating actors experience most directly the constraining influence of established institutional logics and structures on their actions. When their proposed course of action lacks legitimacy, they receive limited organizational support and have limited access to necessary resources, knowledge and (social)

networks which are 'controlled' or owned by institutional actors. In the evaluation of the legitimacy of radical innovation, pragmatic, normative and cognitive elements of the established institutional logic and structure are enacted and reproduced in the realm of action. The pragmatic elements refer to established interests and needs attributed to the organization or established organizational groups that define what is *beneficial*, and what not. The normative elements refer to established norms, values and rules of the organization or organizational groups that define what is *appropriate* and proper, and what not. The cognitive elements refer to the established (and shared) beliefs and frames of reference attributed to the organization or organizational groups that define what is *real*, and what is not real (*i.e.* comprehensible). The enactment of the 'fit' between aspects of the radical innovation and related course of action, and the pragmatic, normative and cognitive elements of the institutional logic and structures, determines whether the radical innovation has or lacks pragmatic, normative or cognitive legitimacy, respectively.

Radical technological innovations can lack pragmatic, normative and cognitive legitimacy, because they consist of novel technologies, address novel application areas, and target novel customer groups, with respect to the dominant institutional logic and structures. The radical innovation ideas can be judged to be not beneficial, inappropriate or incomprehensible with respect to the institutionalized set of interests, norms and beliefs. This lack of legitimacy (as cumulated within a legitimacy crisis) reduces organizational support for the innovation ideas, and limits the access of innovating actors to resources, knowledge and networks necessary for the realization of the radical innovation. Because of this lack of organizational support, and limited access to resources, knowledge and networks, radical innovations are often discontinued or their potential is not fully realized. As such, the theoretical concepts and mechanisms of legitimacy explain why the realization of radical innovations within established high-tech companies is characterized by major difficulties, which is supported by the empirical observations in the case studies. Figure 6-11 represents this part of the developed micro-institutional perspective schematically. As such, Figure 6-11 forms the final extended version of the initial micro-institutional perspective, as discussed in chapter 2 (and resembles similar legitimacy 'process' models of Zimmerman & Zeitz, 2002; Lounsbury & Glynn, 2001).

*Strategic responses*

The initial legitimacy strategy typology of conformation, selection and transformation (Suchman, 1995) has been empirically grounded and extended with the non-conformation and toleration strategy types. The typology defines the different strategic responses used by innovating actors to overcome legitimacy crises and augment the legitimacy of radical innovations with established high-tech companies. The typology demonstrates that innovators have a wide variety of options to augment the legitimacy of innovation and continue with the innovation process. Conforming to institutional logics and structures is not the

only response actors have to follow or can pursue. The identification of selection, transformation, toleration and non-conformation responses to overcome legitimacy crises, echoes the ontological assumption that actors within institutions have agency, have a choice and can make a difference. As such, the identification of the different types of strategic responses explains why and how innovating actors within established companies are able to realize radical innovations ultimately, even though these are plagued by emerging legitimacy crises. It explains how legitimacy crises can be overcome and how institutional logics and structures can be used and changed to accommodate radical innovation, and thus explains the possibility of radical innovation within established high-tech companies as well.

Based on the ontological assumptions of the duality of structure and the reflexivity of social agents (Giddens, 1987; Scott, 2001) we develop the theoretical argument that the legitimacy of proposed courses of action can be augmented by using strategies of conformation, toleration, selection and transformation, and that a legitimacy crises can be overcome (without augmenting legitimacy) by using a strategy of non-conformation (if the circumstances enable this). Actors within institutional systems can deliberately influence the legitimacy of their proposed actions by making use of existing institutional logics and structures. A conformation response incorporates existing institutionalized interests, norms and beliefs within the radical innovation idea to increase legitimacy and embeddedness within existing institutional logics and structures. Or, when adaptations to the radical innovation cannot be made, a conformation response involves abandoning or postponing the ideas to a later stage. With selection, innovating actors purposefully search for a more 'friendly' group within the institutional system that reproduces a more legitimating set of institutionalized interests, norms and beliefs, which consequently reduces the lack of legitimacy. During a transformation response, innovating actors introduce and propagate novel interests, norms and beliefs and merge these with existing institutional logics and structures to better legitimize the innovation. The locus of action of the conformation, selection and transformation strategy is more at the innovating actors side. With a toleration response instead, both innovating actors and the institutional actors play an important role. During a toleration response, innovating actors appeal to alternative (and competing) institutional interests, norms and beliefs within the institutional system that better legitimize the innovation. The institutional actors that reproduce the institutional logic acknowledge the relevance of the alternative institutional interests, norms and beliefs and allow the innovation to continue, even though the innovation is not legitimate with respect to all institutional interests, norms and beliefs (it is only partly legitimate). As such, we argue that existing institutional logics and structures are not clear-cut, minimal and simple, but can embody multiple diverse and competing interests, norms and beliefs, which allow innovating actors room to maneuver and continue innovation without 'full' or conclusive legitimacy of their actions. Finally, based on the assumption of agency within institutional systems, innovating actors can always say no to institutional pressures and ignore the lack of legitimacy of their ideas by following a non-conformation strategy. Non-

conformation is always a possibility, even though it can have severe consequences for the innovating actors and does not resolve the legitimacy crises.

The developed typology of strategic responses and the related theoretical argument explains why the realization of radical innovation is indeed possible by established companies, even though they are also hampered by legitimacy crises at the same time. The presented argument states that although institutional logics and structures are stable over time and have constraining effects on the actions of its members, these logics and structures at the same time also enable innovating actors in enhancing the legitimacy of their actions by strategies of conformation, selection, toleration, transformation and non-conformation. In Figure 6-11, the types of strategic responses and their relationship with other concepts of the micro-institutional perspective are summarized.

*Institutional opportunities and constraints*

Based on the qualitative analysis of the data, we have developed a comprehensive and empirically grounded typology of institutional opportunities and constraints that can be used by innovating actors to pursue particular strategic responses. This novel typology explains why and how a variety of strategic responses is possible within an institutional system and thus provides a better understanding of how the duality of structure and reflexivity of agents within institutional systems must be interpreted. The typology of institutional opportunities and constraints defines which characteristics of the institutional logic and structure, and which characteristics of the institutional position of innovating actors, offer opportunities (or constraints) for legitimation, and allow for the possibility of change of the institutional system. On the basis of the developed typology we can make three related theoretical claims.

The first claim is that the different strategic responses are possible because institutional systems (consisting of logics and structures) are heterogeneous, multiplicitous, ambiguous, and differ in the strength of their regulatory mechanisms. The heterogeneity of institutional systems offer innovating actors the opportunity to search for other institutional groups within the system, for which the radical innovation idea is more legitimate. The multiplicity of institutional interests, norms and beliefs offers innovating actors the opportunity to appeal to the tolerance of institutional actors. The ambiguity of institutional interests, norms and beliefs offers innovating actors the opportunity to introduce novel interests, norms and beliefs into the institutional system. A weak regulatory regime, finally, offers innovating actors the opportunity to ignore legitimacy concerns of institutional actors and continue with their innovation.

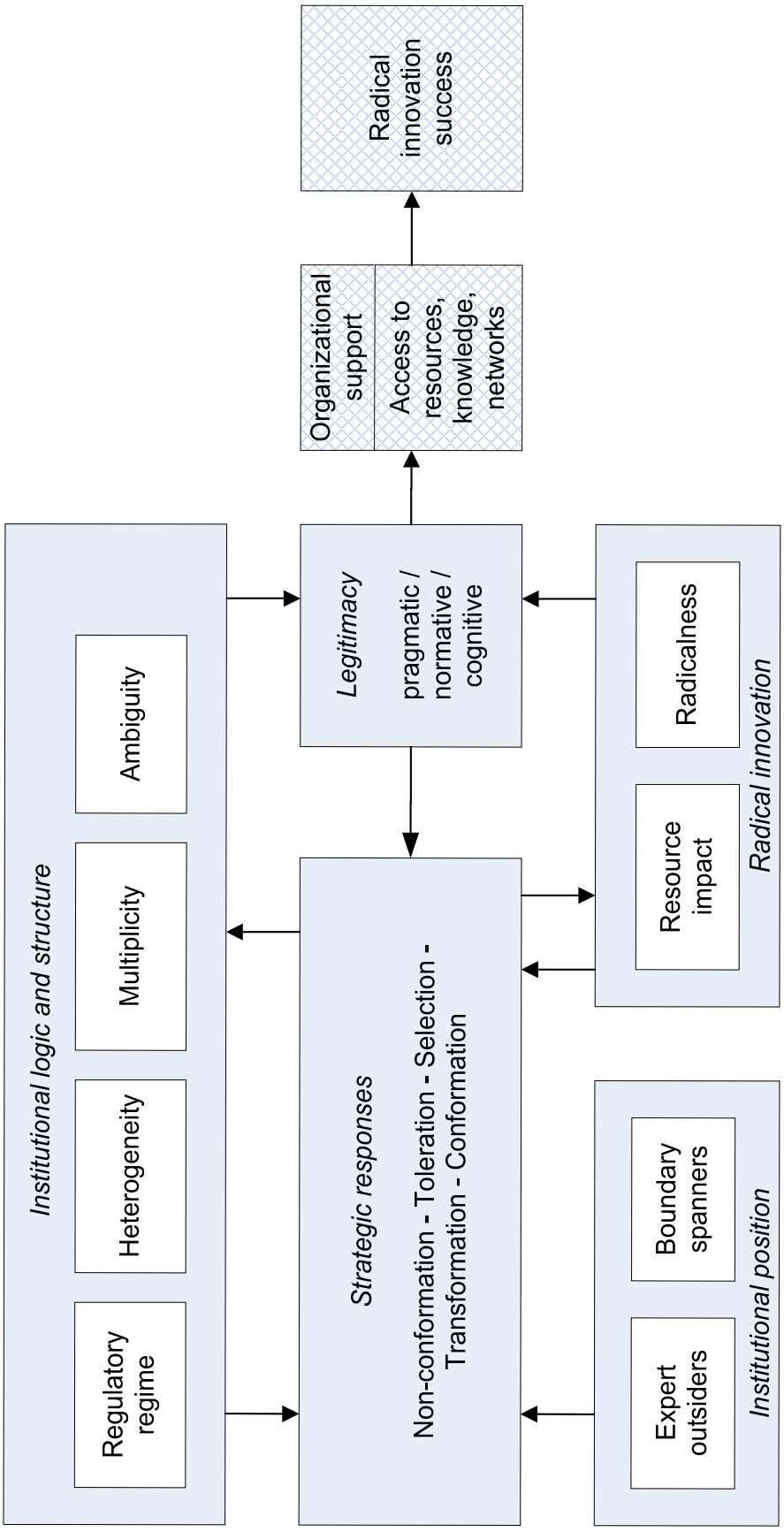


**Figure 6-11 A micro-institutional perspective on radical innovation within established companies**

Second, although institutional opportunities might be present, not all innovating actors are equally well positioned within the institutional system to take advantage of these opportunities. The 'expert outsider' status of innovating actors enables them on the one hand to be more aware of alternative institutional logics and structures, which increases their reflexivity and ability to criticize and ambiguate existing logics. On the other hand, their expert status strengthens the credibility of their critical remarks and allows them more easily to initiate transformation. Another type of institutional position that is relevant for seizing institutional opportunities, is the 'boundary spanner' position. When innovating actors are located at a boundary spanning position in between more coherent (social) networks within the institutional system, they are likely to be more aware of the apparent heterogeneity of the institutional system and enables them to take more easily advantage of this heterogeneity.

Third, following from the duality of structure assumption and the socially constructed nature of institutional logics and structures (see chapter 2 and 5), the identified institutional opportunities and constraints are not 'exogenous variables' that cannot be influenced by the actors within the system, but they are properties of the institutional system enacted by its members. Hence, the apparent heterogeneity, multiplicity and ambiguity are manipulable, although this is a complex effort, takes time and not all actors are equally well positioned to do so. The apparent heterogeneity can be influenced by widening the scope of the radical innovation ideas (within its physical and logical boundaries). And innovating actors that are in a boundary spanning position are more aware of the potential of this action. Dominant institutional logics and structures can be ambiguated by innovating actors with an expert outsider status that are aware of alternative logics and use this to criticize the existing institutional order. The impact of radical innovation ideas on the resources controlled by institutional actors (*i.e.* resource impact) can be reduced by innovating actors to more easily appeal to the multiplicity of institutional interests, norms and beliefs and enable toleration. As such, this theoretical claim explains why and how innovating actors themselves are able to (partially) create the institutional opportunities that allow them to respond in a wide variety of ways to legitimacy crises (even though this is a complex effort and takes time).

Together with the typology of strategic responses, the above mentioned claims explain why (and how) radical technological innovation can be made legitimate within established high-tech companies, which facilitate its realization.

*Strategy preferences within complex institutional contexts*

Based on the qualitative analysis and theory development effort, we have also been able to structure the relationships between institutional opportunities and constraints and the choice for particular strategic responses in more detail. The identification of a preferential order for the different strategic responses, based on the preservation of the radicalness of the innovation ideas and the efforts required

to carry out a particular response from the perspective of the innovating actors, is able to explain the choice for particular strategies within complex institutional contexts (*i.e.* when multiple institutional opportunities and constraints are present at the same time). This preferential order builds upon the ontological assumption of reflexivity, where social agents are able to monitor and reflect upon their actions and that of others, within the boundaries of their institutional environment and the possibilities and impossibilities of the institutional system.

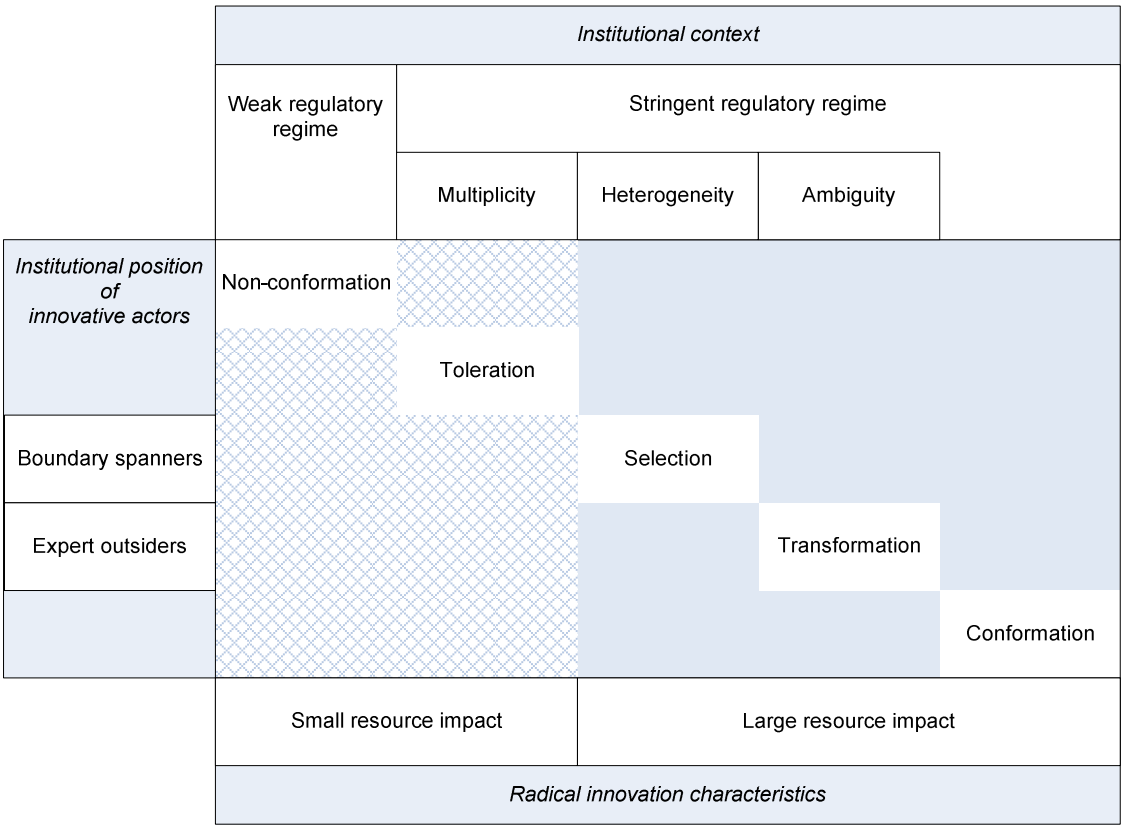


**Table 6-15 Strategy preferences within complex institutional contexts**

Based on the preferential order and the already identified typologies of strategic responses and institutional opportunities and constraints, we can explain which strategies will more likely be pursued and effectively carried out by innovating actors when multiple institutional opportunities and constraints are present (i.e. within complex institutional contexts). This theoretical argument is summarized in the propositional model as represented in Table 6-15. The model proposes that non-conformation is more likely to be initiated when the regulatory regime is weak and the resource impact is low (or can be made low). Toleration is more likely to be initiated when the regulatory regime is more stringent, resource impact is low and the institutional set of interests, norms and beliefs is multiplicitous. A selection response is more likely initiated when the regulatory regime is more stringent, a heterogeneous institutional context exists, resource impact is high and when innovating actors have a boundary spanning position. Transformation responses are more likely to be initiated when again the regulatory regime is stringent, and there exist opportunities of ambiguous institutional interests, norms and beliefs,

which is furthermore enabled by the expert outsider status of innovating actors. Finally, when the regulatory regime is highly stringent, the resource impact is high (and cannot be lowered), and there are no institutional opportunities of heterogeneity or ambiguity, innovating actors are more likely be confined to carry out a conformation strategy, in order to overcome legitimacy crises and continue with radical innovation.

The strategy preferences model within complex institutional contexts thus explains why and which strategic responses are more likely to be pursued by innovating actors when multiple institutional opportunities and constraints are present at the same time. Consequently, it advances our (theoretical) understanding of the enabling and constraining effects of existing institutional logics and structures and the possibility of legitimation, change and radical innovation within established high-tech companies.

## 6.3 Theoretical discussion

The theoretical discussion within this section will address how this study enhances and informs our understanding of radical innovation within institutional systems, and radical technological innovation within established high-tech companies in particular. We will first address how the concepts and relationships of legitimacy crises, strategic responses and institutional opportunities and constraints relate to and extend previous institutional and legitimacy theory. Secondly, we will reflect upon and relate the micro-institutional perspective to previous organizational approaches that explain the difficulty of radical innovation within established companies.

### *6.3.1 Legitimacy crises*

As demonstrated in the previous chapters, the typology of pragmatic, normative and cognitive legitimacy crises builds strongly upon Suchman (1995). His typology has been applied and refined within the context of radical innovation within established companies in this thesis. The different legitimacy crises identified in the radical innovation processes primarily replicate the findings and typology of Suchman. Consequently, it demonstrates the comprehensiveness and validity of his typology of legitimacy (crises) in the context of radical innovation. The legitimacy crises typology as developed in this thesis, involves only of a small adaptation with respect to Suchman's typology. The 'moral' legitimacy type of Suchman, which refers to the appropriateness of a course of action with respect to broader societal norms and values, has been translated (and refined) into the 'normative' legitimacy crises type in this thesis. Normative legitimacy (crises) refers to the appropriateness of a proposed course of action (innovation) with respect to the more local prevailing norms, values and rules of the organization that guide the behavior of its members. The normative legitimacy crises identified, demonstrate a lack of legitimacy of innovative action with respect to established

performance norms, work procedures, and risk avoidance norms. With respect to the initial typology of Suchman (1995) this constitues only a minor refinement.

The legitimacy crises typology adds novel insights to the typology of illegitimacies concerning new product development of Dougherty & Heller (1994). The inductively developed typology of Dougherty & Heller departed from a more general notion of (il)legitimacy which resulted in the definition of more descriptive categories (*e.g.* 'inappropriate or not helpful standards are imposed on product', 'cannot get people to work on product', or 'cannot determine if product fits with firm strategy'; Dougherty & Heller, 1994). Hence, the typology of Dougherty & Heller is very suitable for identifying and *describing* potential illegitimacies. However, their typology is less explanatory and general than the typology developed in this thesis. The typology of pragmatic, normative and cognitive legitimacy (crises) explains more comprehensively and at a more fundamental level *why* legitimacy crises occur and to which elements of the institutional logic and structure these are related. By focusing on conflicts with institutional interests, norms, and beliefs we can more specifically explain why legitimacy crises occur (which also serves to more clearly explain how they can be resolved). This more generalized explanation can also account for the identified illegitimacy types of Dougherty & Heller, but also allows for the identification of different and novel legitimacy crises that do satisfy the more general and theoretically informed definitions of pragmatic, normative and cognitive legitimacy.

Based on the work of Scott (2001), Vermeulen *et al.* (2007) developed a typology of different institutional forces that enable or constrain complex (incremental) product innovation within established financial service companies, which is similar in nature to the typology of legitimacy crises as developed in this thesis. Although the context is very different (radical versus incremental innovation; high-tech companies versus financial service companies), there is a similarity between the different types of legitimacy crises and the different types of institutional forces identified. Vermeulen *et al.*, also identify normative and cultural-cognitive institutional forces types that resemble the normative and cognitive legitimacy crises types of our typology. They also identify *regulative* institutional forces (based on Scott, 2001) that refer to strict adherence to organizational rules, standards and procedures. Instead, in our typology a lack of fit with organizational rules and procedures for doing work and innovation is categorized as a normative legitimacy crises. Both typologies as such acknowledge the importance of the effects of institutional norms, rules and procedures on innovation, albeit using slightly different categories. It must be noted however, that Vermeulen *et al.*, identify more and stronger conflicts between the innovation activities and the institutional rules and procedures (regulative forces) than we can observe in our cases. We have been able to identify only 4 minor normative legitimacy crises of a total of 23. This can be explained by the fact that Vermeulen *et al.*, investigated innovation within the highly formalized and regulated context of financial service companies. In this study, however, the focus was on radical innovation within high-tech companies that already have extensive experience with incremental innovation. We thus can

expect that the rules and procedures within high-tech companies are already much more adapted to accommodate and support incremental and radical innovation. Established high-tech companies will have institutionalized many enabling and supporting rules and procedures for innovation in general during their lifetime, while innovation in the financial service industry is much more uncommon (Vermeulen *et al.*, 2007).

An important element of the legitimacy crises typology developed in this thesis, which is less explicit in the typology of Vermeulen *et al.*, is the *pragmatic* legitimacy type. Our typology more explicitly addresses the constraining effects of institutionalized interests and needs of the organization or organizational groups. As such, this typology makes a clearer distinction between institutional interests (*e.g.* goals, targets, responsibilities) and the institutionalized rules, norms and procedures that protect these interests. This distinction is important, because it serves to identify more clearly the different logics of action to solve either pragmatic or normative legitimacy crises; for instance, if an innovation is not legitimate with respect to institutional interests, actors do not have to change the related (decision making) rules and procedures, but instead can use these rules and procedures to negotiate change of interests. Vice versa, if the innovation is not legitimate with respect to established rules and procedures, actors can appeal to established interests to justify change of these rules and procedures to allow for innovation. As such, the clear distinction between pragmatic and normative legitimacy (crises) allows to better describe empirical reality and forms a relevant addition to the typology of Vermeulen *et al.*, (2007), and consequently also to the institutional forces framework of Scott (2001).

A similar conclusion can be drawn with respect to the work of Zimmerman and Zeitz (2002). They also build upon the institutional framework of Scott (2001) (and Aldrich & Fiol, 1994) and developed a legitimacy process model to explain the survival of new ventures within industries. Their typology of legitimacy types consists of sociopolitical regulatory legitimacy, sociopolitical normative legitimacy, and cognitive legitimacy, similar to the typology of Vermeulen *et al.* (2007) and the institutional framework of Scott (2001). Similarly, we can conclude that the developed legitimacy crises typology of this thesis makes a more clearer distinction between institutional interests and needs, and the regulatory mechanisms and procedures that 'enforce' compliance with these interests (pragmatic vs. normative), than the legitimacy typology of Zimmerman and Zeitz (2002). However, our normative legitimacy crises type may be confounding, as it includes both norms and values, and the rules and procedures that should be adhered to. To clarify this, Suchman (1995) defined different sub-types for moral legitimacy to denote the difference between amongst others consequential and procedural legitimacy (norms vs. procedures, respectively) in his extended legitimacy framework. This is one way to solve potential confusion. Based on the typologies of Zimmerman and Zeitz (2002), and Vermeulen *et al.* (2007) another way would be to make a more clearer distinction between pragmatic, normative,

cognitive *and* regulative legitimacy (crises) to improve validity, consistency and comprehensiveness of the legitimacy crises typology.

### *6.3.2 Strategic responses*

As part of the micro-institutional perspective, we have extended and empirically grounded the initial legitimation strategy typology of Suchman (1995). The identification of conformation, selection and transformation strategies to augment the legitimacy of radical innovation, replicates the initial typology of Suchman. An important contribution of the typology of strategic responses is that it also accounts for non-conformation and toleration responses. These strategies do not *build* or augment legitimacy in a major way, but do enable actors to overcome a legitimacy crises and continue with innovation. These additions are for the research context of this thesis relevant extensions, so we will discuss these findings in more detail.

The typology of strategic responses as developed in this thesis shows a wider variety of options open to innovators to legitimize radical innovation within established companies (or institutions) than most other authors do. Especially, the selection, non-conformation, and toleration responses are relevant additions to the body of knowledge on innovation and legitimation within institutional systems. Most approaches to legitimation vis-à-vis established institutional logics and structures (and strategies to deal with institutional pressures) focus primarily on processes of either conformation or transformation, which have been central topics of investigation within institutional theory for years (e.g. DiMaggio & Powell, 1983; Seo & Creed, 2002; Greenwood & Hinings, 1996). For instance, the legitimation approaches as identified by Dougherty & Heller (1994) in their research on the illegitimacies of product innovation, can be categorized along the strategies of conformation or transformation of our typology (their 'usual' and 'reframed' approaches, respectively). They, however, remain primarily descriptive and do not accommodate for all the observations of this study. Our selection strategy demonstrates that within institutional systems (companies) innovating actors can search and negotiate with multiple differentiated institutional groups to find a group for which the innovation is more legitimate . The identification of a toleration response shows that although radical innovation might be illegitimate to institutional actors and groups, the multiplicity of institutional interests, norms and beliefs offer opportunities to tolerate and allow innovation to continue, because it is legitimate with respect to other valued and institutionalized interests, norms and beliefs. Institutional systems as such offer more room to innovating actors to maneuver than only conformation or transformation, and conclusive legitimacy is not always a necessity for being able to continue. Moreover, under certain circumstances, innovating actors are able to ignore the legitimacy concerns of the institutional actors and follow their own interests and actions, and continue innovation without being legitimate, *i.e.* non-conformation. This more general and broader typology of strategic responses is, as such, able to more accurately describe

the complex reality of radical innovation and legitimation within institutional systems and established companies.

It is interesting to note that the typology of strategic responses developed in this study, resembles the typology of strategies of organizations to deal with institutional pressures as defined by Oliver (1991). Although her focus is different (organizations within institutional environment dealing with institutional processes), there is a resemblance between our conformation type and Oliver's acquiesce response (e.g. habit, comply, imitate); our selection type and Oliver's compromise response (e.g. balance, bargain); our non-conformation type and Oliver's avoid and defy responses (conceal, escape / dismiss, challenge); and our transformation type resembles Oliver's manipulate response. As such, the resemblance of both typologies supports the validity and generalizability of this thesis' findings.

The toleration strategy has not been identified by Oliver (1991) and seems to be a valuable theoretical addition to the research on strategies for dealing with legitimacy and institutional pressures. One could, however, discuss whether toleration is really a strategic response or strategy of *actors* that are constrained by a lack of legitimacy or institutional pressures. Although toleration involves actions of innovating actors to appeal to the multiplicity of institutional interests, norms and beliefs, other institutional actors that allow partly illegitimate actions to continue, play a central role. It is the institutional actors that tolerate, and the innovating actor that appeals to the tolerance of institutional actors. We did include toleration as a strategic response in our typology because we identified a number of cases that demonstrated the relevance of this more 'nuanced' response to deal with legitimacy crises. It is an interesting and theoretically relevant observation, because traditional views of (organizations as) institutions would suggest that when something is perceived illegitimate, institutional actors (and institutional mechanisms) will do anything to stop the illegitimate action. That is precisely the reason why institutions remain so stable and consistent over time. The toleration response, however, suggests that this is not always the case. Institutional actors (and institutions) might be tolerant in some degree to deviations of the status quo and related illegitimate actions. Toleration in this case must not be understood as resulting from a lack of monitoring and regulating capabilities of institutional actors (or institutions), where illegitimate action is allowed because not all action can be controlled, structured or regulated. Instead, toleration involves the deliberate reflection of institutional actors on their set of institutional interests, norms and beliefs, and allowing a partly illegitimate action to continue because discontinuation (and overt control) would conflict with, or harm alternative and more highly valued institutional interests, norms and beliefs. Toleration, as such, is based upon the notion that there exists a hierarchy of institutional interests, norms and beliefs. This hierarchy enables institutional actors to make a trade-off between *allowing* or *prohibiting* illegitimate action and the respective contribution of these decisions to institutional interests, norms and beliefs. In one of the cases (LC 'Selling glass, that is something weird' of the

Reflactone innovation) one of the senior managers said that strategic fit is important for a quick start of the innovation process, but one should not be put down by a lack of strategic fit, because: "...what is not strategic today, might be strategic tomorrow...". This suggests that the toleration of (partly) illegitimate action helps the organization to cope with environmental changes in the future and become adaptive and more robust. Institutional tolerance for deviations of the status quo as such seems to be a pre-condition for institutional adaptation and survival.

So several major contributions of this thesis arise from the empirically grounding, refinement and extension of the initial typology of Suchman (1995). This study demonstrates that innovating actors have a wider variety of options to maneuver within the institutional system to legitimize and enable radical innovation. Innovating actors are not only confined to the extremes of either conforming their actions to fit with the dominant institutional order, or transforming the institutional order (*i.e.* the company) in a major way to enable innovation. The non-conformation strategy and the toleration strategy enable us to describe the actions of innovating actors more precisely, and explain that innovating actors have more room to maneuver within established companies than initially considered. Toleration allows innovating actors to continue with their illegitimate innovation ideas and helps them to proof and justify the relevance of the innovation at a later (less uncertain and ambiguous) stage. The non-conformation strategy acknowledges the reality of resisting innovating actors that ignore established practices and structures and go against the flow, potentially isolating themselves from the rest of the organization. Further research will be needed to validate these theoretical claims.

### *6.3.3 Institutional opportunities and constraints*

As part of the micro-institutional perspective, we have developed a typology of institutional opportunities and constraints that enable or confine innovating actors in their pursuit of particular strategic responses. The identification of characteristics of the institutional system and institutional position of innovating actors that enable or constrain their actions, acknowledges the assumption that institutional structures and logics have both enabling and constraining effects on the actions of social agents. Structure both enables and constrains agency. This duality of structure assumption has only received little attention in recent investigations of institutional processes at micro-levels of analysis. The study of Dougherty & Heller (1995), for instance, has not investigated the enabling and constraining effects of existing institutional arrangements on the different legitimation strategies, and we are not aware of other studies that specifically focused on these aspects in the context of innovation within established companies. Also Suchman (1995) has not focused particularly on the aspects of existing institutional logics and structures that enable particular strategies of legitimation. As such, the mere identification of the typology of institutional opportunities and constraints is an important contribution to the ongoing debate,

as it is able to explain in a better way why particular strategies are chosen and enabled by the existing logics and structures.

The typology of institutional opportunities and constraints resembles some of the institutional antecedents that predict strategic responses to institutional pressures, as defined by Oliver (1991). In her framework the 'multiplicity' of institutional constituents resembles the concept of heterogeneity in our micro-institutional perspective. In her view however, the existence of multiple institutional constituents will trigger organizations to resist institutional pressures because it is difficult for organizations to conform to all, often inconsistent, pressures from multiple constituents. In our view instead, heterogeneity offers the opportunities to select a more 'friendly' institutional group for which the innovation is more legitimate. This alternative argumentation follows from her focus on institutional pressures and the potential for *resistance* of *organizations* to these pressures, while we focus on the potential of legitimation based on existing institutional structures and logics. Another similarity refers to the concepts of constituent dependence and coercive control in Oliver's framework and the notion of regulatory regime and resource impact in our perspective. Oliver states that when the resource dependence on institutional constituents is low and coercive control is limited, organizations are more likely to resist institutional pressures; in our perspective non-conformation is also enabled by a low resource impact (*i.e.* little dependence) and a weak regulatory regime (*i.e.* limited coercive control structures). The identification of the concept of institutional ambiguity in our perspective has no direct resemblance with the other institutional antecedents that Oliver defines. Although Oliver (1991) speaks of the 'consistency' of institutional pressures this refers to the amount of consistency between organizational goals and institutional demands and does not resemble our concept of ambiguity (nor our concept of multiplicity). Another potentially similar antecedent of strategic responses as defined by Oliver is 'environmental uncertainty'. This might be translated to our perspective as being a 'trigger' for institutional ambiguity. However, according to Oliver (1991) environmental uncertainty does not lead to opportunities for transformation (as expected from our perspective), but will urge organizations to imitate and conform to established institutional logics and structures. This interesting contradiction might be clarified in future research. So although there are some similarities between both perspectives, the differences are more interesting and can be partially explained by the different focus of Oliver (1991) on actions of organizations to *resist* institutional pressures, while we focus on actions of innovating actors to *legitimate* and *overcome* institutional pressures (which is a broader focus).

Our typology of institutional opportunities and constraints, and the micro-institutional perspective, also resemble similar findings of recent institutional approaches explaining institutional entrepreneurship, embedded agency and processes of institutional change at *macro-levels* of analysis (*e.g.* Greenwood & Hinings, 1996; Seo & Creed, 2002; Dorado, 2005; Greenwood & Suddaby, 2006; Ragud, Hardy & Maguire, 2007). At first sight, we can distinguish interesting

similarities between the identified typology of institutional opportunities and constraints that enable particular strategic responses at the micro-level, and the recently developed institutional change and institutional entrepreneurship frameworks of specifically Greenwood and Hinings (1996), Seo and Creed (2002) and Greenwood and Suddaby (2006) at macro-levels of analysis (organizations vis-à-vis institutional environments). However, it is more relevant to note that our micro-institutional perspective is able to *complement* these macro-institutional perspectives in important ways. Because our micro-institutional approach and these macro-institutional approaches depart from the same ontological assumptions, it may be possible to find consistent linkages between micro and macro dynamics. In order to do so, we will shortly summarize the similar ontological assumptions and then discuss some potential linkages and apparent differences.

What is similar to the approach developed in this study and in the work of Greenwood & Hinings (1996), Seo & Creed (2002), Dorado (2005), Greenwood & Suddaby (2006) is that an institutional system (institutional structures and logics) is no longer viewed as "... an isolated, abstract phenomena but, rather, as part of a larger whole composed of multiple, interpenetrating social structures operating at multiple levels and in multiple sectors. However, the linkages among the components are neither complete nor coherent. Instead, the component social structures that make up the whole are loosely coupled and more or less autonomous..." (Seo & Creed, 2002: 225). Institutional structures and logics are no longer seen as singular, highly consistent, stringent and all encompassing systems that wholly govern human action. Another similarity is that in their work, actors are also seen as knowledgeably agents that can reflect and act in different ways than following the rules and routines of the institutional order. Consequently, actors face a more complex, fragmented, differentiated and sometimes inconsistent institutional context, which offers more opportunities for agency. Each of the above mentioned authors have identified different characteristics of these more complex institutional contexts that explain how opportunities for agency (and institutional change) arise (similar to our 'institutional opportunities and constraints' typology). Moreover, each of these authors also identify the importance of the network positions of actors (or organizations) for being aware of these opportunities and being able to seize them to initiate particular change actions (similar to our 'institutional position' claims). Also, the enabling or constraining effects of existing power structures and resource dependence relations between actors or groups, have been identified as relevant (similar to our 'regulatory regime and resource impact' claims). So both at macro-level and micro-level similar ontological assumptions lead to the identification of similar institutional dynamics and related mechanisms, although operationalized at different levels of analysis. In the remainder of this section we will elaborate on the linkages between micro- and macro-mechanisms, and identify some complementarities.

Greenwood and Hinings (1996) developed an institutional framework to explain radical organizational change within institutional fields that exert institutional pressures on the actions of organizations. They specifically focused on developing a link between external institutional pressures and dynamics and the response of internally differentiated organizational groups that shape the final response of the organization towards organizational change. In their framework the extent of tight coupling and the extent of sectoral permeability of the external institutional context determines the awareness of internal organizational actors of alternative institutional logics and potential institutional inconsistencies that can be used to initiate change. This closely resembles the concept of ambiguity of institutional logics and structures as identified in our micro-institutional perspective, and how it offers opportunities for transformation. Our concept of ambiguity denotes the shifts in interpretations of the role, function and identity of the organization vis-à-vis changes in the organization's environment. According to Greenwood and Hinings, the awareness of competing or inconsistent institutional logics and structures triggers and fuels the interest dissatisfaction of differentiated organizational groups within the organization. These differentiated organizational groups seek to further their own interests and overcome relative disadvantages and can appeal to external institutional inconsistencies to do so. This closely resembles the concept of the heterogeneity of micro-institutional systems in our perspective, which enables innovating actors to search and select organizational groups that support their innovative ideas based on their differentiated set of established interests, norms and beliefs (which reflects their perception of external institutional contexts and demands). According to Greenwood & Hinings (1996), interest dissatisfaction and the (value) commitment of organizational groups to the dominant institutional order determines the intention and motivation of organizational groups to initiate change. However, change will occur only when this intention is enabled or supported by the existing arrangement of power dependencies within the organization, and a capacity for action by the change agents. In our micro-institutional perspective, solving and overcoming legitimacy crises to gain organizational support (of organizational groups) and access to necessary resources, resembles these notions of power and resource dependence. As such, the framework of Greenwood and Hinings has some strong similarities with our perspective, but the latter perspective explains in more detail how innovating actors are able to legitimize and gain support for change and innovation, and mobilize organizational groups and resources to do so. As such, our perspective and typology operationalizes and elaborates the notions of interest dissatisfaction, power dependencies and capacity for action of the framework of Greenwood & Hinings (1996) in more detail.

In the frameworks of Seo and Creed (2002) and Greenwood & Suddaby (2006) more comprehensive explanations are offered of institutional change and institutional entrepreneurship. As said, both frameworks depart from the ontological assumption that institutional environments (or systems) are multifarious, pluralistic and fragmented. This results in inconsistencies and institutional contradictions that induce conflicts and tensions within and across

social systems, which may, under certain circumstances, shape consciousness and action to change the present order. Seo and Creed identify several different types of institutional contradictions that motivate organizations (and their organizational members) to initiate change. An important institutional contradiction stems from inefficiency concerns of the actors with respect to the dominant institutional logics and structures at industry level. Due to changes in the organization's environment dominant institutional structures may no longer be able to efficiently function in this changed environment. This closely relates to the concept of ambiguity in our micro-institutional perspective, which can be caused by changes in the interpretations of the role, function and identity of the organization within a changing environment. Our study suggests that 'changes' in these views can also be induced by the endogenous discovery of novel technologies and radical innovations (either from the organization within, or as absorption of, and response to scientific developments in the external environment) that ambiguate traditional notions of function, role and identity of the organization. In the framework of Greenwood and Suddaby (2006) the network position of organizations determines the organization's awareness of these institutional contradictions. They state that when organizations are located at a boundary spanning position within their institutional environment, they are more aware of institutional contradictions and are more aware of alternative institutional logics and structures. This resembles our notions of the institutional position of boundary spanners and expert outsiders *within* the organization. Especially, the position of innovating actors as expert outsiders enables them to be more reflexive and aware of ambiguity and alternative logics and structures outside of the organization, and as such fulfills a similar role as the boundary spanning position of organizations in the framework of Greenwood and Suddaby. This demonstrates that there are several important linkages between the micro-institutional opportunities that enable legitimation of innovation and change, and the emergence of macro-institutional contradictions in the larger institutional environment. In future research, it would be interesting to investigate these linkages in more detail.

The institutional frameworks of Seo and Creed (2002) and Greenwood and Suddaby (2006) depart from our micro-institutional perspective, in their focus on the role and actions of *organizations* to initiate institutional change. We specifically focus on what happens *within* the organization that shapes this final response or pattern of action of the organization. As such, our perspective complements the macro-perspectives in important ways. It is interesting to see however, that although the frameworks of these authors do not say anything about micro-institutional dynamics within the organization, they do identify macro-level institutional mechanisms that resemble the mechanisms and processes that we have identified at the micro-institutional level. In their frameworks the institutional contradictions lead to reflective shifts in the consciousness of potential change agents, which leads to actor mobilization. These actors (which in their view are organizations) mobilize alternative frames and logics of institutional arrangements available and relevant in the broader society, which resembles the

different ways of legitimation (*e.g.* toleration, transformation, selection) of innovating actors within organizations. And in their explanations, this enables *collective* action to initiate change, which resembles the search and involvement of multiple supporters for the innovation within a heterogeneous organization. In their view, collective action is mediated by the existing power relations and resource control of these organizations, which closely resembles the processes of legitimation of innovation vis-à-vis heterogeneous organizational groups that control resources within more or less stringent regulatory regimes, as defined in our perspective. The explanation for these similar findings at macro- and micro-levels of analysis (and institutional levels) is that we start from similar ontological and theoretical assumptions, but also the assumption that organizations *are* comprised of groups of individuals that act. It is not that organizations act or have agency, but that the actors and groups within these organizations act and shape a more general pattern of actions of the organization.

We thus can conclude that the identification of institutional opportunities and constraints within existing institutional arrangements, offers a novel and comprehensive theoretical explanation of the choice and pursuit of particular strategic responses to overcome legitimacy crises within established companies. Moreover, it enables us to link micro-institutional dynamics within organizations, to macro-dynamics at the level of organizations vis-à-vis its institutional environment. As such, it complements theoretical frameworks that explain institutional change and institutional entrepreneurship (Greenwood & Hinings, 1996; Seo & Creed, 2002; Greenwood & Suddaby, 2006), with our understanding of the internal dynamics within organizations that shape the patterns of actions of organizations towards it environment.

### *6.3.4 Alternative organizational theory approaches to radical innovation*

The development of a micro-institutional perspective on radical innovation within established high-tech companies also has some implications for and similarities with previous findings based on other theoretical approaches. In the introductory chapter of this thesis we distinguished between economic/strategic approaches, organization learning and problem solving approaches, and organizational design/structure approaches that offer alternative explanations of the difficulties (and possibilities) of radical innovation within established high-tech companies. The developed micro-institutional perspective is able to integrate some of these alternative explanations, and as such offers a more comprehensive and fundamental explanation of the difficulty and possibility of radical innovation.

Central argument emerging from the strategic/economic approaches (Christensen & Bower, 1996; Henderson, 1993; Hill & Rothaermel, 2003) is that radical innovation is inhibited by short term economic considerations and incentives favoring the exploitation of existing competencies and addressing needs of existing customers. This argument is also accounted for by our micro-institutional perspective which implies that radical innovations are often not legitimate with

respect to institutionalized interests and needs attributed to the organization or to established organizational groups. The lack of pragmatic legitimacy resembles the conflicts between radical innovation and short term economic considerations and incentives embodied within the organization. The micro-institutional perspective, however, suggests that these institutionalized interests and needs are not easily changed, as they are usually reinforced by established normative and cognitive elements of the institutional system. Changing the economic incentives and rational decision and investment making criteria is not enough to enable radical innovation. It is also necessary to adapt or transform the shared cognitive beliefs about strategic rationality and economic growth that are embodied within the organization, and the sustaining performance norms and risk avoidance norms of managerial decision makers at multiple positions within the organization. Moreover, the tolerance of managers and decision makers for 'risky' radical innovation activities can be increased by widening their set of decision criteria and incorporating both short and long term, and both real and potential organizational interests and needs.

The central argument of organizational learning approaches is that radical innovation is inhibited by rigidities of organizational routines of problem solving and decision making. Organizational routines are specialized and simplified for reasons of efficiency and bounded rationality, and strongly reflect past experiences of the organization. Established organizational routines as such direct managerial attention to what is already known and what is near to solutions that worked in the past (Henderzon & Clark, 1990; Leonard-Barton, 1992; Levinthal & March, 1993; Ahuja & Lampert, 2001). The emergence of rigid organizational routines that limit the possibility of radical innovation, resembles the cognitive legitimacy crises as identified in our perspective. Widely shared beliefs and cognitive understandings of the world and the role and function of the organization become institutionalized over time and conflict with aspects of the radical innovation. The developed micro-institutional perspective however, makes us more aware of the fact that organizational routines are not only stabilized cognitive structures that enable actors to make sense of the world efficiently and direct attention, but that organizational routines are also infused with normative notions and values, and that they also define roles and responsibilities that bestow some actors with power and resource control, at the expense of other less privileged actors. Consequently, changing organizational routines to accommodate for radical innovation does not only require unlearning or adapting shared beliefs and cognitive structures, but also involves the redistribution of power relations and resource control (which can result in strong resistance), and the propagation of novel norms and ideals that support the change of these routines. As such, we can state that the micro-institutional perspective also accommodates for some of the important explanations based on organizational learning and cognitive views of organizations, but adds some relevant notions that improve our understanding.

From an organizational design stance, bureaucratic and mechanistic organizational designs are considered to be less effective to deal with radical

technological innovation, which is a process characterized by uncertainty and complex problem solving tasks. To successfully execute radical innovation (and exploration) organizational designs should be more organic, decentralized, less formal and more loosely coupled to facilitate autonomy, experimentation and flexibility (Brown & Eisenhardt, 1995; Sheremata, 2000; Benner & Tushman, 2003; Gibson & Birkenshaw, 2004; Jansen *et al.,* 2006). The micro-institutional perspective adds to this explanation that these design solutions do not only allow complex problem solving and innovation tasks to be carried out more effectively, but that these solutions also introduce more institutional opportunities for the legitimation of radical innovation. It would be easier for innovating actors to legitimate their radical ideas when heterogeneity and ambiguity is higher, and when the regulatory regime would be less stringent. Loose coupling of organizational units and decentralization of decision making, increases the apparent heterogeneity of the organization, and consequently increases the opportunity to find alternative support for innovation ideas. Less formal and less bureaucratic design solutions would reduce the strength of the regulatory regime and increase potential ambiguity of institutional interest, norms and beliefs. This would allow innovating actors to go their own way more easily, without defending their ideas against institutional pressures. And it would offer more opportunities to introduce, merge and institutionalize novel interests, norms and beliefs with existing structures to accommodate for and legitimate radical innovation. As such, the micro-institutional perspective as developed in this thesis also replicates some of the findings of organizational design approaches, but also offers an additional explanation for these findings.

In sum, our micro-institutional perspective on radical innovation within established companies integrates some of the central notions of both strategic/economic, learning, and design approaches to organizations. As such, it is able to reconcile some of these different perspectives and offers a more fundamental and comprehensive explanation of the difficulty and possibility of radical innovation within established high-tech companies. Future research is needed to investigate the complementarities and similarities between the different perspectives and approaches in more detail.

## 6.4 Methodological discussion

In chapter 3 we have extensively elaborated on the methodological procedures and rules followed to assure the reliability and validity of this thesis' findings. However, retrospective case studies, related data collection methods and inductive qualitative data analysis methods also exhibit several limitations. In this section we will shortly address these limitations which lead to future research questions.

### *6.4.1 Reliability issues*

By definition retrospective case studies are characterized by the collection of data about events that occurred in the past. This increases the probability that interview data exhibit hindsight bias and other retrospective biases. Moreover, not all the particularities of important events may be remembered by the interviewees. Although we have taken measures to prevent hindsight (and individual) bias by cross checking the findings with multiple organizational members, by means of data triangulation and by selecting recently developed radical technological innovations (Huber and Power 1995), retrospective biases cannot be completely circumvented. To get a better and more reliable insight in the nature of legitimacy crises, strategic responses and institutional circumstances, future research studies could be designed as participant observation studies, enabling close interaction with involved stakeholders during the emergence of a legitimacy crises. Because radical innovations take long periods of time (4-10 years being no exception), cross-sectional studies focusing on single legitimacy crises have pragmatic advantages over longitudinal studies of radical innovation projects.

To assure the reliability of the category and theory development efforts of this thesis, we have taken measures to improve inter-coder reliability by using multiple researchers who have coded different parts of data based on the developed categories and resolving inter-coder differences. Moreover, explanations and coding categories have been extensively discussed with academic peers. This resulted in a set of theoretical concepts, related categories and identified legitimacy crises, responses and circumstances that can be reproduced by other investigators when working on the same set of data. In future research, this theory and category development effort does not have to be redone, but can directly be used to analyze novel qualitative data based on multiple other case studies.

### *6.4.2 Validity issues*

The validity issues concerning the findings and micro-institutional perspective of this thesis can be divided in internal validity and external validity considerations. Internal validity is essentially concerned with the justification of inferences about causal relationships, by ruling out alternative explanations. To assure the internal validity of the relationships between legitimacy crises, strategic responses and institutional circumstances we have complied with several strict theory

development and analysis procedures (Yin, 2003; Strauss & Corbin, 1998). A large case study database was build that contained all collected data to assure that no data would be missed during analysis. We used the method of constant comparison (mediating between induction and deduction) to define and validate developed categories across all 23 cases (identified within the 5 radical innovation processes at 2 different companies) and maintained a chain of evidence supporting the claims. In developing categories and relationships we considered multiple explanations and looked for data that would contradict our claims in order to refine and adapt these claims. Data collection and data analysis continued until theoretical saturation, where new data and extended analysis did no longer contribute novel insights and previous claims were replicated. Following from these protocols and based on this selection of case observations, we can safely state that the internal validity of the developed micro-institutional perspective is relatively high.

The external validity of this thesis' findings refers to the generalizability of the central knowledge claims to other radical innovation settings with different people, a different location and at a different moment in time. Because the micro-institutional perspective has been inductively developed based on a limited number of case studies (we investigated 23 legitimacy crises/responses that occurred within 5 different radical technological innovation processes at 2 different established high-tech companies) we can make no statistical generalizations to population level[18]. Hence, the findings may not be generalizable to other types of radical innovation (other than involving medical electronics, or chemical products) and not to other types of established high-tech companies (non-European, with a different age, operating in different industries). However, we have taken several measures to enhance the external validity of the developed theory and findings, which do enables us to make generalizations based on a (contextual) similarity argument. During the data analysis and theory development effort we have tried to identify *general* social mechanisms that play a central role in the explanation of the observed phenomena and not to stick to more descriptive and idiosyncratic explanations. Building upon an established and valid body of knowledge on institutional theory and legitimacy theory has additionally helped to focus on the identification and further development of these general mechanisms. Moreover, the comparison across several different cases has at least helped to reduce some of the particularities of the radical innovation and company context.

Based on these measures we have good reasons to assume that the claims and findings of this study will also hold for other radical technological innovation processes within other established high-tech companies (although we cannot say this with complete certainty and future tests are needed). Based on the generality of our claims (and the embeddedness within past institutional and legitimacy theory) we can also assume that our claims can be generalized outside of the

[18] This was also not the aim of this thesis. The aim was not to test hypothesis, but to develop theory.

context of radical *technological* innovation within established *high-tech* companies, to the context of radical innovation (and related radical organizational change) in *general,* within established companies in general, in so far as these radical innovations induce pragmatic, normative and cognitive legitimacy crises vis-à-vis the established institutional logic. Future research is however necessary to determine with certainty whether the claims and conclusions of the developed micro-institutional perspective will indeed hold for these similar, but more broadly defined organizational contexts.

## 6.5 Future research questions

Based on the findings of this study and the theoretical discussion of the resulting micro-institutional perspective, several relevant future research questions can be identified. We will first formulate several questions that address validity issues of the developed claims and propositions. Secondly, we will define some questions that address potential theoretical extensions and relationships with other perspectives.

*Validating and testing theoretical claims of the micro-institutional perspective*

As we have already argued, the claims of the micro-institutional perspective have been inductively developed based on a limited number of case studies in two particular organizational settings. Hence, it is necessary to further validate the identified legitimacy crises typology, the strategic response typology, and the institutional opportunities and constraints typology, and their interrelationships, in other research settings. One challenge for future research is to use and apply the micro-institutional perspective to investigate a number of other radical technological innovations in several other established non-European companies, within different high-tech industries (other than medical electronics and chemical products) to determine and enhance the validity of the theoretical claims.

Furthermore, the model of strategy preferences within complex institutional contexts allows us to formulate hypotheses in the future, which predict under which institutional circumstances, which strategic responses are more likely to be pursued by innovating actors. These hypotheses allow us to test the predictive value of this model across a larger number of legitimacy crises cases in the future. It is also necessary to test the underlying logic of the preferred ordering of strategic responses based on the preservation of radicalness versus required efforts and time to carry out these strategies from the perspective of innovating actors. This is an important assumption of the strategy preferences model and it is interesting to investigate what motivates innovating actors within institutionalized companies and what kind of tradeoffs they make in allocating time and effort. Does the realization of the innovation ideas motivate innovating actors primarily, or are organizational status, support and confirmation stemming from the alignment of their actions with the established institutional order also important? At what critical moment will innovating actors stop fighting the lack of legitimacy of their

innovative ideas and conform to the status quo? These relevant questions should be addressed in future research.

*Intended and unintended consequences of strategic responses*

This thesis primarily focused on the investigation of legitimacy crises, strategies favoring legitimation and the institutional circumstances that enable or constrain the strategies. It is worthwhile and relevant to more closely investigate the intended effects of each of the strategies on the amount of organizational support and the access to resources, knowledge and people. Underlying assumption of this thesis is that the different strategies have also different effects on these variables, even though they all enable innovating actors to overcome legitimacy crises. However, transformation may result in much wider support for the innovation than selection, for instance. Moreover, toleration may result primarily in some kind of temporally bound legitimacy that is easily disrupted by external and internal events that redirect strategic priorities. Besides, each of the strategies can also have unintended effects (Suchman, 1995). Conformation and selection strategies may, for instance, also lead to goal displacement by involving other stakeholders or incorporating their interests, which reduces the degrees of freedom of innovating actors and flexibility in the innovation process. Similarly, a highly effective transformation response might increase legitimacy and support in a major way, but can also lead to early escalation of commitments and early lock-in into novel interest, norms and beliefs, which reduces the flexibility of the radical innovation process and can set expectations too high and rigid. Because this thesis focused primarily on the direct effects on the legitimacy of innovation, it is interesting to investigate more closely relevant other intended and unintended effects of the different strategic responses.

*Process dynamics*

A related and promising avenue for future research is to investigate the dynamics and sequence patterns of strategic responses over time. In this study we primarily investigated legitimacy crises and strategic responses *across* cases, and not longitudinally (although the histories of the radical innovation processes are described longitudinally). The data suggest however that we might be able to identify recurring and typical patterns of succeeding strategic responses over time (using event and process analysis *cf*. Poole *et al*., 2000). The intended and unintended effects of the strategic responses (goal displacement, escalating commitment, increased embeddedness) may exclude the use of particular strategies in the future and narrow down the options. As such, the choice for particular strategies may be path-dependent on previous strategies (and crises) and may not only be affected by local institutional circumstances bound in time and space. For instance, when conformation responses are used to solve legitimacy crises in the beginning of the innovation process, this may limit the opportunities at a later stage to initiate transformation or selection due to the co-opting of stakeholders and increased embeddedness into established logics and structures.

The frequent use of non-conformation responses in the beginning of an innovation process may lead to recurring legitimacy crises at a later stage, which may be difficult to solve by conformation or selection strategies because the non-conforming actors have alienated themselves from the rest of the organization. It is very interesting and relevant to understand these potential 'path' dependencies between the different strategic responses (and related legitimacy crises) and get insight in potential *vicious* or *virtuous* cycles of legitimation (Masuch, 1985) that enable, stall or unintentionally undermine the realization of radical innovation within established high-tech companies.

*Linking micro- to macro-institutional dynamics*

As argued in section 6.3.3 on the theoretical discussion of the typology of institutional opportunities and constraints, several potential linkages exist between micro- and macro-institutional perspectives on innovation and institutional change that require further study and elaboration. The micro-institutional perspective developed in this thesis accounts for institutional processes and legitimacy crises that concern radical innovation *within* established companies. The organization and organizational groups reproduce institutionalized sets of interests, norms and beliefs for which the innovation can be more or less legitimate. These institutional sets of interests, norms and beliefs however, are however not the result of only *inwardly* focused institutional processes, but are partially reproduced and influenced by the external environment of the organization. The different organizational groups develop differentiated institutional logics and structures in their interaction with the outside world. And their reproduction partially depends on expectations held by external stakeholders like customer groups, governmental agencies, shareholders, and professional organizations. The organization must thus not be viewed as a closed system. This implies that legitimacy crises of radical innovation within established companies may not only reflect local micro-institutional pressures, but may reflect external institutional pressures exerted by institutional logics and structures at the sectoral or industry level. Hence, although we focused on legitimacy crises of radical innovation within organizations, it is very likely that radical innovations may also encounter legitimacy crises that extend the boundaries of the organization, and involve external stakeholders of the organization (*e.g.* customers, standardization organizations, shareholders, etcetera). It is thus very insightful to investigate these boundary issues of internal and external legitimacy crises during radical innovation by established companies, and how innovating actors deal with this different demands for legitimation.

Moreover, as argued in section 6.3.3, the micro-institutional opportunities identified (*e.g.* ambiguity, heterogeneity, multiplicity) contain linkages to institutional contradictions that are enacted at the level of the institutional environment of the organization. Local ambiguity of micro-institutional logics may reflect institutional contradictions at the industry level. The heterogeneity of micro-institutions (organizations) and multiplicity of micro-institutional logics

and structures can reflect the potentially inconsistent demands of multiple external stakeholders and institutions at the sector and industry level. It is thus highly relevant to investigate how institutional contradictions external to the organization create and influence the institutional opportunities at micro-levels of analysis within the organization. Investigating these linkages will enable us to better understand how macro-institutional processes and micro-institutional processes are related and both influence the realization of radical technological innovation within local and larger institutions.

### 6.6 Practitioner implications

The results of this thesis are primarily of a theoretical nature and inform the ongoing scientific debate about innovation within organizations and institutions. The findings however, also help to get better insight in the complex struggles that innovating actors face to legitimate their radical innovation ideas within established companies. The findings have several relevant implications for radical innovators (and senior managers) within established companies to enable radical technological innovation in a better way. These implications are not of a prescriptive nature, but must be seen as emancipatory and enhancing the reflexivity of both innovators and senior managers. Being more reflexive and aware of the complexities and legitimation struggles surrounding radical innovation enhances the agency of practitioners and allows them to choose differently from what they would always do in these situations.

Realizing radical technological innovation within established high-tech companies does not only require dedication to solve technical problems, but also requires dedication to build a bridge between novel ideas and the established organization. During the radical innovation process, innovators will probably encounter multiple legitimacy crises at several moments in time, which need to be overcome to gain organizational support and access to resources, knowledge and people. This thesis shows what type of legitimacy crises innovators encounter and what strategies they can use to overcome these crises, which also informs the type of skills they need to be successful.

Realizing radical innovation ideas will often lead to the emergence of either pragmatic, normative or cognitive legitimacy crises, because they introduce novel technological principles, novel technological competencies, novel application areas, and novel products that target novel customer groups of the organization. Radical innovation ideas as such can conflict with strongly vested interests of established organizational groups, bureaucratic rules and procedures, widely shared norms and values for doing business and realizing innovation, and rigid thought worlds of senior management and established groups within the organization. These vested interests, norms and rules, and thought worlds are related and often mutually reinforce each other. This makes the debates about these legitimacy conflicts complex and difficult to solve, but also crucial to gain organizational support and access to resources, knowledge and people. These

legitimacy crises will most likely occur when the radical innovation ideas need substantial support in terms of resources (investment decisions), when intra-organizational boundaries are crossed to get access to knowledge and competencies of others, and when collaboration with other organizational groups is necessary to successfully realize innovation. At those moments, innovators should be aware that legitimacy crises will emerge and that they need to dedicate time and efforts to legitimate their ideas. Innovators should be aware of the fact that their innovation ideas might not only conflict with strategic priorities and economic goals (pragmatic aspects) of senior management, the organization or organizational groups, but they most often also conflict with particular views of organizational reality, identity and organizational boundary definitions. Moreover, the innovation ideas and related activities may conflict with strongly held norms and rules for doing work and innovation at the organization or group. This suggests, that innovators should not only address the economic and interest based aspects of the innovation (by developing a business case), but must also address more deeply embedded views of reality and identity, and norms and rules for doing work and business. If these conflicts are tackled more fundamentally, organizational support will be stronger and more robust, and access to resources, knowledge and people will be sustained into the future.

As the identification of the different legitimation strategies shows innovators can choose from a number of options and approaches to solve emerging legitimacy crises. A non-conformation strategy will allow the innovators to continue with their innovation ideas (when they have sufficient resources themselves) but it doesn't tackle the more fundamental legitimacy problems of their ideas. These legitimacy crises can be ignored for the time being, but will probably resurface when collaboration across intra-organizational boundaries is required and larger investments are necessary. So although non-conformation can be useful at the short term, innovators should be aware that the legitimacy crisis is not solved and needs to be tackled at a later stage. Similarly, innovators can appeal to the multiplicity of institutional interests, norms and beliefs to allow for toleration of their partly illegitimate innovation ideas. Toleration is more easily achieved when the resource impact on the organization is kept low, so when it is possible resource demands should be minimized. Although toleration allows innovators to continue with their innovation, it is also a temporal and fragile state. As organizational circumstances change and new strategic events occur, the hierarchy of institutional interests, norms and beliefs might be restructured, leading to different priorities, which might de-legitimize the innovation again. Toleration as such, does not create a stable safe haven for innovators and their ideas, and deeply felt legitimacy issues must inevitably be addressed more fundamentally at a later stage. A more effective legitimation strategy would be to search and explore the organization for potential supporters for whom the innovation ideas are already more legitimate. Innovators must thus step outside the confined and safe boundaries of their own organizational groups and actively promote their innovation ideas throughout the organization to discover potential supporters and collaborators. Innovators can improve the chances of finding a more friendly group of supporters or

collaborators by improving their boundary spanning position (becoming member of cross-organizational teams, committees, initiatives) or involving actors with such a boundary spanning position in their innovation team (for instance, senior managers). Also defining and framing innovation ideas in a broader way allows them to appeal to a broader set of organizational groups with differentiated sets of institutional interests, norms and beliefs. If this strategy is to be pursued, innovators should dedicate sufficient time and efforts to the search, promotion and negotiating process with alternative organizational sponsors. The transformation strategy is focused on fundamentally solving apparent legitimacy problems concerning the radical innovation ideas. It also requires dedicated amounts of time and efforts by the innovators to successfully complete such a strategy. Transformation is aimed at introducing, propagating and institutionalizing novel interests, norms and beliefs, which is a complex and time consuming process. It aims to convince senior management and other organizational groups of necessary changes to the established logics and structures of the organization. It propagates changes in established strategic goals and plans, changes in the way of thinking about organizational identity and reality, and aims to change existing rules and procedures. The success of such a strategy is enhanced by linking novel interests, norms and beliefs (that legitimate the innovation) to apparent ambiguous debates about the strategic future of the organization and inconsistencies between the current view of the organization and changes in the organization's environment. Involving expert outsiders to frame these ambiguities and inconsistencies and the consequential need for change helps to justify these novel interests, norms and beliefs (evidently, this role can also be fulfilled by senior management). Finally, when all other strategies fail or when no opportunities are present to pursue them, a conformation strategy may enable innovators to solve the legitimacy crisis and continue with the innovation process. However, incorporating interests and needs of established organizational groups, complying to existing rules and procedures, or reframing the innovation to match established views of organizational reality, may lead to illogical or impossible adaptations to the innovation plans. When this occurs, innovators may decide to withdraw their ideas and postpone them to a later stage when the organizational circumstances seem more favorable.

Innovators within established high-tech companies can enlarge the number of options for legitimation by improving their organizational positions. Participating in cross-organizational unit initiatives, committees or social activities, improves their boundary spanning position and makes them more aware of the opportunities of heterogeneity and their ability to seize these opportunities. Hence, innovators (or members of the radical innovation team) should be good social networkers that feel comfortable working across intra-organizational boundaries. Furthermore, innovators (or members of the innovation team) should have access to expert outsiders (either outside or inside of the organization) that can be involved in transformation strategies to justify necessary changes in established interest, norms and beliefs. Hence, it is important to establish good connections with experts in the field of interest that also know the organization,

and who are able to build a bridge between environmental changes, radical innovation and the established organization.

In order to be successful at the legitimation of radical innovation within established companies and get support and access to necessary resources, knowledge and networks, innovators (and their teams) benefit from several related skills. Evidently, innovators must be highly skilled in their technical professions to deal with the technological complexities and puzzles of innovation. They must however, also have well developed negotiation skills to convince senior management and organizational groups of the legitimacy of their radical innovation ideas. This does not only call for 'pure' negotiation skills over value, benefits and interest, but also skills of rhetorics and the creative use of language to envision novel organizational possibilities that legitimate radical innovation. Innovators must have the sensitivity and abilities to appeal to norms, values and beliefs to induce change and legitimate innovation. As such, innovators should be both dedicated to their technological innovation, and be dedicated to fight for their ideas, understand legitimacy concerns, and build a bridge between the innovation and the established organization.

## 6.7 Conclusions

Innovation is among the top strategic priorities of many CEOs of large established companies. Current technological and scientific developments have a strong impact on the competitive and industrial landscape of many established companies, and newcomers are able to seize many of the opportunities in a more effective and agile way. Being able to successfully realize radical innovation within established companies is thus of crucial importance for long term survival and sustained corporate growth. However, radical innovation appears to be very difficult for established companies and most attempts fail because of organizational inertia, bureaucratic rigidity and conservative mindsets. Consequently, there is a clear need to understand the reasons why radical innovation is so difficult for established companies, but also to understand why some established companies are indeed relatively successful in realizing radical innovation despite these difficulties.

Until now, organizational researchers have addressed the problem of radical innovation from a variety of theoretical perspectives which lead to complementary, but also fragmented insights. Moreover, some of the recent work seemed to only scratch the surface of more fundamental problems related to radical innovation in established companies, and consequently proposed solutions that not really solve problems or remain trivial. We argued that a (micro-)institutional perspective on radical innovation in established high-tech companies is able to offer a more fundamental and more comprehensive explanation of both the difficulty and possibility of radical innovation. An institutional perspective on innovation and organizations acknowledges the view that organizations are more than rational, instrumental structures to achieve designated goals, but that they are infused with

values, norms, vested interests and shared views of organizational reality, which are reproduced by its organizational members on a day to day basis. And exactly those institutional aspects of organizational life are for a large part responsible for the difficulties of radical innovation within established companies. However, institutional theorists argue that these institutionalized aspects of organizational life also contain the seeds of organizational change that allow radical innovation to be realized. Although previous researchers have already addressed various aspects and elements of an institutional understanding of innovation within organizations, a comprehensive institutional perspective on radical innovation within established companies at a micro-level of analysis is still lacking. Hence, developing such a micro-institutional perspective on radical innovation seemed a promising research avenue to further our understanding of radical innovation within established companies. We formulated the objective of this thesis accordingly:

> The objective of this thesis is to develop an empirically grounded micro-institutional perspective on radical innovation within established high-tech companies that explains both the difficulty and possibility of radical innovation within established companies, by examining both the constraining and enabling effects of institutional logics and structures on the actions of radical innovators.

Building upon past institutional research and legitimacy theory (Suchman, 1995) and incorporating ontological assumptions of structuration theory (Giddens, 1984) a multiple embedded case study has been conducted to answer three important research questions in order to develop the micro-institutional perspective on radical innovation within established companies. For each of the research questions we will summarize the answers and main conclusions.

*Legitimacy crises*

Past research has argued that innovations frequently fail within established companies because they lack legitimacy vis-à-vis institutional logics and structures (Dougherty & Heller, 1994). Legitimacy is necessary to gain (organizational) support for innovative ideas and get access to necessary resources, knowledge and people (Aldrich & Fiol, 1994; Suchman, 1995; Lounsbury & Glynn, 2001; Zimmerman & Zeitz, 2002). Although previous researchers have investigated legitimacy problems of product innovation within established companies, the identified typology of illegitimacies, remains rather descriptive and does not specifically address radical technological innovation within established high-tech companies (Dougherty & Heller, 1994). Also most researchers tend to treat legitimacy as a one-dimensional concept and have not empirically investigated what types of legitimacy crises hinder innovation (Aldrich & Fiol, 1994; Lounsbury & Glynn, 2001; Zimmerman & Zeitz, 2002). Following from this, the first research question of this thesis was defined as:

1. What types of legitimacy crises do innovators encounter during their pursuit of radical innovation activities within established high-tech companies?

Building upon the legitimacy typology of Suchman (1995) we have empirically grounded and refined a legitimacy crises typology, consisting of pragmatic, normative and cognitive legitimacy crises. Pragmatic legitimacy crises involve a lack of fit between the radical innovation ideas and institutionalized interests of the organization or organizational groups. Pragmatic legitimacy essentially concerns the beneficiality of the radical innovation with respect to established interests. Normative legitimacy crises involve a lack of fit between the radical innovation ideas and institutionalized norms and rules of the organization or organizational groups. Normative legitimacy is essentially concerned with the appropriateness of the radical innovation with respect to established norms, values and rules. Cognitive legitimacy crises involve a lack of fit between the radical innovation ideas and institutionalized beliefs and views of organizational reality. Cognitive legitimacy is essentially concerned with the comprehensibility of the radical innovation with respect to established and widely shared beliefs and cognitive schemata. During the five different radical technological innovation processes at two different high-tech companies we identified a total of 23 different legitimacy crises. The majority of these legitimacy crises concerned either pragmatic or cognitive legitimacy crises, and only 4 legitimacy crises were of a normative type. The identified legitimacy crises in the different radical innovation processes inhibited the innovation process and needed to be solved or otherwise overcome, in order for the innovating actors to continue (see chapter 4 for an extensive elaboration)

As such, we have answered research question one and developed an empirically grounded legitimacy crises typology concerning radical innovation within established high-tech companies. This typology improves our understanding of the reasons for the difficulty of radical innovation within established companies. These difficulties emerge because radical innovation is often not legitimate with respect to firmly held and institutionalized interests, norms, rules and beliefs, and consequently receives little organizational support and gains limited access to resources, knowledge and people needed to realize the innovation successfully. This demonstrates how existing institutional logics and structures limit and hinder the realization of radical innovation within established companies. The legitimacy crises typology is an important contribution to previous institutional research on innovation and forms an important part of the developed micro-institutional perspective.

*Strategies to address legitimacy crises*

Past institutional research has identified several different strategies of actors (and organizations) to deal with a lack of legitimacy and related institutional pressures for conformity (Oliver, 1991; Dougherty & Heller, 1994; Suchman, 1995;

Greenwood & Hinings, 1996; Lounsbury & Glynn, 2001; Zimmerman & Zeitz, 2002; Seo & Creed, 2002). Most empirical studies have focused on either processes of conformation to institutional logics and structures, or processes of transformation of institutional logics and structures to allow for innovation and change. The frameworks of Oliver (1991) and Suchman (1995) however suggest that innovating actors might have a wider variety of strategies available to augment legitimacy and overcome legitimacy crises. However, most of the suggested and identified strategies, have been defined at macro-levels of analysis (organization versus its institutional environment) and have only been limitedly grounded in empirical reality. Hence, it is necessary to investigate particularly the strategies used by innovating actors to overcome legitimacy crises in the context of radical innovation within established high-tech companies. This would enable us to more comprehensively understand how innovating actors are able to overcome these crises and realize radical innovation nevertheless. Following from this, we defined research question two as:

2. What strategies do innovators use to address legitimacy crises, potentially augmenting the legitimacy of their radical innovation activities within established high-tech companies?

Building upon the legitimation strategy typology of Suchman (1995) we have developed an empirically grounded typology of strategic responses used by innovating actors to overcome legitimacy crises, and which potentially augment the legitimacy of their radical innovation ideas and activities. The initial typology of Suchman (1995) has been extended with two novel strategy types, namely non-conformation and toleration. These two strategies complement the previously identified strategies of conformation, selection and transformation. A conformation strategy involves the adaptation of innovation ideas and activities to better match institutionalized interest, norms and beliefs. During conformation, innovating actors incorporate established interests in their ideas, comply with the existing norms and rules, and adopt widely shared beliefs and cognitive schema to frame the radical innovation. If adaptation of ideas and activities is not possible for technological or logical reasons, conformation entails withdrawal and cancellation of (parts of) the radical innovation ideas, or postponement of these ideas to a later moment. Selection strategies involve the search and selection of alternative organizational groups within the organization for which the radical innovation ideas are more legitimate and better fitting with their differentiated set of established interests, norms, rules and beliefs. Selection does not require any adaptations to the radical innovation ideas or activities that would make it less radical. A transformation strategy involves the introduction, propagation and institutionalization of novel interests, norms and beliefs that better legitimate the radical innovation ideas. Transformation, as opposed to conformation, does not entail an adaptation of the radical ideas, but instead existing institutional logics and structures are changed and reconfigured with novel interests, norms and beliefs to accommodate (for) the radical innovation in a better way. A toleration strategy occurs when the institutional actors allow the (partly) illegitimate radical

innovation to continue, because prohibiting the innovation would damage other more valued institutional interests, norms and beliefs. A non-conformation strategy refers to the actions of innovating actors to deliberately ignore the legitimacy concerns of institutional actors completely and continue innovation nevertheless. During non-conformation innovating actors do not adapt plans, ideas and activities, and do not improve the legitimacy of their radical innovation.

Based on the extensive case analysis we showed that innovating actors within established companies use these different strategies to deal with legitimacy crises. The majority of strategies used by innovating actors in the five different radical innovation processes concerned conformation (10 out of 23), followed by transformation (6 out 23). Selection and toleration strategies could both be observed in three separate instances of a legitimacy crisis, and non-conformation was only identified one time. It is important to note that during each of the radical innovation processes multiple different strategies were used to deal with separate legitimacy crises that occurred over time. The developed typology of strategic responses to legitimacy crises demonstrates that innovating actors use a wider variety of strategies to overcome legitimacy crises than previously identified and proposed. As such, the strategies of non-conformation, toleration and selection are important additions to our understanding of how radical innovation is legitimated, continued and realized within established high-tech companies, even though radical innovation is initially plagued by a lack of legitimacy. The typology of strategic responses is an important part of our micro-institutional perspective as it defines how innovating actors exercise their agency and overcome legitimacy crises.

*Institutional opportunities and constraints*

Although past institutional research on innovation within established companies (*e.g.* Dougherty & Heller, 1994; Vermeulen *et al.*, 2007) has acknowledged actors' agency and freedom to initiate different strategies to overcome legitimacy crises and augment the legitimacy of innovation, the characteristics of the institutional context (or system) that enable actors to do so, remain relatively unexplored. Recent research on institutional entrepreneurship and institutional change at macro-levels of analysis (organizations within their institutional environments) suggests however that not all actors (organizations) are equally well positioned to initiate particular strategies and that not all institutional circumstances allow for the same strategies to be followed (DiMaggio, 1988; Greenwood & Hinings, 1996; Scott, 2001; Seo & Creed, 2002; Dorado, 2005; Greenwood & Suddaby, 2006). In order to develop a micro-institutional perspective on radical innovation within established high-tech companies, it was thus necessary to investigate in more detail and at micro-levels of analysis which institutional circumstances enable innovating actors to initiate particular strategies to augment the legitimacy of radical innovation activities. This led to the formulation of the final research question:

3. What institutional circumstances enable or constrain innovating actors seeking to pursue particular strategies to augment the legitimacy of their radical innovation activities within established high-tech companies?

Building upon the ontological assumptions of the duality of structure and the reflexivity of social agents of Giddens's structuration theory (Giddens, 1984; de Rond, 2003) we developed a typology of institutional opportunities (and constraints) that are used by innovating actors to initiate particular strategic responses. The typology defines four characteristics of the dominant institutional logic and structure that offer innovating actors the opportunities to pursue specific strategies. First of all, the strength of the regulatory regime (consisting of formal decision making rules and resource allocation rules) influences the choice for either a non-conformation strategy or the other strategies. When the regulatory regime is weak, this offers innovating actors the opportunity to ignore legitimacy concerns and follow a non-conformation strategy. When it is strong, the other strategies will more likely be followed. Secondly, the multiplicity of institutional logics and structures, refers to the co-existence of multiple alternative and sometimes competing institutionalized interests, norms and beliefs. When the multiplicity is high, this offers the opportunity to innovating actors to appeal to the tolerance of institutional actors. Innovating actors can appeal to alternative and competing institutional interests, norms and beliefs that seemingly better legitimate their radical innovation ideas, and convince institutional actors to tolerate their partly illegitimate innovation ideas based on these competing interests, norms and beliefs. Thirdly, the heterogeneity of the institutional context refers to the existence of multiple institutional groups within the organization that have differentiated sets of institutionalized interests, norms and beliefs. As such, heterogeneity offers the opportunities to innovating actors to pursue a selection strategy and search for a group for which the innovation is already more legitimate. Fourthly, the ambiguity of institutional logics and structures refers to the existence of conflicting or confusing interpretations of institutional interests, norms and beliefs. The ambiguity of institutional logics can be used by innovating actors to initiate a transformation strategy and introduce and propagate novel interests, norms and beliefs into the existing institutional order. These four characteristics of the institutional context (*i.e.* institutional opportunities) enable (or constrain) innovating actors in their choice for the five different strategic responses.

We have also identified two characteristics of the institutional position of innovating actors that allow them to more easily seize the institutional opportunities identified before. When innovating actors are located at a boundary spanning position within the organization, they will be more aware of the heterogeneity of the institutional context and will have more easily access to potential alternative sponsors or collaborators. A boundary spanning position is characterized by a central position in-between different (more coherent) social networks within the established organization. When innovating actors have an

expert outsider status, they are more aware of alternative institutional logics and structures and changes in the environment of the organization. This enables them to reflect on and potentially ambiguate existing institutional arrangements more easily. Moreover, their expert status and outside experience grants them legitimacy to question commonly held interpretations of the dominant institutional logic more easily, within the organization. These two characteristics of the institutional position of innovating actors operates in tandem with the institutional opportunities (and constraints) identified above, and explains why and how innovating actors are able to initiate the different strategies to overcome legitimacy crises.

This empirically grounded typology of institutional opportunities and constraints is a relevant and novel contribution to previous institutional work on innovation within established companies, although similarities can be identified with several macro-institutional perspectives developed recently (Oliver, 1991; Greenwood & Hinings, 1996; Seo & Creed, 2002; Greenwood & Suddaby, 2006). The typology of institutional opportunities and constraints forms an important part of our developed micro-institutional perspective and operationalizes the ontological assumptions of the duality of structure and the reflexivity of social agents. As argued, institutional logics and structures do not only limit radical innovation by causing legitimacy crises, these structures also empower and offer the opportunities to innovating actors to solve these legitimacy crises. Moreover, innovating actors may even create the institutional circumstances to be appropriated for the legitimation of their activities.

*Concluding remarks*

The micro-institutional perspective developed in this thesis consists of the typologies of legitimacy crises, strategic responses, and institutional opportunities and constraints, and the relationships between them. This micro-institutional perspective offers a fundamental and comprehensive explanation of the difficulties and possibility of radical technological innovation within established high-tech companies. It demonstrates that although radical innovations are inhibited by emergent legitimacy crises, innovating actors can overcome these crises if they are willing and able to seize the institutional opportunities around them. Innovators should not be put down by an initial lack of legitimacy, because heterogeneity, multiplicity, ambiguity and weak regulatory regimes offer many opportunities to legitimate radical innovation, and gain organizational support and access to necessary resources, knowledge and people. We hope this novel perspective on radical innovation enables organizational scholars to develop more fundamental and more effective organizational solutions for established companies to become more innovative, although future research remains necessary. And when this novel perspective also helps practitioners and innovators of this world to become more aware and reflexive of both the complexity *and* possibility of radical innovation within established companies, this thesis has succeeded in its objective.

# Appendix: Overview of the case analysis

# Case 1: AlphaSys – DaXo

| Case | Legitimacy crisis | Institutional circumstances | Strategy |
|---|---|---|---|
| LC 1.1<br>Biology is a new way of working | *Cognitive*<br><br>A new way of thinking (biology) was less legitimate with respect to the established way of thinking and developing technological solutions based on the dominant logic of physics, electronics and engineering.<br><br>*Normative*<br><br>A new way of working (biology has a focus on experimentation) was less legitimate with respect to the established way of working (physics, electronics have a focus on simulation). | *Ambiguity*<br><br>• Application of the established procedures and norms on the 'biologists way of working' did not lead to satisfying results, which challenged and ambiguated the applicability of the established procedures and norms.<br><br>*Expert outsiders*<br><br>• | *Transformation*<br><br>Adapting established way of working to incorporate novel 'biologists' way of working and giving the biologists more room for experimentation. |
| LC 1.2<br>Developing a competency in molecular biology and biochemistry | *Cognitive*<br><br>Developing a novel competency in 'biochemistry' was not legitimate with respect to the established view of organizational identity and the common understanding of what an 'electronics' company is and does. | *Ambiguity*<br><br>• Paradigm and industry changes challenge and fuel the ambiguation of the consistency and fitness of established views of organizational identity.<br><br>*Expert outsiders*<br><br>• Expert outsiders (Prof. Burton and the | *Transformation*<br><br>Popularizing a new industry model and new role that the company can play in the changing industry of merging bio- and hardware technologies, which better legitimates the new competency. |

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| | | NBD team of Newman) stimulate and initiate the ambiguation and transformation process. | |
| LC 1.3 We don't want to get wet | *Cognitive*<br><br>Developing a novel competency in 'fluids' was not legitimate with respect to the established view of organizational identity and the common understanding of what a 'hardware' company is and does.<br><br>*Pragmatic*<br><br>Dominant groups think that a 'hardware' company cannot excel in a 'fluid' competency. Developing this new competency was thus not seen as beneficial, but instead as a high risk. | *Ambiguity*<br><br>• Presenting facts that ambiguate the established view of organizational identity: 'we are not only a hardware company, but we have also worked for years with fluids in other technologies'.<br><br>*Expert outsiders*<br><br>• Expert outsiders (Prof. Burton and the NBD team of Newman) stimulate and initiate the ambiguation and transformation process. | *Transformation*<br><br>Demonstrating the relatedness and familiarity of novel competency with the company and reframing organizational identity accordingly.<br><br>Stimulating novel interests by demonstrating the benefits of the integration of the new competency with the established competencies. |
| LC 1.4 What is the link with traditional imaging? | *Cognitive*<br><br>The radical innovation was not legitimate with respect to the established view of what the companies' business is and what its' product lines are. The innovation does not build upon or directly relates to the existing product lines. | *Ambiguity*<br><br>• The novel and still relatively ambiguous concept of the 'total care cycle' business/-product portfolio is used to initiate transformation.<br><br>*Expert outsiders*<br><br>• - | *Transformation*<br><br>Popularizing and establishing a new model of the AlphaSys business and product portfolio, which incorporates and positions the DaXo innovation in a more legitimate way. |

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| LC 1.5 Budget and hiring processes don't match required flexibility | *Normative*<br><br>The need of the radical innovation team for fast, flexible and empowered decision making was not legitimate within the context of the established procedures, formalities and norms at the company. | *Stringent regulatory regime*<br><br>• explicit formal procedures for budget and resource allocation strongly embedded in institutional structures<br>• decision making authority resides at upper management levels | *Conformation*<br><br>Compliance with the established procedures and norms for budget approval and personnel hiring within the company, although this limited the flexibility of the innovative actors. |
| LC 1.6 Golden standard in sepsis diagnosis | *Normative*<br><br>The radical innovation is based on a novel technological principle. This novel principle was less legitimate with respect to the established working practices, standards and procedures of the potential users/customers. | *Not applicable / external legitimacy crisis* | *Transformation*<br><br>Stimulating novel interests and needs of the customer by demonstrating and validating relative advantages of the radical innovation. Involving leading experts in the field that support the radical innovation. Establishing new industry and user guidelines and norms that support the radical innovation. |

# Case 2: AlphaSys – Zapim

| Case | Legitimacy crisis | Institutional circumstances | Strategic response |
|---|---|---|---|
| LC 2.1<br>Distinguishing Zapim from established technologies | *Cognitive*<br><br>The ideas to establish the radical innovation as an independent technology and new business was not legitimate with respect to commonly held interpretations of the innovation as a 'variant' of already existing technology. | *Ambiguity*<br><br>• Confusion about the categorization of the Zapim innovation as being a variant of the established 'MR-technology' is used to initiate transformation.<br><br>*Expert outsiders*<br><br>• - | *Transformation*<br><br>Innovative actors invent and popularize a new label ('imaging tracer') for particular components of the technology to make a clear distinction between the 'old' and 'new' technology. |
| LC 2.2<br>Publication and the wake of competition | *Cognitive*<br><br>The ideas to publish in a major journal about the radical innovation and thus stimulate the interests of the academic community was not legitimate with respect to the established 'business and competitive advantage' frame of reference at the product division.<br><br>*Pragmatic*<br><br>The ideas to publish in a major journal about the radical innovation and thus stimulate the interests of the academic community was not legitimate with respect to the established strategic goals and interests of the product division. | *Weak regulatory regime*<br><br>• lack of formal procedures delineating decision authority<br>• lack of resource control influence of institutional actors | *Non-conformation*<br><br>The innovative actors push forward and decide to publish the article without consent of the product division. |

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| LC 2.3 Finding a place in AlphaSys | *Pragmatic*<br><br>The ideas to integrate the radical innovation with an existing technology and commercialize it through the related business unit was not legitimate with respect to established ('financial performance') goals and responsibilities of this business unit. The required investment in the radical innovation did not help the business unit achieve its performance targets on the short term. | *Stringent regulatory regime*<br><br>• the decision making authority for 'contract research' projects resides at the SBUs of AlphaSys<br>• the SBUs of AlphaSys have control over the necessary resources for 'contract research' projects. | *Conformation* (postponement)<br><br>The ideas to integrate the Zapim technology with existing technology are not pushed forward. The innovative actors decide to wait until a later stage, when technical risks are smaller and circumstances at the business unit more favorable. |
| LC 2.4 Too risky to invest | *Pragmatic*<br><br>The ideas to continue with research and development of the novel technology was not legitimate with respect to the established goals and responsibilities ('focus on high performance targets and core business' at the Technology Office of the product division.<br><br>*Cognitive*<br><br>The argumentation used to justify continuation with the novel technology was not legitimate with respect to the established criteria and models for technology funding (the 'business potential' logic) in use at the Technology Office of the product division. | *Heterogeneity*<br><br>• Multiple product / business units within product division<br>• CTO Office at product division<br>• Multiple technology incubators<br>• Research department / multiple research groups<br><br>*Boundary spanner*<br><br>• The director of the research program RPIS (Mr. Boisson) at the research department has many working relations with the different business units, CTO Office, but also most research groups, and the different management committees at the research department. | *Selection*<br><br>After a search process an alternative source of funding is negotiated with the Research department itself. The idea for the technology (development) satisfied the funding criteria ('lab venture') and interests of the Research department. |

# Case 3: AlphaSys – Icon

| Case | Legitimacy crisis | Institutional circumstances | Strategic response |
|---|---|---|---|
| LC 3.1<br>Canceling development budget for Icon MR | *Pragmatic*<br><br>Investing in the radical innovation project was not legitimate with respect to the established interests of senior management and their dominant focus on maximizing short-term business profitability and shareholder value. | *Stringent regulatory regime*<br><br>• the final decision making authority for all innovation projects resides at the CEO and board of management of AlphaSys<br>• the CEO and board of management of AlphaSys have control over necessary resources for this specific project | *Conformation* (postponement)<br><br>Compliance with the established interests and focus of the CEO and senior management. The radical Icon project was put on hold and budgets were recalled. At a later stage, when organizational conditions seemed more favorable, the project is started up again. |
| LC 3.2<br>Developing an Icon Pavilion for CT | *Cognitive*<br><br>The radical innovation was not legitimate with respect to the established view and approach of the market and the established value proposition model of the existing business unit.<br><br>*Pragmatic*<br><br>The radical innovation was not legitimate with respect to the established interests and goals of the business unit, following out of their market approach and value proposition. | *Heterogeneity*<br><br>• Multiple sales organizations<br>• Multiple product / business units within product division<br>• Cross business unit networks<br>• CTO Office at product division<br>• Multiple staff departments at corporate level<br>• Cross product division networks<br><br>*Boundary spanner*<br><br>• One of the North American sales managers (Ms. West) was also part of a 'cross product division' network and | *Selection*<br><br>After a search process an alternative supporter (corporate marketing executive/CMO) agrees to sponsor the initiative, because he had better matching interests/needs and a shared view of the future of the company. |

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| | | had good working relations with members of the other product divisions, the sales organizations, and corporate staff units. | |
| LC 3.3 Multilevel solutions and business boundaries | *Cognitive*<br><br>The multilevel aspects of the radical innovation were not legitimate with respect to the established business scope definitions of individual business units.<br><br>*Pragmatic*<br><br>Investing in aspects/components of the radical innovation that transgressed established business boundaries and related responsibilities and interests was seen as not beneficial to the individual business units. | *Stringent regulatory regime*<br><br>• decision making authority for development projects resides at the SBUs of AlphaSys.<br>• The SBUs own and control the necessary budgets and resources for development projects. | *Conformation*<br><br>Adaptation of the radical Icon ideas to match individual business unit boundaries and interests. Most multilevel aspects/components were cancelled to create a better fit between the scope of the ideas and the scope of the business unit product lines. |
| LC 3.4 Patient experiences versus technological solutions | *Cognitive*<br><br>The radical innovation ideas are based on thinking in terms of 'user experiences'. This worldview is however not legitimate with respect to the established and dominant 'technology driven' worldview of engineers and technical product developers at the high-tech company. | *Stringent regulatory regime*<br><br>• decision making authority for development projects resides at the SBUs of AlphaSys. Omega Design is viewed as service unit to the SBU clients.<br>• The SBUs own and control the necessary budgets and resources for development projects. | *Conformation*<br><br>Some 'experience' based aspects of the radical innovation are cancelled or adapted to meet technical, financial and timing constraints dictated by the dominant groups and the established 'technology driven' logic of 'engineering'. |

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| LC 3.5 Icon research program and business unit interests | *Pragmatic*<br><br>Investing in a general research program that transgressed established business unit boundaries was seen as not legitimate with respect to the individual interests and needs of the business units. | *Stringent regulatory regime*<br><br>• decision making authority for research and development programs resides at the SBUs of AlphaSys. Omega Design is viewed as service unit to the SBU clients.<br>• The SBUs own and control the necessary budgets and resources for research and development programs. | *Conformation* (withdrawal)<br><br>The proposal for a general research program was cancelled at that time. No further efforts were made to adapt the research plans or ideas to solve the legitimacy issue. |

# Case 4: PhemCo – Treemax

| Case | Legitimacy crisis | Institutional circumstances | Strategic response |
|---|---|---|---|
| LC 4.1 Research on hyperbranched materials – continuing after failure | *Normative*<br><br>The research project on the 'invention' did not produce positive results on the short term. Continuing with such a highly uncertain project was not legitimate with respect to the established norms for doing R&D projects for a business unit.<br><br>*Pragmatic*<br><br>Continuing with a highly uncertain project on the 'innovation' was not legitimate with respect to the established interests and needs of the business unit. It did not contribute to their short term business goals. | *Multiplicity*<br><br>• the innovation serves longer term business interests<br><br>*Resource impact*<br><br>• relatively low resource impact due to external government subsidies | *Toleration*<br><br>The research project is allowed to continue by the institutional actors (the business unit management) although short term results are negative and do not match established norms for doing research projects. |
| LC 4.2 Treemax applications versus day to day focus of business unit | *Pragmatic*<br><br>After the invention of the main technology, various proposals were made for research into different promising application areas. These multiple longer term ideas were not very legitimate with respect to the established shorter term interests and focus on day to day issues of the business unit. | *Stringent regulatory regime*<br><br>• decision making authority for application research and development projects resides at the SBUs of PhemCo, and thus at the SBU CR.<br>• The SBU CR owns and controls the necessary budgets and resources for application research and development projects. | *Conformation*<br><br>The innovative actors adapted the plans and proposals for multiple Treemax applications for the SBU CR and focused only on one of the many potential application areas. As such they conformed to the established shorter term interests of the business unit. |

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| LC 4.3 Canceling Treemax Dental applications | *Cognitive*<br><br>One of the innovative applications of the new technology (a low volume, specialty chemicals business) was not legitimate with respect to the organizational identity and dominant view of what a 'bulk chemical' company is and does.<br><br>*Pragmatic*<br><br>The innovative application was not legitimate with respect to the established interests and goals of the company, following from the dominant view of organizational identity and view of what their competencies are. | *Stringent regulatory regime*<br><br>• formal (and final) decision making authority for new business ventures resides at the upper management level (the directors) of the V&BD group of PhemCo. | *Conformation* (Withdrawal)<br><br>The innovative actors of Treemax complied to the concerns of the upper management of the V&BD unit and cancelled their ideas for Treemax Dental applications. |
| LC 4.4 Cutting back the Treemax venture | *Pragmatic*<br><br>The continuation of the innovation venture was no longer legitimate with respect to the established interests and goals of the company. It was not seen as strategic and relevant to the longer term strategy and realization of growth goals of the company. | *Multiplicity*<br><br>• the innovation strengthens the corporate image of 'being an innovative company'<br><br>*Resource impact*<br><br>• relatively low resource impact due to major budget cut backs in the venture | *Toleration*<br><br>The strategic relevance and fit of the venture with PhemCo remain weak. However, the institutional actors (Board of Directors and top management of the Innovation Centre) allowed the venture to continue. |

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<td rowspan="2">LC 4.5 Strategic fit or no strategic fit</td>
<td rowspan="2">Pragmatic<br><br>The innovation venture is not legitimate with respect to the longer term strategic goals of the company. The businesses of the innovation venture do not match with the established and designated end-markets as defined by dominant groups within the company.<br><br>Cognitive<br><br>The proponents of the innovation venture reason from a 'technology push' and 'fit with technological competencies' focus. This approach/way of thinking is not legitimate with respect to the established way of thinking in terms of 'fit with end-markets and market driven innovation' of the dominant group.</td>
<td>Stringent regulatory regime<br><br>• formal (and final) decision making authority for (longer term) strategic initiatives and new ventures at PhemCo resides at the Board of Directors of PhemCo.<br>• The Board of Directors owns and controls the necessary budgets and resources for new strategic initiatives and new ventures at PhemCo.</td>
<td>Conformation<br><br>The innovative actors of the Treemax venture adapted their business plans to create a better alignment with the established and designated end-markets of PhemCo and their typical customer needs.</td>
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<td>Ambiguity<br><br>• The still ambiguous but generally supported future vision for PhemCo as a 'specialty chemical company' offers opportunities for transformation.<br><br>Expert outsiders<br><br>• The Treemax venture team is loosely coupled to the rest of the PhemCo organization. They can operate relatively independent in a 'specialty chemicals' business that is novel to the rests of PhemCo.</td>
<td>Transformation<br><br>Innovative actors popularize new ways of thinking about the future vision of the company. They demonstrate that the Treemax venture is a prime example of what the company could be in the future, in terms of business models and competencies. As such they stimulate new ways of thinking and new interests.</td>
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| LC 4.6 Changing a culture of risk aversion | *Pragmatic*<br><br>In general, radical innovation is less legitimate with respect to the established interests of safeguarding long term investments in large scale manufacturing plants, of dominant groups within the company.<br><br>*Normative*<br><br>In general, radical innovation is less legitimate with respect to the established norms of 'risk aversion' at dominant groups of the company. | *No observations* | *No observations-* |

# Case 5: PhemCo – Reflactone and Reflactix

| Case | Legitimacy crisis | Institutional circumstances | Strategic response |
|---|---|---|---|
| LC 5.1 Strategic problems threaten Reflactone | *Pragmatic*<br><br>The innovation project was no longer legitimate with respect to the established interests of a business unit that focused on safeguarding their position in their current business. | *Heterogeneity*<br><br>• Multiple business units<br>• Multiple product divisions<br>• V&BD business unit<br>• Shared Research Unit<br><br>*Boundary spanner*<br><br>• Prof. Maddox, director of the Shared Research Unit has many working relations with the different business units, divisions, V&BD and the research groups. | *Selection*<br><br>Search for alternative internal sponsors. After reframing and broadening the innovative ideas in scope and aim (i.e. technology platform with many different application areas), the ideas matched well with the interests of the Venture and Business Development unit, who agreed to sponsor the project in the future. |
| LC 5.2 Opting out Reflactone | *Pragmatic*<br><br>One of the innovative applications of the technology ('Reflactone') was no longer legitimate with respect to the established interests of the company. It involved too high risks, little growth opportunities and little synergies with established businesses. | *Stringent regulatory regime*<br><br>• the Board of Directors of PhemCo have formal decision making authority for novel strategic initiatives and new business/-technology development projects. | *Conformation*<br><br>After extensive and rational analysis of the business potential of Reflactone in the electronic display market, the innovative actors agreed to meet the concerns and interests of the company and the Reflactone application was licensed out to a former technology partner. |

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| LC 5.3 Selling glass… that is something weird | *Cognitive*<br><br>The radical innovation was not legitimate with respect to the established view of organizational identity and the established view of what the company is and does.<br><br>*Pragmatic*<br><br>The radical innovation was not legitimate with respect to the established interests of existing business units of the company. It has little fit and low synergy with existing businesses of the company. | *Multiplicity*<br><br>• the innovation strengthens the corporate image of 'being an innovative company'<br>• the innovation can become strategic in the future<br><br>*Resource impact*<br><br>• relatively low resource impact due to simple pilot plant<br>• potentially high rewards | *Toleration*<br><br>Although the radical innovation idea remained 'strange' with respect to established views of organizational identity, and had little synergy and fit with established businesses, the institutional actors in the company decided to allow the innovation to continue. |

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# Summary

**Realizing radical innovation in established high-tech companies**
**A micro-institutional perspective**

Radical technological change and radical innovation have a strong impact on the competitive landscape of established high-tech industries. Companies that are able to seize the opportunities of technological change and are able to realize radical innovations (developing novel technological competencies, products and businesses) despite the higher risks involved, can secure and sustain their competitive advantage for the future. Being able to successfully realize radical innovation is thus of crucial importance for the long term survival and sustained growth of high-tech companies. Many studies show, however, that the opportunities of technological change are absorbed by newcomers to the industry in a more effective and agile way, leaving established high-tech companies far behind. Established companies frequently go into economic decline after radical technological change, because their existing technologies cannot meet the same level of performance as the new technologies developed by newcomers. Consequently, there is a clear need to understand the reasons why radical innovation is so difficult for established companies, but also to understand why some established companies are indeed relatively successful in realizing radical innovation despite these difficulties.

In the past years, organizational researchers have addressed the problem of radical innovation from a variety of theoretical perspectives. Central conclusion of most organizational studies is that radical innovation attempts frequently fail because of organizational inertia and rigidity of established high-tech companies. One of the reasons for this rigidity is that organizational structures and organizational routines are usually based upon and organized around the established technologies and existing dominant designs, allowing the company to perform efficiently in stable environments, but limiting flexibility and change. Moreover, the economic incentives for established companies to exploit existing competencies and technologies are usually much stronger than to explore novel alternatives. Short term economic considerations favor protection and improvement of existing technological competencies as they show more certain and immediate financial returns and match better with the needs of mainstream customers. Besides, radical technologies that substitute or cannibalize existing technologies endanger the rent generation of the company.

Although past studies have shed light on the intricacies of radical innovation within established companies, most of these insights remain fragmented and focus primarily on the difficulties (and failure) of radical innovation and less on how innovators (or entrepreneurs) within established high-tech companies are able to overcome these difficulties. Instead, recent (micro-)institutional explanations of

radical innovation within established high-tech companies seem to offer a more comprehensive and fundamental explanation of the difficulty of radical innovation in established companies. An institutional perspective acknowledges the view that organizations are more than rational, instrumental structures to achieve designated goals, but that they also are infused with values, norms, vested interests and shared beliefs about organizational reality. Radical technological innovation initiatives often conflict with these institutionalized values, norms, interests and beliefs, which results in a lack of *legitimacy* of the innovation ideas. And because these initiatives lack legitimacy, they receive less support of institutional decision makers within the organization and gain only limited access to necessary resources, knowledge and people, which hinders innovating actors to successfully realize radical innovation.

From an institutional perspective, we are thus able to explain the failure of radical innovation within established companies because of its lack of legitimacy vis-à-vis dominant institutional logics and structures. Past institutional researchers have also, although tentatively, suggested how innovators (or entrepreneurs) within established companies overcome these difficulties and augment the legitimacy of their radical innovation ideas. Recent institutional research assumes that actors within organizations (institutions) are not passive conformers to institutional pressures, but are able to choose otherwise and change existing institutional arrangements to accommodate for the radical innovation. Innovators can use various legitimation strategies to build up the legitimacy of their ideas and can solve legitimacy crises in order to gain institutional support and access to necessary resources, knowledge and networks. Although several types of strategies to overcome illegitimacies have already been identified in past research (primarily, conformation or transformation strategies), several scholars suggest there might be a wider variety of strategic responses available to innovators to continue radical innovation, despite the initial lack of legitimacy. Moreover, institutional researchers argue that not all actors within an organization (or institution) are equally well positioned and skilled to initiate these strategies to overcome a lack of legitimacy, and that particular characteristics of the institutional context offer opportunities to initiate certain strategies, while constraining others. However, which typical characteristics of the institutional context and position of actors enable them to follow particular strategies has not been investigated at micro-levels of analysis (i.e. *within* estbalished companies) so far.

So, although previous researchers have already developed various promising institutional explanations of the difficulty and possibility of radical innovation within established organizations, a comprehensive institutional perspective at a micro-level of analysis is still lacking. There is a clear need to investigate in more detail the different types of strategies used by innovators to overcome legitimacy crises and the institutional circumstances that enable innovators to do so. Hence, the objective of this thesis is to extend previous theory and develop an empirically grounded micro-institutional perspective on radical innovation within established high-tech companies that explains both the difficulty and possibility of radical

innovation within established companies, by examining both the constraining and enabling effects of institutional logics and structures on the actions of radical innovators.

In order to develop such a micro-institutional perspective, this thesis extends and builds upon past institutional and legitimacy theory and answers three related research questions: 1) what types of legitimacy crises occur during radical technological innovation activities in established high-tech companies? 2) What types of strategies do innovators use to address legitimacy crises and to potentially augment the legitimacy of these radical innovation activities? And, 3) what institutional circumstances enable or constrain innovators seeking to pursue particular strategies to overcome legitimacy crises and to augment the legitimacy of radical innovation activities in established high-tech companies? The answers to these three questions provide a detailed insight in the causes of the difficulties of realizing radical innovation in established companies, but also the different ways in which innovators overcome these difficulties to realize succeful radical innovations nevertheless.

*Methodology*

Because the aim of this thesis is to develop a micro-institutional perspective on radical technological innovation within established high-tech companies, this thesis can be characterized as a theory development effort. In order to extend and develop theory, while building upon and incorporating theoretical ideas from past research, the methodology used in this thesis is an adapted form of case study research and grounded theory development. It uses qualitative data analysis techniques to extend theory and discover novel concepts, relationships and mechanisms, and ground it in empirical observations. The detailed and intimate analysis of multiple insightful radical innovation cases allows for cross-case comparison to discover general patterns and increases the robustness of this thesis' findings. For this thesis, we are specifically interested in radical technological innovation within established companies that have a track record in innovation and are competent in incremental innovations and exploitation, but who experience difficulties with realizing radical innovation nevertheless. This implies that we selected companies that are operating within a high-tech industry, are long established and are competent (incremental) innovators. The two European companies selected for this investigation are operating in the advanced electronics industry and in the advanced chemicals industry, and exist both for more than 100 years. Both companies have also successfully realized many incremental innovations over the years, and even introduced a number of radical technological innovations, although these were characterized by a complex and difficult innovation process.

In total, we selected and investigated five radical technological innovations that embody novel technologies or technological principles, address familiar or novel application areas, and focus on familiar or novel market segments. We investigated

three radical innovation processes at the advanced electronics company, and two at the advanced chemicals company. During each of the radical innovation processes (taking on average 5 to 9 years from invention to first market introduction) multiple legitimacy crises occurred and a variety of strategies were used by the innovators to overcome these crises. In total we have identified 23 different legitimacy crises and 23 different strategies across the five cases, which have been used for the cross-case comparison, data analysis and theory development process in this thesis. In the remainder of this summary the central findings of the data analysis and the answers to the three research questions are presented.

*Legitimacy crises*

Building upon past institutional and legitimacy theory we have empirically grounded and refined a legitimacy crises typology, consisting of pragmatic, normative and cognitive legitimacy crises. Pragmatic legitimacy crises involve a lack of fit between the radical innovation ideas and institutionalized interests of the organization or organizational groups. Pragmatic legitimacy essentially concerns the beneficiality of the radical innovation with respect to established interests. Normative legitimacy crises involve a lack of fit between the radical innovation ideas and institutionalized norms and rules of the organization or organizational groups. Normative legitimacy is essentially concerned with the appropriateness of the radical innovation with respect to established norms, values and rules. Cognitive legitimacy crises involve a lack of fit between the radical innovation ideas and institutionalized beliefs and views of organizational reality and organizational identity. Cognitive legitimacy is essentially concerned with the comprehensibility of the radical innovation with respect to established and widely shared beliefs and cognitive schemata embedded within the organization. During the five different radical technological innovation processes at two different high-tech companies we identified a total of 23 different legitimacy crises. The majority of these legitimacy crises concerned either pragmatic or cognitive legitimacy crises, and only 4 legitimacy crises were of a normative type. The identified legitimacy crises in the different radical innovation processes inhibited the innovation process and needed to be solved or otherwise overcome, in order for the innovating actors to continue.

As such, this thesis answered research question one by developing an empirically grounded legitimacy crises typology concerning radical innovation within established high-tech companies. This typology improves our understanding of the reasons for the difficulty of radical innovation within established companies. These difficulties emerge because radical innovation is often not legitimate with respect to firmly held and institutionalized interests, norms, rules and beliefs, and consequently receives little organizational support and has limited access to resources, knowledge and people needed to realize the innovation successfully. This demonstrates how existing institutional logics and structures limit and hinder the realization of radical innovation within established companies. The legitimacy crises typology is an important contribution to previous institutional

research on innovation and forms an important part of the developed micro-institutional perspective.

*Strategic responses*

Building upon past institutional and legitimacy theory we have developed an empirically grounded typology of strategic responses used by innovating actors to overcome legitimacy crises, and which potentially augment the legitimacy of their radical innovation ideas and activities. Past legitimacy and legitimation theory has been extended with two novel strategy types, namely non-conformation and toleration. These two strategies complement the previously identified strategies of conformation, selection and transformation. A conformation strategy involves the adaptation of innovation ideas and activities to better match institutionalized interests, norms and beliefs. During conformation, innovating actors incorporate established interests in their ideas, comply with the existing norms and rules, and adopt widely shared beliefs and cognitive schema to frame the radical innovation. If adaptation of ideas and activities is not possible for technological or logical reasons, conformation entails withdrawal and cancellation of (parts of) the radical innovation ideas, or postponement of these ideas to a later moment. Selection strategies involve the search and selection of alternative organizational groups within the organization for which the radical innovation ideas are more legitimate and better fitting with their differentiated set of established interests, norms, rules and beliefs. Selection does not require any adaptations to the radical innovation ideas or activities that would make it less radical. A transformation strategy involves the introduction, propagation and institutionalization of novel interests, norms and beliefs that better legitimate the radical innovation ideas. Transformation, as opposed to conformation, does not entail an adaptation of the radical ideas, but instead existing institutional logics and structures are changed and reconfigured with novel interests, norms and beliefs to accommodate (for) the radical innovation in a better way. A toleration strategy occurs when the institutional actors allow the (partly) illegitimate radical innovation to continue, because prohibiting the innovation would damage (or not contribute to) other more valued institutional interests, norms and beliefs. A non-conformation strategy refers to the actions of innovating actors to deliberately ignore the legitimacy concerns of institutional actors completely and continue innovation nevertheless. During non-conformation innovating actors do not adapt plans, ideas and activities, and do not improve the legitimacy of their radical innovation.

Based on the extensive case analysis this thesis demonstrates that innovating actors within established companies use these different strategies to deal with legitimacy crises. The majority of strategies used by innovating actors in the five different radical innovation processes concerned conformation (10 out of 23), followed by transformation (6 out 23). Selection and toleration strategies could both be observed in three separate instances of a legitimacy crisis, and non-conformation was only identified once. It is important to note that during each of the radical innovation processes multiple different strategies were used to deal

with separate legitimacy crises that occurred over time. The developed typology of strategic responses to legitimacy crises demonstrates that innovating actors use a wider variety of strategies to overcome legitimacy crises than previously identified and proposed. As such, the strategies of non-conformation, toleration and selection are important additions to our understanding of how radical innovation is legitimated, continued and realized within established high-tech companies, even though radical innovation is initially plagued by a lack of legitimacy. The typology of strategic responses is an important part of our micro-institutional perspective as it defines how innovating actors exercise their agency and overcome legitimacy crises.

*Institutional circumstances*

Building upon past institutional and structuration theory, and the ontological assumptions of the duality of structure and reflexivity of social agents, we developed a typology of institutional opportunities (and constraints) that are used by innovating actors to initiate particular strategic responses. The typology defines four characteristics of the dominant institutional logic and structure that offer innovating actors the opportunities to pursue specific strategies. First of all, the strength of the regulatory regime (consisting of formal decision making rules and resource allocation rules) influences the choice for either a non-conformation strategy or the other strategies. When the regulatory regime is weak, this offers innovating actors the opportunity to ignore legitimacy concerns and follow a non-conformation strategy. When it is strong, the other strategies will more likely be followed. Secondly, the multiplicity of institutional logics and structures, refers to the co-existence of multiple alternative and sometimes competing institutionalized interests, norms and beliefs. When institutional multiplicity is high, this offers the opportunity to innovating actors to appeal to the tolerance of institutional actors. Innovating actors can appeal to alternative and competing institutional interests, norms and beliefs that seemingly better legitimate their radical innovation ideas, and convince institutional actors to tolerate their partly illegitimate innovation ideas based on these competing interests, norms and beliefs. A toleration strategy is moreover, more easily realized when the resource impact of the innovation ideas on the institutional context is relatively low. Thirdly, the heterogeneity of the institutional context refers to the existence of multiple institutional groups within the organization that have differentiated sets of institutionalized interests, norms and beliefs. As such, heterogeneity offers the opportunities to innovating actors to pursue a selection strategy and search for a group for which the innovation is already more legitimate. Fourthly, the ambiguity of institutional logics and structures refers to the existence of conflicting or confusing interpretations of institutional interests, norms and beliefs. The ambiguity of institutional logics can be used by innovating actors to initiate a transformation strategy and introduce and propagate novel interests, norms and beliefs into the existing institutional order. These four characteristics of the institutional context (*i.e.* institutional opportunities) enable (or constrain) innovating actors in their choice for the five different strategic responses.

We have also identified two characteristics of the institutional position of innovating actors that allow them to more easily seize the institutional opportunities identified before. When innovating actors are located at a boundary spanning position within the organization, they will be more aware of the heterogeneity of the institutional context and will have more easily access to potential alternative sponsors or collaborators. A boundary spanning position is characterized by a central position in-between different (more coherent) social networks within the established organization. Instead, when innovating actors have an expert outsider status, they are more aware of alternative institutional logics and structures and changes in the environment of the organization. This enables them to reflect on and potentially ambiguate existing institutional arrangements more easily. Moreover, their expert status and outside experience grants them legitimacy to question commonly held interpretations of the dominant institutional logic more easily, within the organization. These two characteristics of the institutional position of innovating actors operates in tandem with the institutional opportunities (and constraints) identified above, and explains why and how innovating actors are able to initiate the different strategies to overcome legitimacy crises.

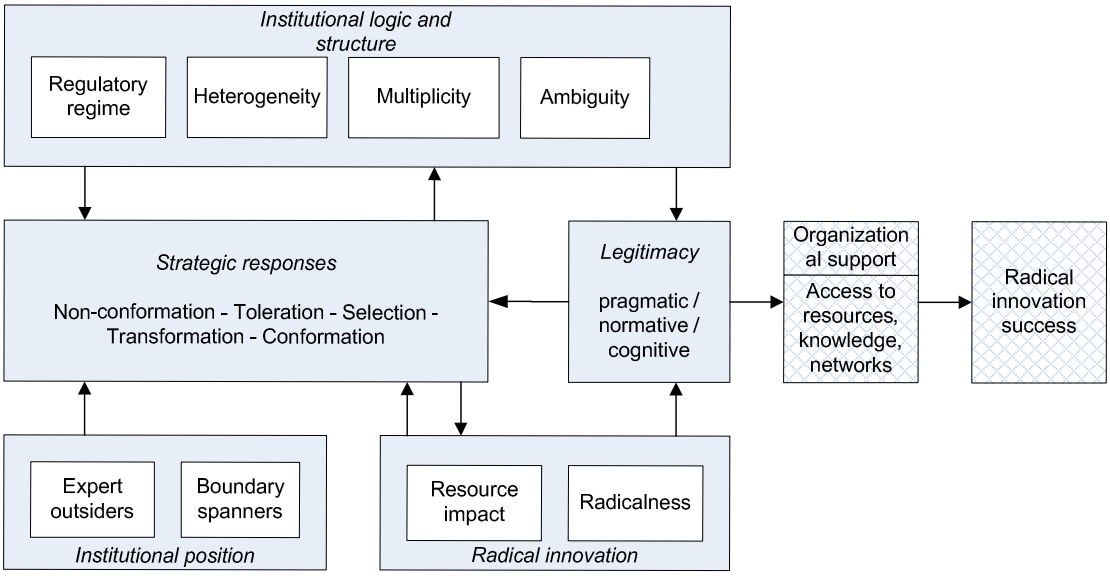


**Figure 1** A micro-institutional perspective on radical innovation

This empirically grounded typology of institutional opportunities and constraints is a relevant and novel contribution to previous institutional work on innovation within established companies, although similarities can be identified with several macro-institutional perspectives developed recently. The typology of institutional opportunities and constraints forms the third and final part of our developed micro-institutional perspective and operationalizes the ontological assumptions of the duality of structure and the reflexivity of social agents. As argued, institutional logics and structures do not only limit radical innovation by causing legitimacy crises, these structures also empower and offer the opportunities to innovating

actors to solve these legitimacy crises. Moreover, innovating actors themselves may even create the institutional circumstances to be appropriated for the legitimation of their activities.

*Conclusion*

The micro-institutional perspective developed in this thesis consists of the typologies of legitimacy crises, strategic responses, and institutional opportunities and constraints, and the relationships between them. This micro-institutional perspective offers a fundamental and comprehensive explanation of the difficulty and possibility of radical technological innovation within established high-tech companies. It demonstrates that although radical innovations are inhibited by emergent legitimacy crises, innovating actors can overcome these crises if they are willing and able to seize the institutional opportunities around them. Innovators should not be put down by an initial lack of legitimacy, because heterogeneity, multiplicity, ambiguity and weak regulatory regimes offer institutional opportunities to legitimate radical innovation, and gain organizational support and access to necessary resources, knowledge and people. This novel micro-institutional perspective on radical innovation enables organizational scholars to develop more fundamental and more effective organizational solutions for established companies to become more innovative, although future research remains necessary. And when this novel perspective also helps the innovators of this world to be more aware and reflexive of both the complexity *and* possibility of radical innovation within established companies, this thesis has succeeded in its objective.

# About the author

Stephan van Dijk was born on October 12, 1975 in Groningen, the Netherlands. After moving to Soest, he attended Het Baarnsch Lyceum, and graduated in 1994. In the same year he started his studies Agricultural Systems Sciences at the Wageningen University. He graduated *Cum Laude* in 1999 and specialized in Operations Research and Operations Management. His Master's thesis concerned the discrete event systems modeling of logistic food supply chains. After that, he worked for three years as researcher on various projects at Wageningen University and as business consultant at a small consultancy firm. In 2003 he started his PhD research at the Eindhoven University of Technology, Faculty of Technology Management, on the topic of innovation management and innovation strategy. During his PhD he collaborated extensively with high-tech companies in different industries. His PhD research has been presented at several academic conferences and he wrote and co-authored book chapters, papers and a book on project management. Several articles based on his PhD thesis are submitted to the international journals of Organization Studies and Organization Science.

Following the motto 'practice what you preach', Stephan currently works as business developer and project manager at the Knowledge Valorization Centre of the Delft University of Technology and is amongst others responsible for the screening, scouting and business development of new inventions at the Faculty of Industrial Design Engineering. For one day a week, he will continue working on furthering our understanding of the strategic management of innovation, academic entrepreneurship, and micro-institutional theory.

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